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ABSTRACT

The challenge to academia is to invest in services that will turn the abundance of electronic data into sound, useful, compelling information products. The process of filtering, labeling, refining, and packaging, that is, the process of editing and publishing, takes resources and will be shaped by the electronic world in significant ways. This essay is concerned with this process. The pace of investment in digital communication within academia may well be led by its value in education, service broadly defined, and research; in each case, institutional revenues and success may depend on effective deployment of appropriate digital communication. The opportunity to distribute journals electronically has implications for publishers' costs and revenues. Digital documents can be distributed at lower cost than paper; the network may also reduce some editorial costs. However, sustaining high production values will continue to involve considerable cost because quality editing and presentation are costly. On the revenue side, sale of individual subscriptions may, to some degree, yield to licenses for access via campus intranets and to pay-per-look services. Publishers are likely to work with an agent for design and distribution of electronic information. In contemplating how to take advantage of electronic publications, universities and their libraries must consider how conventional operations might be pruned to allow for more expenditure on electronic information products. In the end, universities should be drawn to the electronic information services because of their superiority in instruction, their reach beyond the academy, and their power in the creation of new ideas. (Contains 31 references.) (AEF)

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Electronic Publishing in Academia: An Economic Perspective

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Electronic Publishing in Academia

An Economic Perspective[1]

The Library at Washington University reports 150,000 hits per year on its electronic, networked *Encyclopedia Britannica* at a cost to the Library of four cents per hit.[2] This rate of use seems to be an order of magnitude larger than the rate of use of the print version of the document in the library. At the same time, the volunteer Project Gutenberg whose goal was to build an electronic file of 10,000 classic, public domain texts on the Internet has failed to sustain itself.[3] The University of Illinois decided it could no longer afford to provide the electronic storage space and no other entity stepped forward to sustain the venture.

A first lesson here is that production values, the quality of indexing and presentation, the packaging and marketing of the work, matter. Those ventures that take the approach of unrestricted free access don't necessarily dominate ventures that collect revenues. When a shopper asks "What does it cost?" we can naturally respond "What is it worth to you?" Electronic communication among academics is growing when it is valuable. In contemplating investments in electronic publishing, the publisher's, and indeed academia's, goal is to create the most value for the funds invested. Generally, the freebie culture that launched the Internet represents only a subset of a much wider range of possible uses. Many quality information products that flow through the Net will be generating revenue flows sufficient to sustain them.

The *Encyclopedia* gives a second lesson, namely, that the costs of electronic distribution may be significantly less than print. Serviceable home encyclopedias on CD now cost about $50 and *Britannica* is about $300, a small fraction of the price of the print editions of the same encyclopedias just a few years ago. Indeed, the latest word processing software includes tools that will allow anyone who uses word processing to create documents tagged for posting on the World Wide Web. Essentially, anyone who owns a current vintage computer with sufficient network connection can make formatted text with tables and graphics available instantly to everyone on the Net. The cost of such communication is a small fraction of the cost of photocopying and mailing documents.

An important consequence of the dramatic decline in the cost of sharing documents is the likelihood of a dramatic increase in the quantity of material available. Everyone who writes may post the whole history of their work on the web at little incremental cost. Availability is then hardly an issue.

The challenge to academia is to invest in services that will turn the ocean of data into sound, useful, compelling information products. The process of filtering, labeling, refining, and packaging, that is, the process of editing and publishing, takes resources and will be shaped by the electronic world in significant ways. This essay is concerned with this process.

Scholar

Begin with first principles. Academia may become more useful to our society at large by communicating electronically. When electronic scholarship is more valuable, our institutions will invest more.

Scholarship plays three roles in our society. First, academia educates the next generation of professionals, managers, and leaders. Second, it makes formal knowledge available to society at large, stimulating the development of new products, informing debates on public policy, and improving understanding of our culture. Third, it develops new knowledge. Digital communication ought ultimately to be judged by how well it serves these three activities, teaching, service, and research. Consider each in turn.

Access to networked, digital information is already enhancing education. More students at more institutions have access to more information because of the World Wide Web. About 60 percent of high school graduates now pursue some college, and President Clinton has called for universal access to two years of college.[4] The importance of the educational mission is growing. Of course, today networked information is sporadic and poorly organized relative to what it might someday become. Still, the available search services, rapid access, and the wide availability of the network are sufficient to demonstrate the power of the tool. Contrast the service with a conventional two-year college library whose size depends on the budget of the institution, when access often depends on personal interaction with a librarian, and where a student must plan a visit and sometimes even queue for service. Access to well-designed and supported Web-based information gives promise of promoting a more active style of education. Students may have more success with more open-ended assignments, participate in on-line discussion with others pursuing similar topics, and get faster feedback from more colorful, more interactive materials. Integrating academic information into the wider universe of Web information seems likely to have important benefits for students when it is done well.

Similarly, many audiences for academic information outside the walls of the academy already use the World Wide Web. Engineering Information, Inc., (EI) for example, maintains a subscription web site for both academic and non-academic engineers.[5] A core feature of the service is access to the premier index to the academic engineering literature with a fulfillment service. But EI's Village offers on-line access to professional advisers, conversations with authors, and services for practicing engineers. Higher quality, more immediate access to academic information seems likely to play an increasing role in the information sectors of our society, including nearly every career where some college is a common prerequisite. Higher education seems likely to find wider audiences by moving its best materials to the networked, digital arena.

In the business of generating new knowledge, the use of networked information is already accelerating the pace. Working papers in physics, for example, are more rapidly and widely accessible from the automated posting service at Los Alamos than could possibly be achieved by print.[6] In text oriented fields, scholars are able to build concordances and find patterns in ways impossible with print. Duke University's digital papyrus, for example, offers images of papyri with rich, searchable descriptive information in text.[7] In economics, the web gives the possibility of mounting data sets and algorithmic information and so allows scholars to interact with the work of others at a deeper level than is possible in print. For example, Ray Fair maintains his 130 equation model of the US economy on the web with data sets and a solution method.[8] Any scholar who wants to experiment with alternative estimations and forecasting assumptions in a fully developed simulation model may do so with modest effort. In biology, the Human Genome Project is only feasible because of the ease of electronic communication, the sharing of databases, and other on-line tools.[9] In visually oriented fields, digital communication offers substantial benefits, as video and sound may be embedded in digital documents. Animated graphics with sound may have significant value in simulation models in science. In art and

drama, digital files may allow comparative studies previously unimaginable. Digital communication, then, may have its most significant consequence in accelerating the development of new knowledge.

The pace of investment in digital communication within academia may well be led by its value in education, service broadly defined, and research. In each case, institutional revenues and success may depend on effective deployment of appropriate digital communication. Of course, individual scholars face a significant challenge in mastering the new tools and employing them in appropriate ways. It is also worth emphasizing that not all things digital are valuable. However, when digital tools are well used, they are often significantly more valuable than print.

Publisher

The evolution of the digital arena will be strongly influenced by cost and by pricing policies. Cost is a always a two-way street, a reflection, on the one hand, of the choices of authors and publishers who commit resources to publication and, on the other, of the choices of readers and libraries who perceive value. Publishers are challenged to harvest raw materials from the digital ocean and fashion valuable information products. Universities and their libraries must evaluate the possible ways of using digital materials and restructure budgets to deploy their limited resources to best advantage. Between publisher and library stands the electronic agent who may broker the exchange in new ways. Consider first the publisher.

The opportunity to distribute journals electronically has implications for the publishers' costs and revenues. On the cost side, the digital documents can be distributed at lower cost than paper. The network may also reduce some editorial costs. However, sustaining high production values will continue to involve considerable cost because quality editing and presentation are costly. On the revenue side, sale of individual subscriptions may, to some degree, yield to licenses for access via campus intranets and to pay-per-look services.

Publisher Costs

The central fact of the publishing business is the presence of substantial fixed cost with modest variable cost. The cost of gathering, filtering, refining, and packaging shapes the quality of the publication but does not relate to distribution. The cost of copying and distributing the publication is a modest share of the total expense. A publication with high production values will have high fixed costs. Of course, with larger sale, the fixed costs are spread more widely. Thus, popular publications have lower cost per copy because each copy need carry only a bit of the fixed cost. In thinking about a digital product, the publisher is concerned to invest sufficiently in fixed costs to generate a readership that will pay prices that cover the total cost.

There is a continuum of publications, from widely distributed products with high fixed costs but lower prices to narrowly distributed products with low fixed costs but higher prices. We might expect an even wider range of products in the digital arena.

To understand one end of the publishing spectrum, consider a publisher who reports full financial accounts and is willing to share internal financial records, namely, the American Economic Association (AEA). The AEA is headquartered in Nashville but maintains editorial offices for each of its three major journals in other locations. The AEA has 21,000 members plus 5,500 additional journal subscribers. Membership costs between $52 and $73 per year

(students $26) and members get all three journals. The library rate is $140 per year for the bundle of three journals. The Association had revenues and expenditures of $3.7 million in 1995.

The AEA prints and distributes nearly 29,000 copies of the *American Economic Review* (AER), the premier journal in economics. The AER receives nearly 900 manuscripts per year and publishes about 90 of them in quarterly issues. A *Papers and Proceeding* issue adds another 80 or so papers from the Association's annual meeting. The second journal, the *Journal of Economic Perspectives* (JEP) invites authors to contribute essays and publishes more topical, less technical essays, with 56 essays in four issues in 1995. The third journal, the *Journal of Economic Literature* (JEL) contains an index to the literature in economics, indexing and abstracting several hundred journals, listing all new English-language books in economics, and reviewing nearly 200 books per year. The JEL publishes more than 20 review essays each year in four quarterly issues. The three journals together yield about 5,000 pages, about 10 inches of linear shelf space, per year. The index to the economic literature published in JEL is cumulated and published as an *Index of Economic Articles in Journals* in 34 volumes back to 1886, and distributed electronically as *EconLit* with coverage from 1969. The *Index* and *EconLit* are sold separately from the journals.

This publisher's costs are summarized in figure 1. Some costs seem unlikely to be affected by the digital medium, while others may change significantly. The headquarters function accounts for 27 percent of the AEA's budget. The headquarters maintains the mailing lists, handles the receipts, and does the accounting and legal work. It conducts an annual mail ballot to elect new officers, and organizes an annual meeting that typically draws 8,000 persons.[10,11] The headquarters function seems likely to continue in about its current size as long as the AEA continues as a membership organization, a successful publisher, and a coordinator of an annual meeting.[12] Declining membership or new modes of serving members might lead to reduction in headquarters costs. In the short run, headquarters costs are not closely tied to the number of members or sale of journals.

The AEA's second function is editing, the second block in figure 1. Thirty-six percent of the AEA's annual expenditures goes to the editorial function of its three journals. Eighty-eight percent of the editorial cost is for salaries. The editorial function is essential to maintaining the high production values that are necessary for successful information products.

Operating digitally may provide some cost saving in the editorial function for the *American Economic Review*. The editors could allow manuscripts to be posted on the Internet, referees could access network copies, and dispatch their comments via the network. The flow of some 1,600 referee reports that the AER manages each year might occur faster and at lower cost to both the journals and the referees if the network were used in an effective way.[13] However, the editorial cost will continue to be a significant and essential cost of bringing successful intellectual products to market. Top quality products are likely to have higher editorial costs than lower quality products.

The top two blocks shown in figure 1 describe the 48 percent of the AEA's total budget that goes to printing and mailing. These functions are contracted out, and have recently gone through a competitive bid process. The costs are likely to be near industry lows. The total printing and mailing costs split into two parts. One part doesn't vary with the size of the print run and is labeled as fixed cost. It includes design and typesetting and thus will remain, to a

significant degree, as a necessary function in bringing high quality products to market.[14] The variable-cost part of printing and mailing reflects the extra cost of paper, printing, and mailing individual paper issues. These 23 percent of total Association expenditures, $800,000 out of $3.7 million total, might be reduced considerably by using distribution by network. However, as long as some part of the journal is distributed in print, the Association will continue to incur significant fixed costs in printing.

In short, distribution of the journals electronically by network might lower the AEA's expenditures by as much as 23 percent.[15]

Publisher Revenue

Figure 2 summarizes the American Economic Association's revenues in six categories. Thirty-eight percent of revenue comes from individual memberships. Another five percent comes from the sale of advertising that appears in the journals. Nineteen percent comes from the sale of subscriptions, primarily to libraries. Another 19 percent comes from royalties on licenses of the *EconLit* database, most of these royalties come from SilverPlatter, a distributor of electronic databases. Less than half of one percent of revenues come from selling rights to reprint journal articles. Finally, 17 percent of revenues come from other sources, primarily income from the cumulated reserves as well as net earnings from the annual meeting.[16]

Distributing the journals electronically by network seems likely to change the revenue streams. What product pricing and packaging strategies might allow the AEA to sustain the journals? If the journals are to continue to play an important role in the advance of the discipline, then the Association must be assured that revenue streams are sufficient to carry the necessary costs.

If the library subscription includes a license for making the journals available by network to all persons within a campus, then a primary reason for membership in the Association may be lost. With print, the main distinction between the library subscription and the membership subscription is that the member's copy can be kept at hand while the library copy is at a distance and may be in use or lost. With electronic delivery, access may be the same everywhere on the campus network. The license for electronic network distribution may then undercut revenues from memberships, a core 38 percent of AEA revenues.

The demand for advertising in the journals is probably motivated by distribution of journals to individual members. If individual subscriptions lag, then advertising revenue may fall as well. Indeed, one may ask the deeper question of whether ads associated with electronic journals will be salient when the journals are distributed electronically? The potential for advertising may be particularly limited if the electronic journals are distributed through intermediaries. If a database intermediary provides an index to hundreds of journals and provides links to individual articles on demand, advertising revenue may acrue to the database vendor rather than the publisher of the individual journal.

The AEA might see 43 percent of its revenues (the 38 percent from member fees plus the 5 percent from advertising) as vulnerable to being cannibalized by network licensure of its journals. With only a potential 23 percent saving in cost, the Association will be concerned to increase revenues from other sources so as to sustain its journals. The 20 percent shortfall is about $750,000 for the AEA. Here are three strategies: a) charge libraries more for campus-use licenses, b) increase revenues from pay-per-look services, c) enhance services for members so as to sustain member revenues. Each of these strategies may provide new ways of generating

revenue from existing readers, but importantly, may attract new readers.

The Campus License

The Association could charge a higher price to libraries for the right to distribute the electronic journals on campus networks. There are about four memberships for each library or other subscription. If membership went to zero because the subscriptions all became campus intranet licenses, then the AEA would need to recoup the revenues from four memberships from each campus license to sustain current revenues. If network distribution lowered AEA costs by 20 percent, then the campus intranet license need only recoup the equivalent of two memberships. Libraries currently pay double the rate of memberships, so the campus intranet license need be only double the current library subscription rate. That is, the current library rate of $140 would need to go to about $280 for a campus-wide intranet license for the three journals.[17] Of course, many campuses have more than one library subscription, say one each in the social science, management, law, and agriculture libraries. The Association might then set a sliding scale of rates from $280 for a small (one library print subscription) campus to $1,400 for a large (five library print subscription) campus.[18] These rates would be the total revenue required by the Association for campus-subscription assuming that the library's print subscriptions are abandoned. A database distributor would add some mark-up.

The campus intranet rate for electronic access is easily differentiated from the print library subscription because it provides a license for anyone on the campus intranet to use the journals in full electronic format. This rate could be established as a price for a new product, allowing the print subscriptions to continue at library rates. Transition from print to electronic distribution could occur gradually with the pace of change set by libraries. Libraries would be free to make separate decisions about adding the campus intranet service and, later, dropping the print subscription.

Individual Association members could continue their print subscriptions as long as they wish, reflecting their own tastes for the print product and the quality of service of the electronic one as delivered. Indeed, individual members might get passwords for direct access to the on-line journals. Some members may not be affiliated with institutions that subscribe to network licenses.

It is possible that the campus intranet license will be purchased by campuses that have not previously subscribed to the AEA's journals. If the institution's cost of participating in network delivery is much less than the cost entailed in sustaining the print subscription, for example, the avoidance of added shelf space as will be discussed below, then more campuses might sign on. This effect may be small for the AEA because it is the premier publisher in economics, but might be significant for other journal publishers.

Pay-Per-Look

The AEA has had minimal revenues from reprints and royalties on copies. Indeed, it pioneered in guaranteeing in each issue of its journals, a limited right to copy for academic purposes without charge.[19] The Association adopted the view that the cost of processing the requests to make copies for class purposes (which it routinely granted without charge), were not worth incurring. By publishing a limited, no-charge right to copy, it saved itself the cost of managing the granting of permissions and saved campuses the cost of seeking them.

With electronic distribution, the campus intranet license will automatically grant permission for the journals to be used in course reserves and in print-on-demand services for classes.

On campuses with too little commitment to instruction in economics to justify a library subscription or a campus intranet license, there may still be occasional interest in use of journal articles. There may be law firms, businesses, consulting enterprises, and public interest groups who occasionally seek information and would value the intensity of exploration found in academic journals. With the ubiquitous Internet, they should be able to search a database on-line for a modest usage fee, identify articles of interest, and then call up such articles in full-image format on a pay-per-look basis. Suppose the Internet reaches a million people who are either on campuses without print library subscriptions today or not on campuses at all, but who would have interest in some occasional use of the academic material. This market represents a new potential source of revenue for the AEA which could be reached by an Internet-based a pay-per-look price.

What rate should the Association set per page to serve the pay-per-look market without unduly cannibalizing the sale of campus intranet licenses? Let's take a one-print library subscription campus rate at $280 per year for access to about 3,500 published pages of journal articles (leaving aside the index and abstracts). One look at each published article page per year at eight cents per page would equal the $280 license. A campus that had a distribution of users that averaged one look at each page would break-even with the campus intranet license with a pay-per-look rate of eight cents per page. This rate is the rate of net revenue to the Association, the database distributor may add a mark-up. For discussion, suppose the database distributor's mark-up is 100 percent. If the Internet users beyond the campus intranet licenses looked at 2 million pages per year at 16 cents per page including fees to the Internet service provider, the Association would recoup nearly a quarter of its lost membership revenue from the intranet licenses from this source.

A critical issue for the emergence of a pay-per-look market is the ability to account for and collect the charges with a low cost per transaction. If accounting and billing costs $10 per hit with hits averaging 20 pages, then the charge might be $14.00 per hit ($10 to the agent, $4 to the AEA). Such a rate compares well with the $30 per exchange of costs incurred in conventional interlibrary loan. Yet such high transactions costs will surely limit the pay-per-look market.

A number of enterprises are offering or plan to offer electronic payment mechanisms on the Internet.[20] In the library world, RLG's WebDOC system may have some of the necessary features. These systems depend on users being registered in advance with the web-bank. As registered users they have accounts and encrypted "keys" that electronically establish their identity to a computer on the net. To make a transaction, a user need only identify herself to the electronic database vendor's computer using the "key" for authentication. The vendor's computer checks the authentication and debits the readers' account at the web-bank. In this fashion, secure transactions may occur over the network without human intervention at costs of a few cents per hit. If such web-banks become a general feature of the Internet, web-money will be used for a variety of purposes. The incremental cost of using them for access to information should be modest and the pay-per-look market gain importance. Mark-ups per transaction might then be quite modest, with gross charges per page in the vicinity of 10 to 20 cents. This rate compares with the four cent per page cost of the *Britannica* when no per page charge is imposed as mentioned in the opening sentence of this essay.

The core idea here is that individual readers make the decisions about when to look at a document under a pay-per-look regime. The reader must face a budget constraint, that is, have a limited set of funds for use in buying information products or other services. The fund might be subsidized by the reader's institution, but the core choices about when to pay and look are made individually. When the core decision is made by the reader with limited funds, then the price elasticity of demand for such services may be high. With a highly elastic demand, even for profit publishers will find that low prices dominate.

Current article fulfillment rates of $10 to $20 could fall by an order of magnitude. The MIT Press offers to deliver individual articles from its electronic journals for $12. EI Village delivers reprints of articles by fax or other electronic means for fees in this range.

Enhanced Member Services

A third strategy for responding to the possible revenue shortfall from the loss of memberships at the AEA would be to enhance membership services. One approach, proposed by Hal Varian, would be to offer superior access to the electronic journals to members only.[21] The electronic database of journal articles might be easily adapted to provide a personal notification to each member as articles of interest are posted. The Association's database service for members might then have individual passwords for members and store profiles of member interests so as to send e-mail notices of appropriate new postings. The members' database might also contain ancillary materials, appendices to the published articles with detailed derivations of mathematical results offered in software code (for example, as *Mathematica* notebooks), copies of the numerical data sets used in empirical estimation, or extended bibliographies. The members' database might support monitored discussions of the published essays, allowing members to post questions and comments and an opportunity for authors to respond if they wish. These enhancements generally take advantage of the personal relationship a member may want to have with the published literature, a service not necessarily practical or appropriate for libraries.

Indeed, one divide in the effort to distinguish member from library access to the journal database is whether the enhancement would have value to libraries if offered. Libraries will be asked to pay a premium price for a campus intranet license. They serve many students and faculty who are not currently members of the AEA and who are unlikely to become members in any event; for example, faculty from disciplines other than economics. Deliberately crippling the library version of the electronic journals by offering lower resolution pages, limited searching strategies, a delay in access, or only a subset of the content, will be undesirable for libraries and inconsistent with the Association's goal of promoting discussion of economics. However, there may me some demand for lower quality access at reduced prices. The important point is that for membership to be sustained, it must carry worthwhile value when compared to the service provided by the campus license.

Another approach is simply to develop new products that will have a higher appeal to members than to libraries. Such products could be included in the membership fee, but offered to libraries at an added extra cost. One such product would be systematic access to working papers in economics. Indices, abstracts, and in some cases, the full-text of working papers are available without charge at some sites on the World Wide Web today. The Association might ally itself with one of these sites, give the service an official status, and invest in the features of the working paper service to make it more robust and useful. Although freebie working paper services are useful, an enhanced working paper service for a fee (or as part of membership)

might be much better.[22]

To the extent that enhanced services can sustain memberships in the face of readily available campus intranet access to journals, the premium for campus intranet access could be lower.

The AEA might offer a discount membership rate to those who opt to use the on-line version of the journals in lieu of receiving print copies. Such a discounted rate would reflect not only the Association's cost saving with reduced print distribution but also the diminished value of membership given the increased prospect of campus intranet licenses.

To the extent that the pay-per-look market generates new revenue, then the campus intranet rate could also be less. The total of the Association's revenues need only cover its fixed and variable costs. (The variable cost may approach zero with electronic distribution.) If membership revenues dropped by two-thirds and pay-per-look generated one-quarter of the gap, then the premium rate for the campus intranet license need be only one-third to one-half above current rates, say, $200 for a one-print subscription campus to $1,000 for a five-print library subscription campus (net revenue to the Association after the net distributor's mark-up).

Other Publishers

At the other end of the publishing spectrum from the AEA are those producing low volume publications. Some titles have few personal subscriptions and depend primarily on library subscriptions that are already at premium rates. For these titles, replacing the print subscription with an intranet license will simply lower costs. The Johns Hopkins University Press offers its journals electronically at a discount in substitution for the print.

Some titles may have mostly personal subscriptions with no library rate, including popular magazines like the *Economist*. Such publications might simply be offered as personal subscriptions on the Internet with an individual password for each subscriber. The distribution by network would lower distribution costs and so ought to cause the profit maximizing publisher to offer network access to individuals at a discount from the print subscription rate. Such a publication may not be available by campus intranet license.

The *Journal of Statistics Education* (JSE) is distributed via the Internet without charge. It began with an NSF/FIPSE grant to the North Carolina State University in 1993. The JSE receives about 40 manuscripts per year and, after a peer review, publishes about 20 of them.[23] The published essays are posted on a web site and a table of contents and brief summaries are dispatched by e-mail to a list of about 2,000 interested persons. JSE's costs amount to about $25,000 per year to sustain the clerical work necessary to receive manuscripts, dispatch them to suitable referees, receive referee reports, and return them to the author with the editor's judgment. The JSE also requires a part-time system support person to maintain the server that houses the journal. The JSE has not charged for subscriptions, receives no continuing revenue, and needs about $50,000 per year to survive. Merger with a publisher of other statistics journals may make sense, allowing the JSE to be bundled in a larger member service package. Alternatively, it might begin to charge a subscription fee for individuals and a campus license rate for libraries. Making the transformation from a no-fee to a fee-based publication may prove difficult. A critical issue is how much fixed cost is necessary to maintain reasonable production values in a low volume publication. At present, JSE is seeking a continuing source of finance.

In general, a publisher will consider three potential markets: (1) the campus intranet

license/library sale, (2) the individual subscription, and (3) the pay-per-look/individual article sale. These three markets might be served by one title with shared fixed costs. The issue of whether to offer the title in each market and at what price will reflect the incremental cost of making the title available in that market, the elasticity of demand in each market, and the cross price elasticities between markets. For example, the price of the campus license will have an effect on individual subscription sales, and the price of the individual subscriptions will have an effect on the sale of individual articles, and vice versa. The more elastic the demands, the lower the prices, even for for-profit publishers. With higher substitution between the three forms, the closer the prices will be across the three forms.[24]

Economies of Scope

To this point, the analysis applies essentially to one journal at a time, as though the journal were the only size package that counted. In fact, of course, the choice of size of package for information could change. Two centuries ago, the book was the package of choice. Authors generally wrote books. Libraries bought books. Readers read books. In the last fifty years, the size of package shifted to the journal in most disciplines. Authors write smaller packages, that is, articles, and get their work to market more quickly in journals. The elemental information product has become more granular. Libraries commit to journals and so receive information faster and at lower cost per unit. In deciding what to read, readers depend on the editors' judgment in publishing articles. In short, libraries buy bigger packages, the journals, while authors and readers work with smaller units, the articles.

With electronic distribution, the library will prefer to buy a still larger package, a database of many journals. A single, large transaction is much less expensive for a library to handle than the multiple, small transactions. Managing many journal titles individually is expensive. Similarly, readers may prefer access to packages smaller than journal articles. They are often satisfied with abstracts. The electronic encyclopedia is attractive because it allows one to zip directly to a short, focused package of information with links to more. Authors, then, will be drawn to package their products in small bundles embedded in a large database with links to other elements of the database with related information. Information will become still more granular.

If the database becomes the dominant unit of trade in academic information, then those with better databases may thrive. The JSTOR enterprise appears to have recognized the economies of scope in building a database with a large quantity of related journal titles. JSTOR is a venture spawned by the Mellon Foundation to store archival copies of the full historic backfiles of journals and make them available by network. The core motive is to save libraries the cost of storing old journals. JSTOR plans to offer 100 journal titles within a few years. Some of the professional societies, for example, psychology and chemistry, exploit economies of scope in the print arena by offering dozens of journal titles in their disciplines. Elsevier's dominance in a number of fields is based in part on the exploitation of scope with many titles in related subdisciplines. The emergence of economies of scope in the electronic arena is illustrated by Academic Press's offer to libraries in Ohio Link. For ten percent more than the cost of the print subscriptions the library had held, it could buy electronic access to the full suite of Academic Press journals electronically on Ohio Link.

To exploit the economies of scope, the electronic journal might begin to include hot links to other materials in the database. The electronic product would then deliver more than the print version. Links to other web-sites is one of the attractive features of the web-version of the *Encyclopedia Britannica*. An academic journal database could invite authors to include the

electronic addresses of references and links to ancillary files. Higher quality databases will have more such links.

The American Economic Association eschews scope in the print arena, preferring instead to let a hundred flowers bloom and to rely on competition to limit prices. Its collection of three journals does not constitute a critical mass of journal articles for an economics database and so it must depend on integration with other economics journals at the database level. The Johns Hopkins University Press's Muse enterprise suffers similar lack of scope. Although it has 45 journal titles, they are scattered among many disciplines and do not, collectively, reach critical mass in any field.

The emergence of more powerful, network-based working paper services seems likely to lower the cost of the editorial process, as mentioned above. A common, well-managed electronic working-paper service might make the cost of adding a journal title much lower than starting a title from scratch without access to electronic working papers. The enterprise that controls a capable working paper service may well control a significant part of the discipline and reap many of the advantages of scope in academic publishing.

In fact, a capable electronic working paper service could support multiple editors of a common literature. One editor might encourage an author to develop a work for a very sophisticated audience and publish the resulting work in a top academic journal. Another editor might invite the author to develop the same ideas in a less technical form for a wider audience. Both essays might appear in a common database of articles and link to longer versions of the work, to numerical data sets, bibliographies, and other related material. The published essays will then be front-ends to a deeper literature available on the Net.

Rents

In addition to limiting the number of journals it produces, the American Economic Association differs from many publishers by emphasizing low cost. The price of its journals is less than half the industry average for economics journals, and the differential between library and individual rates is low.[25] If the AEA's goal were to maximize profit, it could charge authors more, charge members and libraries more, make more revenue from its meetings, and launch more products to take advantage of its reputation by extending its scope. The rents available in this marketplace are then left to the authors, members, libraries, and competing publishers. The AEA is not maximizing its institutional rents.

Other non-profit publishers may seek higher revenues, to capture more of the available rents, and use the proceeds to generate more products and association services. Lobbying activities, professional certification and accreditation, more meetings, and more journals are common among professional societies.

Many for-profit publishers seek to maximize the rents they can extract from the marketplace for the benefit of their shareholders. In considering how to package and price electronic products, the for-profit publishers will continue to be concerned with finding and exploiting the available rents. The profit maximizing price for a journal is determined by the price elasticity of demand for the title and the marginal cost of producing it. With convenient network access, there may be an increase in demand that would allow a higher price, other things equal. How the price elasticity of demand might change with network access is unknown. The fall in marginal cost with electronic distribution need not lead to a lower price.

One might then ask how a shift to electronic publishing may affect the size of the rents and their distribution. A shift to the database as the optimal size package with falling marginal costs would seem both to increase the size of potential rents and to make easier their exploitation for profit. Suppose control of a powerful working paper service gives a significant cost advantage to journal publishers. Suppose further that academic institutions find major advantages in subscribing to large databases of information rather than making decisions about individual journal titles. The enterprise that controls the working paper service and the database of journals may then have considerable rent capturing ability. The price elasticities of demand for such large packages may be low and the substitutes poor, and so the mark-ups over costs may be substantial. The possibility of a significant pay-per-look market with high price elasticity of demand might cause the profit maximizing price to be lower. The possibility of self-publication at personal or small scale web sites offers a poor substitute to integration in a database because web search engines are unlike to point to them appropriately.

Library

In contemplating how to take advantage of electronic publications, universities and their libraries face two problems. First, they face decisions about scaling back costly conventional operations so as to make resources available for acquiring electronic licenses. Second, the cost savings occur in a variety of ways, each with its own history, culture, and revenue sources. Although many boards of trustees and their presidents might like all of the funds within their institutions to be fungible, in fact they face limitations on their ability to reduce expenditures in one area so as to spend more in another. If donors or legislatures are more willing to provide funds for buildings than for electronic subscriptions, then the dollar cost of a building may not be strictly comparable to the dollar cost of electronic subscriptions. Universities are investing more in campus networks and computer systems and are pruning elsewhere as the campuses become more digital. The following paragraphs consider how conventional operations might be pruned so as to allow more expenditure on electronic information products.

Conventional Library Costs

It is possible that some universities will view electronic access to quality academic journals as sufficiently attractive to justify increasing their library budget to accommodate the electronic subscriptions when publishers seek premium prices for electronic access. Some universities place particular emphasis on being electronic pioneers and seem willing to commit surprising amounts of resources to such activities. Other universities owe a debt to these pathfinders for sorting out what works. However, for most institutions, the value of the electronic journals will be tested by middle management's willingness to prune other activities so as to acquire more electronic journals. The library director is at the front line for such choices and an understanding of the basic structure of the library's expenditures will help define the library director's choices.

Figure 3 provides a summary picture of the pattern of costs in conventional academic libraries. The top four blocks correspond to the operating budgets of the libraries. Acquisitions account for about a third of the operating budget. To give a complete picture, the bottom section of the figure also accounts for the costs of library buildings. The cost of space is treated as the annual lease value of the space including utilities and janitorial services. The total of the operating budget plus the annualized cost of the building space represents a measure of the total institutional financial commitment to the library.

Library management typically has control only of the operating budget. Let's suppose that, on average, campus intranet licenses to electronic journals come at a premium price, reflecting both the electronic database distributor's costs as well as adjustments in publishers pricing behavior as discussed above. The library, then, confronts a desire to increase its acquisition expenditure, possibly as much as doubling it.

A first choice is to prune expenditures on print so as to commit resources to digital materials. Some publishers offer lower prices for swapping digital for paper and in this case, swapping improves the libraries budget. Some publishers may simply offer to swap digital for print at no change in price. However, many may expect a premium gross price for digital access on the campus intranet. The library manager may seek to trim other acquisition expenditures so as to commit to more digital access. For several decades, academic libraries have been reducing the quantity of materials acquired so as to adjust to increases in prices. The possibility of substantial cuts in the quantity of acquisitions so as to afford a smaller suite of products in electronic access seems unappealing and so may have limited effect.

A second possible budget adjustment is to prune technical service costs. The costs of processing arise from the necessity of tracking the arrival of each issue, claiming those that are overdue, making payments, adjusting catalog records, and periodically binding the volumes. If the electronic journal comes embedded in a database of many journals, the library can make one acquisition decision and one payment. It need have little concern for check-in and the claiming of issues. Testing the reliability of the database will be a concern but presumably large database providers have a substantial incentive to build in considerable redundancy and reliability and will carefully track and claim individual issues, once for all. The library will avoid binding costs. The library will likely have some interest in building references to the electronic database into its catalog. Perhaps the database vendor will provide suitable machine readable records to automate this process.

A third possibility is the library's public service operations. Until a substantial quantity of materials are available and widely used via network, the demand for conventional library hours, reference, and circulation services may change only modestly. In 1996, a third to a half of the references in my students' essays were to World Wide Web sources. However, these sources generally complemented conventional sources rather than being substitutes for them. As front-line journals become commonly accessible by campus networks, the demand for conventional library services may decline. For example, campuses that operate departmental and small branch libraries primarily to provide convenient access to current journals for faculty might be more likely to consolidate such facilities into a master library when a significant number of the relevant journals are available on the Net. These changes are likely to take a number of years to evolve.

A fourth possibility concerns the cost of library buildings. When journals are used digitally by network, the need for added library space declines. Libraries will need less stack space to hold the addition of current volumes. In many larger libraries, lesser used, older volumes are currently held in less expensive, off-site facilities, with new volumes going into the prime space. The marginal stack space, then, is off-site, with costs of perhaps $0.30 per volume per year as a continuing cost for sustaining the perpetual storage of the added volumes.[26] Replacing a 100 year run of a journal with an electronic backfile ought to save about $30 per year in continuing storage costs at a low-cost, remote storage facility. Reductions in the extent of processing and in public services will also reduce requirements for space.

The library building expenses typically do not appear in operating budgets, so saving space has no direct effect on the library budget. The capital costs of buildings are frequently raised philanthropically or paid through a state capital budget, keeping the costs out of the university current accounts. Even utilities and janitorial services may appear in a general university operating budget rather than appearing within the library account. Savings in building costs will accrue to those who fund capital projects and to university general budgets, but often, not to the library operating budget. University presidents and boards may redirect their institutions' capital funds to more productive uses. Of course, the interests of philanthropy and the enthusiasm of state legislators may pose some limit on the ability to make such reallocations. Moreover, library building projects occur relatively infrequently, say every 25 years or so. The savings in capital may not be apparent for some time, or indeed, ever if capital budgets are considered independently of operating budgets. Library buildings, particularly the big ones in the middle of campuses, come to play a symbolic role, an expression of the university's importance, a place of interdisciplinary interaction, a grand presence. Because symbols are important, the master library facility will continue to be important. The marginal savings in building expense will probably be in compact or remote storage facilities and in departmental and smaller branch libraries. Digital access ought then to save the larger campus community some future commitment of capital, but the savings will be visible mostly to the president and board.

A fifth possibility is savings in faculty subscriptions. In law, business, and other schools where faculty have university expense accounts, faculty may be accustomed to paying for personal subscriptions to core journals from the accounts. If the university acquires a campus-wide network license for such journals, the faculty members may rely on the campus license and deploy their expense accounts for other purposes. By adjusting the expense account downward in light of the offering of campus licenses for journals, the university may reclaim some of the cost of the journals. On those campuses and in those departments where faculty members do not have expense accounts and where personal copies of core journals are necessary for scholarly success, the faculty salaries might be adjusted downward over a course of time to reflect the fact that faculty may use the campus license rather than pay for personal subscriptions. Indeed, when the personal subscriptions are not deductible under federal and state income taxes, the cost of subscriptions to the faculty in after tax dollars may be greater than the cost to the university using before tax dollars. As a result a shift to university site licenses for core journals should be financially advantageous for faculty and the university.

In sum, the university may find a number of ways to economize by shifting to digital journals distributed by network. Although direct subscription prices may go up in some cases, the university may trim technical and public services, save space, and offer more perquisites to faculty at some saving in cost.

Electronic Agent

Publishers could establish their own digital distribution function by creating a Universal Resource Locator (URL) for each title. The publisher would deal directly with libraries and individual readers. For a number of reasons, the publisher is likely to prefer to work with an agent for electronic distribution. Just as the typesetting and printing is usually performed by contractors, so the design and distribution of electronic products is likely to involve specialized agents. However, the role of electronic distribution agent is becoming more important than that of the printer for two important reasons. The first arises because of economies of scale in

managing access to electronic services. The second concerns the potential advantages of integrating individual journals into a wider database of academic information. The electronic agent accepts materials, say journal titles, from publishers and mounts them on electronic services to be accessed by the Internet. The agent captures economies of scale in maintaining the service, in supporting a common payment mechanism, a common search interface and search engine, and may take other steps to integrate articles and journal titles so that the whole is greater than the sum of the parts.

OCLC was an early entrant in the market for electronic distribution of academic journals with *Online Clinical Trials*. *Online Clinical Trials* was priced at $220 for institutions and $120 for individuals.[27] OCLC is shifting to a World Wide Web interface in January, 1997 and hopes to offer more than 250 journal titles soon. OCLC's new approach offers publishers the opportunity to sell electronic access to journals by both subscription and pay-per-look.[28] It charges libraries an access fee based on the number of simultaneous users to be supported and the number of electronic journals to which the library subscribes. Libraries buy subscriptions from publishers. Publishers may package multiple titles together and set whatever rates they choose. The following discussion puts the strategies of OCLC and other electronic agents in a broader context.

Storage and Networks

With electronic documents, there is a basic logistical choice. A storage intensive strategy involves using local storage everywhere. In this case, the network need not be used to read the journal. At the other extreme, the document might be stored once-for-the-world at a single site with network access used each time a journal is read. Between these two extremes, there is a range of choices. With the cost saving of fewer storage sites comes the extra cost of increased reliance on data communication networks.

Data storage is an important cost. Although the unit costs of digital storage have fallen and will continue to fall sharply through time, there is still a considerable advantage to using less storage. Data storage systems involve not simply the storage medium itself, but a range of services to keep the data on-line. A data center typically involves sophisticated personnel, back-up and archiving activities, and the cost of upgrading software and hardware. If ten campuses share a data storage facility, the storage cost per campus should be much less than if each provides its own. Having one storage site for the world might be the lowest storage cost per campus overall.

To use a remote storage facility involves data communication. The more remote the storage, the greater the reliance on data networks. A central problem for data communication is congestion. Data networks typically do not involve traffic-based fees. Indeed, the cost of monitoring traffic so as to impose fees may be cost prohibitive. Monitoring network traffic so as to bill to individuals on the basis of use would require keeping track of the origin of each packet of data and accounting for it by tallying a register that notes source, time, and date. Because even simple mail messages may be broken into numerous packets for network shipment, the quantity of items to be tracked is much more numerous than tracking telephone calls. If every packet must go through the toll plaza, the opportunity for delay and single points of failure may be substantial. Because each packet may follow a different route, tracking backbone use with a tally on each leg would multiply the complexity. Traffic-based fees seem to be impractical for the Internet. Without traffic-based fees, individual users do not face the cost of their access. Just as with urban highways at rush hour, each individual sees only his or her own trip, not the adverse effect of his or her trip in slowing others down. An engineering response to highway

congestion is often to build more highways. Yet, the added highways are often congested as well. In data networking, an engineering solution is to invent a faster network. Yet, individuals deciding to use the network will see only their personal costs, and so have little incentive to economize. The demand for bandwidth on networks will surely grow with the pace of faster networks, for example, with personal videophones and other video intensive applications. Without traffic-based pricing, congestion will be endemic in data networks.

Another response to network congestion is to build private networks with controlled access. Building networks dedicated to specific functions seems relatively expensive, but may be necessary to maintain a sufficient level of performance. Campus networks are private, and so access can be controlled. Perhaps investments in networking and technical change can proceed fast enough on individual campuses to allow the campus network to be reliable enough for access to journals and other academic information.

As the telephone companies have launched data network services, they seem likely to introduce time-of-day pricing. Higher rates in prime time and higher rates for faster access speeds are first steps in giving incentives to economize the use of the network and so to reduce congestion. America On Line (AOL) ran into serious difficulty when in late 1996 it shifted from a per hour pricing strategy to a flat monthly rate to match other Internet service providers. AOL was swamped with peak period demand, demand it could not easily manage. The long distance telephone services seem to be moving to simpler pricing regimes, dime-a-minute, for example. The possibility of peak period congestion, however, likely means that some use of peak period pricing in telephones and in network services will remain desirable. In the end, higher education's ability to economize on data storage will depend on the success of the networks in limiting congestion.

Some milestones in the choice of storage and networks are illustrated along the horizontal margin of figure 4. The rapid growth of the World Wide Web in the last couple of years has represented a shift toward the right along this margin, with fewer storage sites and more dependence on data communication. The World Wide Web allows a common interface to serve many computer platforms, replacing proprietary tools. Adobe's Portable Document Format (PDF) seems to offer an effective vehicle to present documents in original printed format with equations, tables, and graphics, yet allow text searching and hypertext links to other websites. The software for reading PDF documents is available without charge, compatible with many web browsers, and allows local printing. Some of the inconveniences of older network-based tools are disappearing.

The electronic agent may have an advantage over either the publisher or the library in taking advantage of the rightward shift. That is, the electronic agent may acquire rights from publishers and sell access to libraries, while taking responsibility for an optimal choice of storage sites and network access. Storage might end up in a low cost location with the electronic agent responsible for archiving the material and migrating the digital files to future hardware and software environments.

Integration into a Database

The second advantage for an electronic agent is in integrating individual journal titles and other electronic materials into a coherent database. The vertical margin of figure 4 sketches a range of possibilities. At root, a journal title stands as a relatively isolated vehicle for the distribution of information. In the digital world, each title could be distributed on its own CD or have its own

Universal Resource Locator on the web. Third party index publishers would index the contents and provide pointers to the title and issue, and perhaps to the URL. Indeed, the pointer might go directly to an individual article.

However, relatively few scholars depend on a single journal title for their work. Indeed, looking at the citations shown in a sampling of articles of a given journal reveals that scholars typically use a range of sources. A database that provides coherent access to several related journals, as in the second tier of figure 4, offers a service that is more than the sum of its parts.

At yet a higher level, an agent might offer a significant core of the literature in a discipline. The core of journals and other materials might allow searching by words and phrases across the full content of the database. The database then offers new ways of establishing linkages.

At a fourth level, the organizing engine for the database might be the standard index to the literature of the discipline, such as *EconLit* in economics. A search of the database might achieve a degree of comprehensiveness for the published literature. A significant fraction of the published essays might be delivered on demand by hitting a "fulfill" button. Fulfillment might mean delivery of an electronic image file via network within a few seconds or delivery of a facsimile within a few minutes or hours.

At a fifth level, the database might include hot-links from citations in one essay to other elements of the database. The database might include the published works from journals with links to ancillary materials, numeric data-sets, computer algorithms, an author's appendices discussing methods and other matters. The database might invite commentary and so formal publications might link to suitably moderated on-line discussions.

The electronic agent may have an advantage over publishers who offer only individual journal titles in integrating materials from a variety of sources into a coherent database. The agent might set standards for inclusion of material that specifies metatags and formats. The agent might manage the index function, indeed, the index might be a basis for forward integration with database distribution as Engineering Information has done. This issue is discussed more fully below.

Integration of diverse materials into a database is likely to come with remote storage and use of networks for access. Integrating the material into a database by achieving higher levels of coherence and interaction among diverse parts may be at lower cost for an electronic agent than for publishers of individual journals or for individual libraries. The agent is able to incur the cost of integration and storage once for the world.

Agent's Strategy

Given the interest of publishers in licensing their products for campus intranets and the universities' interest in securing such licenses, there is opportunity for enterprises to act as brokers, to package the electronic versions of the journals in databases and make them accessible, under suitable licenses, to campus intranets. The brokers may add a mark-up to reflect their cost of mounting the database. The size of the mark-up will reflect the extent of integration as well as the choice of storage strategy.

SilverPlatter became the most successful vendor of electronic index databases, making them available on compact disks for use on campus intranets with proprietary software. OCLC plays

an important role in offering such databases from its master center in Ohio. A number of other vendors have also participated in the index market and are likely to seek to be brokers for the electronic distribution of journals. Ovid is a third vendor, one that supports sophisticated indexing that integrated full-text with standard generalized mark-up language (SGML) and hypertext mark-up languge (HTML) tagging.

A core strategy will probably be to mount the database of journals on one or more servers on the World Wide Web, with access limited to persons authorized for use from licensed campuses or through other fee-paid arrangements. This strategy has three important parts, the database server, the Internet communication system, and the campus network.

The advantage of the World Wide Web approach is that the data can be made accessible to many campuses with no server support on any campus. A campus intranet license can be served remotely, saving the university the expense of software, hardware, and system support for the service.

The risk of the Web strategy is with the Internet itself and its inherent congestion. OCLC used a private data communication network so as to achieve a higher level of reliability than the Internet and will do the same to assure high quality TCP/IP (the Internet Protocol) access. Some campuses may prefer to mount database files locally, using CD-ROMs and disk servers on the campus network. Some high intensity campuses may prefer to continue to mount the most used parts of databases locally even at extra cost, as a method of ensuring against deficiencies in Internet services.

The third element after storage and the Internet is the campus network. Campus networks continue to evolve. Among the hundred universities seeking to be top-ten universities, early investment in sophisticated networking may play a strategic role in the quest for rank. On such campuses, network distribution of journals should be well supported and popular. Other campuses will follow with some lag, particularly where funding depends primarily on the public sector. Adoption within ten years might be expected.[29]

The electronic agent, then, must choose a strategy with two elements, a storage and network choice and an approach to database integration.

Journal publishers generally start at the bottom left, the closest to print. They could make a CD and offer it as an alternative to print for current subscribers. The AEA offers the *Journal of Economic Literature* on CD instead of print for the same price.

Moves to the upper left seem to be economically infeasible. Integrating more materials together increases local storage costs and so tilts the storage-network balance toward less storage and more network. With more data integration, the agent's strategy will shift to the right.

Moves to the lower right with reduced storage costs and more dependence on networks should involve considerable cost savings but run risks. One risk is of network congestion. A second is of loss of revenues because traditional subscribers drop purchases in favor of shared network access. The viability of these strategies depends on the level of fees that may be earned from network licenses or pay-per-look.

Moves along the diagonal up and to the right involve greater database integration with cost savings from lower storage costs and more dependence on networks. The advantage of moves

upward and to the right is the possibility that integration creates services of significantly more value than replicating print journals on the Internet. When database integration creates significantly more value, subscribers will be willing to pay premium prices for using products with remote storage with networks. Of course, network congestion will remain a concern.

A move toward more database integration raises a number of interesting questions. The answers to these questions will determine the size of the mark-up by the electronic agent. How much should information from a variety of sources be integrated into a database with common structure, tags, and linkages? For a large database, more effort at integration and coherence may be more valuable. Just how much effort, particularly how much hand effort, remains an open question. If the electronic agent passively accepts publications from publishers, the level of integration of materials may be relatively low. The publisher may provide an abstract and metatags and might provide Universal Resource Locators for linking to other network sites. The higher level of integration associated with controlled vocabulary indexing, and a more systematic structure for the database than comes from journal titles would seem to require either a higher level of handwork by an indexer or the imposition of standard protocols for defining data elements. Is a higher level of integration of journal material from a variety of sources sufficiently valuable to justify its cost? The index function might be centralized with storage of individual journals distributed around the net. Physical integration of the database is not necessary to logical integration, but will common ownership be necessary to achieve the control and commonality necessary for high levels of integration?

A second question concerns how an agent might generate a net revenue stream from its initial electronic offerings sufficient to allow it to grow. The new regime will not be borne as a whole entity, rather it will evolve in relatively small steps. Each step must generate a surplus to be used to finance the next step. Early steps that generate larger surpluses seem likely to define paths that are more likely to be followed. Experimentation with products and prices is already underway. Those agents finding early financial success are likely attract publishers and libraries, and to be imitated by competitors.

JSTOR has captured the full historic run of a significant number of journals, making the promise of 100 titles in suites from major disciplines within three years. However, it does not yet have a program for access to current journals. Its program then is primarily to replace archival storage of materials libraries may or may not have already acquired in print.

OCLC's approach is to sell libraries access services while publishers sell subscriptions to the information. The publisher can avoid the cost of the distribution in print, a saving if the electronic subscriptions generate sufficient revenue. The unbundling of access from subscription sales allows the access to be priced on the basis of simultaneous users, that is akin to the rate of use, while the information is priced on the basis of quantity and quality of material made available. Of course, the information may also be priced on a pay-per-look basis and so earn revenue as it is used. What mix of pay-per-look and subscription sales will ultimately prevail is an open question.

A third question is whether publishers will establish exclusive arrangements with electronic agents, or whether they will offer non-exclusive licenses so as to sustain competition among agents. Some publishers may prefer to be their own electronic agents, retaining control of the distribution channels. If database integration is important, this strategy may be economic only for relatively large publishers with suites of journals in given disciplines. Many publishers may choose to distribute their products through multiple channels both to capture the advantages of

more integration with other sources, but also to promote innovation and cost savings among competing distributors.

As the electronic agents gain experience and build their title lists, competition among them should drive down the mark-ups for electronic access. If the store-once and network strategy bears fruit, the cost saving in access should be apparent. If higher levels of database integration prove to be important, the cost savings may be modest. Cost savings here are in terms of units of access. As the cost of access falls, the quantity of information products used may increase. The effect on total expenditure, the product of unit cost and number of units used, is hard to predict. If the demand for information proves to be price elastic, then as unit costs and unit prices fall, expenditures on information will increase.

The electronic agents will gather academic journals from publishers and distribute them in electronic formats to libraries and others. They will offer all available advantages of scale in managing electronic storage, optimize the use of networks for distribution, offer superior search interfaces and engines, and take steps to integrate materials from disparate sources into a coherent whole. The agent will be able to offer campus intranet licenses, personal subscriptions, and pay-per-look access from a common source. The agent may manage sales, accounting, billing, and technical support. Today, agents are experimenting with both technical and pricing strategies. It remains to be seen whether single agents will dominate given content areas, whether major publishers can remain apart, or whether publishers and universities can or should sustain a competitive market among agents.

Conclusion

Higher education faces a significant challenge in discovering what academic information will succeed on the Net. In 1996, the MIT Press launched *Studies in Nonlinear Dynamics and Econometrics* (SNDE), one of six titles that the Press distributes by network. The price per year is $40 for individuals and $130 for libraries.[30] MIT's strategy seems to be to launch titles in disciplines where an electronic journal has some extra value, for example, including links to computer code and data sets.[31] The rates for the journals seem to be well below those quoted by OCLC's electronic journal program and lower than at least some new print journals. The cost of launching a new journal electronically seems to be falling. It remains to be seen whether the electronic journals will attract successful editors and valued manuscripts from authors, but the venture shows promise. The number and quality of electronic journals continues to grow. MIT has decided to forgo the use of an electronic agent and so depend only on conventional, independent indexing services for database integration, an incremental approach. Yet, the potential seems greater than an individual journal title reveals.

When Henry Ford launched the first mass produced automobile, he chose a design that carried double the load, went three times farther, and four times faster than the one-horse buggy it replaced, and yet was modestly priced. Successful digital information products for academia seem likely to exploit the inherent advantages of the digital arena, the timeliness, the sophisticated integration of new essays into the existing stock, the links from brief front-end items to more elaborate treatment, the opportunity to interact with the material by asking for "fulfillment," "discussion," and the "underlying data." Network delivery will make possible both the campus intranet license and the sale of information on a pay-per-look basis. It will allow the material to be more readily consulted in circles beyond the academy.

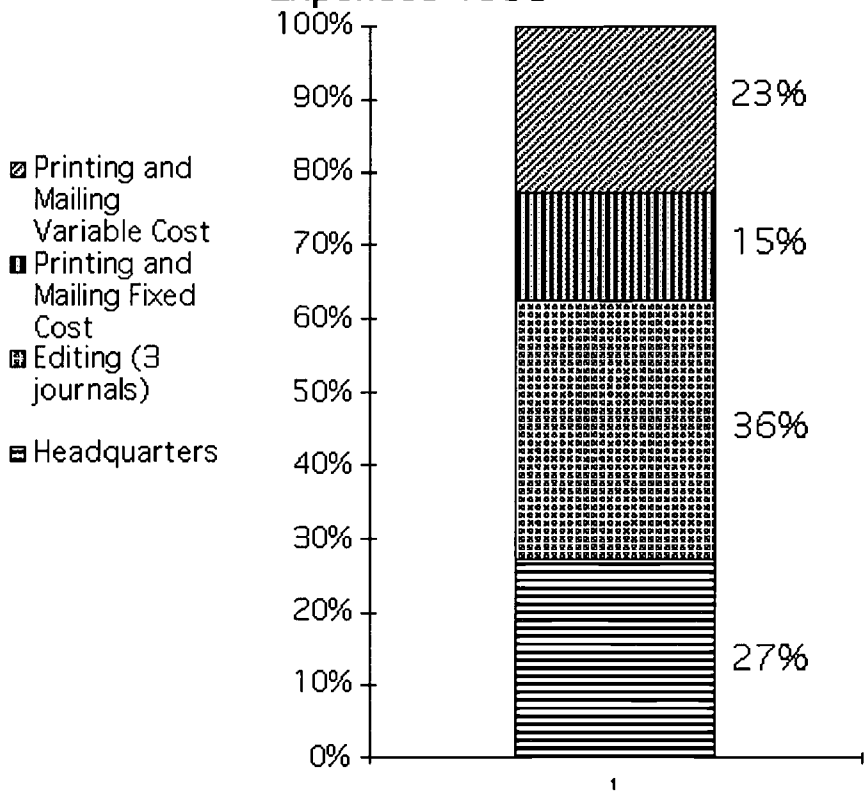
Electronic agents will play significant new roles as intermediaries between publishers and campuses by handling the electronic storage and distribution, and by integrating material into a more coherent whole. Universities and their libraries will make adjustments in operations so as to expend less on conventional activities and more on digital communication.

Of course, there are unknowns. Agents and publishers will experiment to discover optimal pricing strategies. Agents will explore different ways of storing and delivering electronic products and different approaches to integration. Campuses and libraries will consider just what extra dimensions of service are worth their price. The process here is one of bringing order, meaning, and reliability to the emerging world of the Internet, of discovering what sells and what doesn't.

In the end, universities should be drawn to the electronic information services because of their superiority in instruction, their reach beyond the academy, and their power in the creation of new ideas. American higher education is largely shaped by competitive forces, the competition for faculty, students, research funding, public, and philanthropic support. In different ways, the private and public sector, the large institutions and the small, the two-year and four-year institutions share the goal of doing a better, more cost effective job of expanding the human potential. When artfully done, the digital sharing of ideas seems likely to expand that potential significantly.

Figure 1

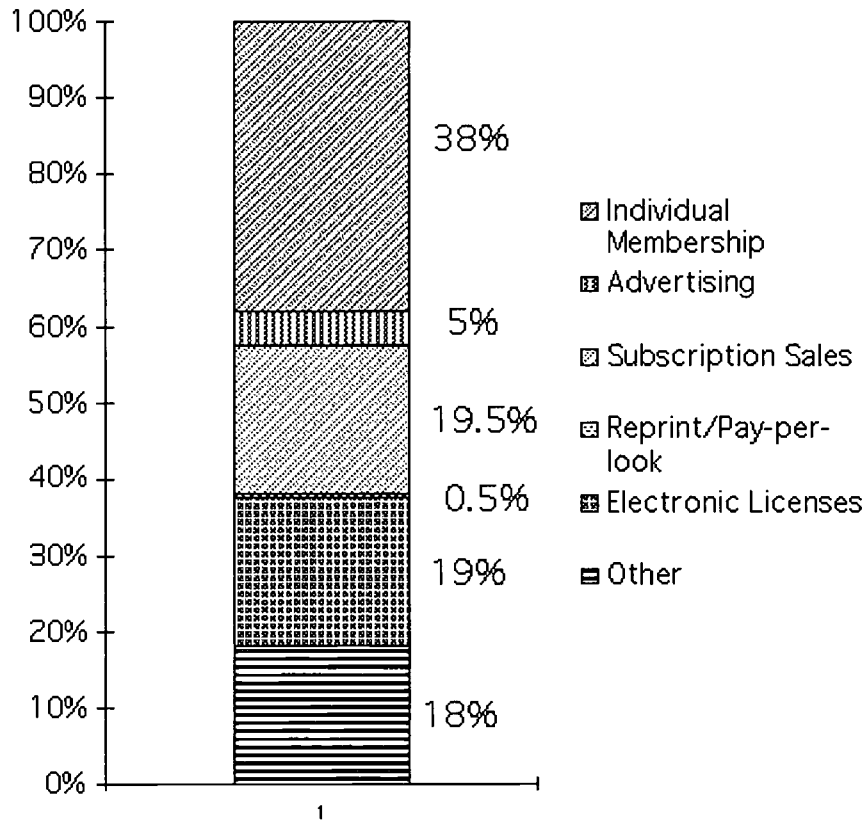
American Economic Association Expenses 1995



Source: Elton Hinshaw, "Treasurer's Report," *American Economic Review*, May, 1996 and unpublished reports.

Return to the Document

Figure 2
American Economic Association
Revenues 1995



Source: Elton Hinshaw, "Treasurer's Report," *American Economic Review*, May, 1996 and unpublished reports.

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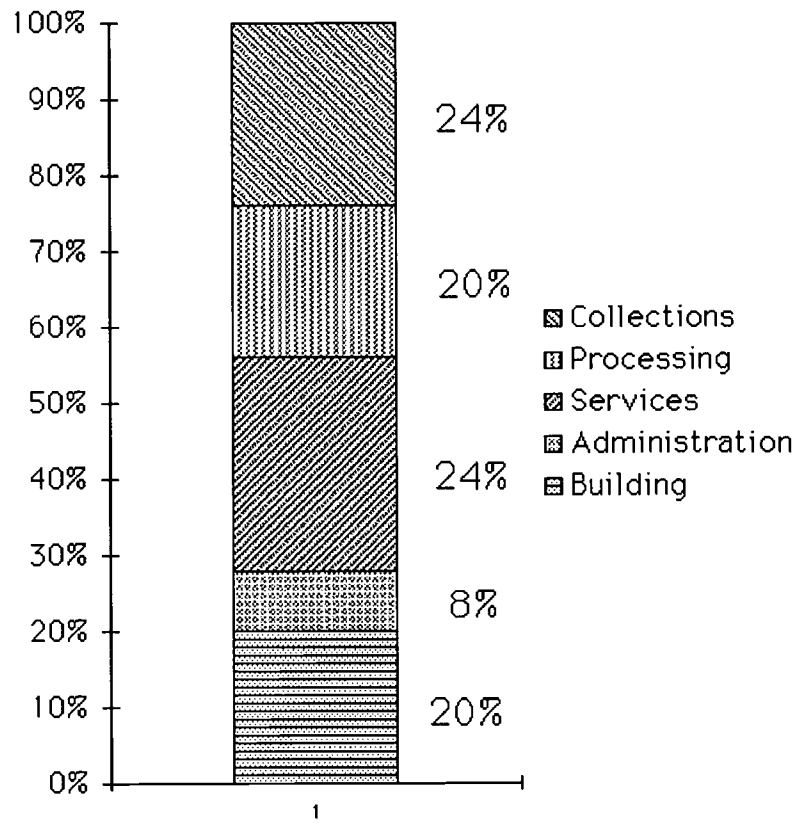
Figure 3
Conventional Library Costs



source: Heuristic characterization based on Association of Research Libraries Annual Statistical Survey on expenditures on materials and operating budgets, and the author's own studies of library space and technical service costs.

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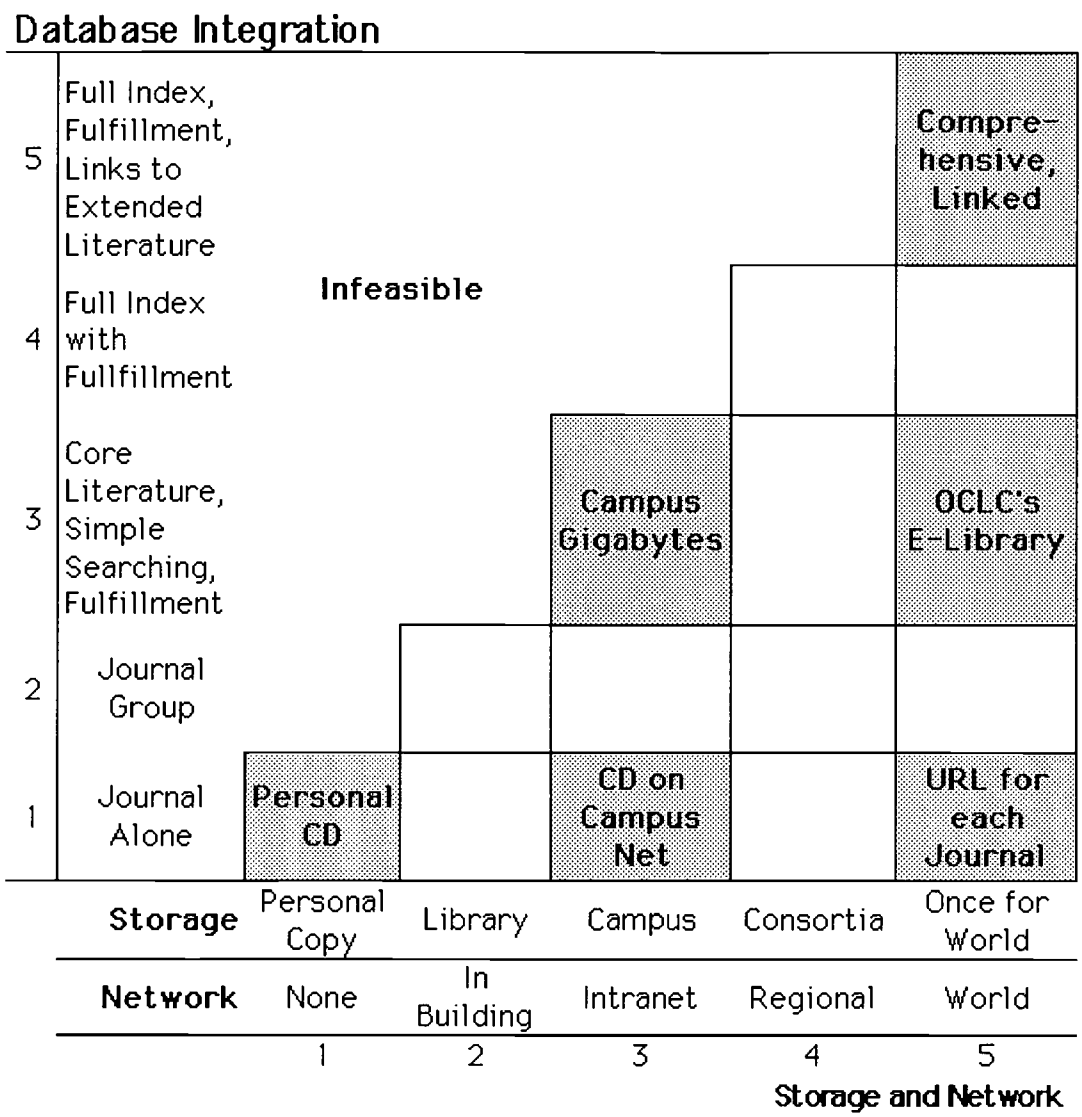
Figure 4
Network Intensity and Database Integration



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FOOTNOTES:

1. I appreciate the help of Elton Hinshaw and the American Economic Association in understanding its operations and the comments of Paul Gherman, David Lucking-Reiley, and Flo Wilson on an earlier draft of this essay.

2. Shirley Baker, talk at Washington University, November, 1996.

3. Robin Frost, "The Electronic Gutenberg Fails to Win Mass Appeal," *Wall Street Journal*, November 21, 1996, p. B6. Project Gutenberg was a twenty-five year effort led by Michael S. Hart at the University of Illinois to create, store, and make accessible ASCII files of public domain materials from the Constitution, the Bible, Shakespeare, and beyond.

4. Stephen Burd, "President Pushes Tax Breaks to Help Families Afford College," *Chronicle of Higher Education*, January 17, 1997, p. A33.

5. www.ei.org

6. http://xxx.lanl.gov/

7. http://scriptorium.lib.duke.edu/papyrus/ offers 1,373 images of Egyptian papyri with a significant database of descriptive textual material.

8. http://fairmodel.econ.yale.edu/

9. http://gdbwww.gdb.org/

10. The headquarters publishes *Job Openings in Economics* (JOE) seven times a year with nearly 1,500 job announcements. In 1995, JOE had about 4,000 subscribers and generated about $41,000 of revenue with a base rate of $15 per year ($7.50 for students, $25 for nono-members and institutions). The sum of monthly printing and mailing cost was associated with the number of copies produced and the number of pages per copy for 1995 and 1996 as follows (with t-ratios in parenthesis):

```
Print & Mail = - 1,129.57 + 0.875 # of copies + 76.725 pages per issue

                    (-2.83)   (7.35)              (17.2)
```

This relationship is estimated from data on each of 14 issues over the two years and has an adjusted R-square of =0.957. Over this era, JOE averaged 25 pages per issue (ranging from 11 to 51). With seven issues per year, this equation forecasts total printing and mailing costs of $30,019 for 4,000 copies.

JOE became available without charge on a gopher site at Vanderbilt in 1994 and moved to the University of Texas in 1997 (http://www.econ.utexas.edu/joe/) in 1994. The JOE gopher is generating about 25,000 hits per month in 1996 and the subscription list of the printed JOE has dropped to 1,000. The Print & Mail relationship estimated above forecasts a cost of $11,645 for 1,000 copies. The Association will move from a net revenue position of $11,000 ($41,000 - $30,019) in the all print regime to about a zero net ($15,000 - $11,645) with print subscription sales at about a 1,000. Of course, the Association incurs fixed costs in producing JOE that may be similar under both regimes.

11. The headquarters also publishes a Directory of membership biennially. The Directory became available on-line at the University of Texas in 1995 and is getting about 4,600 hits per month.

Because the Directory comes with membership, we have no measure of the rate of decline in the demand for the print version.

12. At some point in the future, membership ballots might be solicited and received by the Internet.

13. The AER's reviewing process is double-blind, with author's names withheld from reviewers and reviewer's names kept from authors. When nearly all working papers are posted on the World Wide Web, the refereeing may become single-blind de facto. Anyone who wants might search the title listing in the working paper file and so identify the author. When working papers are generally accessible on the Net, they would seem to be usable in the editorial process with some saving in cost but with some loss in anonymity.

14. The fixed costs of a print run (but not typography) would be eliminated entirely if print were abandoned completely. The fixed costs of electronic distribution would replace them in part. Presumably, the more sophisticated the electronic files submitted by authors, the lower the fixed cost of production at the publisher.

15. Since 1995, the Association has made the JEL available in CD-ROM format instead of print for the same price. The CD-ROM costs about the same to produce on the margin per subscriber as a printed issue of a large journal. The CD-ROM contains the page images of the published journal and is distributed by mail. Its advantage is not reduced cost, but increased subscriber benefit: It adds the power of electronic searching. Therefore, this version is gaining popularity. More than ten percent of the AEA's members opted for the CD-ROM version of JEL in 1996.

16. The annual meeting contributed a net of about $125,000 in 1995.

17. Assume the current library subscription rate of $140 yields 20 percent of the AEA's gross and that membership plus ads yields $70, about 40 percent. Assume the shift to electronic distribution lowers total expenditures by 20 percent, a saving of about $140 per library subscription. The campus intranet license then needs to generate double its current amount, about $280.

18. The notion of doubling the library subscription rate in setting a rate for the campus intranet license is meant to define the Association's probable revenue goals, but not to define the rate structure. The rate structure will need to be tied to something more substantial like enrollment and total research dollars. Alternatively, the rate could be set on the basis of a forecast of the hit rate. OCLC's electronic journal service sets rates on the basis of the number of simultaneous users. The level of rates would likely be set so as to yield about double the current library print subscriptions unless other revenue is forthcoming as discussed in the following paragraphs.

19. Here is part of the language the AEA prints on the copyright page. "Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or direct commercial advantage and that copies show this notice on the first page or initial screen of a display along with the full citation, including the name of the author."

20. Jared Sandberg "Cash Advances Aid Electronic Commerce," *Wall Street Journal*,

September 30, 1996 p. B8, reports an offering from CyberCash, a firm working with Visa and several banks. Cybercash put the cost of a transaction at between eight and 31 cents for purchases between $0.25 and $10.

http://www.research.digital.com:80/SRC/millicent/ describes the protocols and tools developed by Digital Equipment Corporation to facilitate Web transactions in fractions of cents. "The key innovations of Millicent are its use of brokers and of scrip. Brokers take care of account management, billing, connection maintenance, and establishing accounts with vendors. Scrip is microcurrency that is only valid within the Millicent-enabled world."

21. Draft essay at http://alfred.sims.berkeley.edu/jep.html.

22. See Malcolm Getz, "Petabytes of Information," in *Advances in Library Administration and Organization*, XII (JAI Press, 1994) pp. 203-37. Here are some features that might be added to the network working paper service. Each Association member might receive a private password and encryption key. When the member submits a paper with the password and key, the service would return a time-stamped digital authentication message. This message and the posting would establish ownership to the working paper at the time of submission. The working paper service might include a more elaborate system of tagging papers, including the author's sense of the target audience, degree of originality, sophistication, empirical content, and revision number. The service might include links to comments.

23. E. Jacquelin Dietz, "The Future of the Journal of Statistics Education," North Carolina State University, mimeo, 1996.

24. The issue of optimal pricing for three products that share a fixed cost and where cross elasticities are not zero should be explore formally.

25. David Carpenter and Malcolm Getz, "Evaluation of Library Resources in the Field of Economics: A Case Study," *Collection Management* 20:1/2, 1995, pp. 49-89.

26. See Malcolm Getz, "Information Storage," *Encyclopedia of Library and Information Science*, Vol. 52, Supplement 15, 1993, pp. 201-39. High density off-site storage might yield an annual cost of $0.30 per volume and so, about $3.00 of capital cost.

27. OCLC's Electronic Journals Online (EJO) preceded the web-based program. With EJO, OCLC charged publishers for mounting their journals, much as a printers charge for printing. This approach did not attract many publishers. The OCLC website (www.OCLC.org) lists several titles. Here is a sample of subscription rates.

The Online Journal of Current Clinic Trials from Chapman & Hall, distributed by OCLC:

Institutional: $220.00, Individual: $120.00, Student (with ID): $ 49.00, Network (unlimited access): $3,000.00.

Online Journal of Knowledge Synthesis for Nursing from Sigma Theta Tau International, distributed by OCLC: Individuals, $ 60.00; Institutions, $250.00.

28. OCLC, "Bringing Your Publications Online With OCLC," (Dublin, Ohio, c. 1996) and

OCLC, "A Complete Electronic Journals Solution for Your Library," (Dublin, Ohio, c. 1996).

29. Malcolm Getz, John J. Siegfried and Kathryn H. Anderson "Adoption of Innovations in Higher Education," *The Quarterly Review of Economics and Finance*, forthcoming.

30. http://mitpress.mit.edu/jrnls-catalog/snde.html. SNDE is one of six electronic journals offered by the MIT Press in 1996. The library rate includes a license to store the journal on a campus facility and make it available in library reserve services.

31. http://mitpress.mit.edu/jrnls-catalog/chicago.html puts the subscription rate at $30 for individuals, $125 for libraries, with a $12 fee for downloading an individual article.

For additional information about the conference, or The Andrew W. Mellon Foundation's scholarly communication initiatives, please contact Richard Ekman. For additional information about ARL or this web site contact Patricia Brennan, ARL Program Officer at (202) 296-2296.

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