
Introduction

LEWIS G. LIU

THIS *LIBRARY TRENDS* ISSUE contains contributions from library and information science researchers as well as economists. The contributors were identified based on their previous empirical research and publications in economics of libraries and library information services. The manuscripts were reviewed by the issue editors, the *Library Trends* editor-in-chief, as well as an anonymous reviewer when necessary. Final approved articles are included in this issue. Publications in this issue are characterized by empirical research. Almost all the contributions are empirical in terms of having theoretical or analytical frameworks, and original data collection, or real-world cases.

The theme of this issue is economics of libraries. However, when discussing economics of libraries, one would naturally think of economics of information since libraries are information-provision institutions and many library operations and management decisions are made based on costs of journal subscriptions, monographs, databases, and online information systems. The scope of economics of information is much broader than many think. The literature on economics of information and libraries may consist of the following areas: asymmetric information (e.g., George A. Akerlof, 1970; A. Michael Spence, 1974; and Joseph E. Stiglitz, 1977); microeconomic studies on libraries as decision-making institutions, such as studies on economies of scale and management of libraries using production functions (e.g., Stanley W. Black, 1969; Robert M. Hayes, 1979) and cost functions (e.g., Michael D. Cooper, 1979, 1983; Paul Kantor, 1981; Larry DeBoer, 1992; Lewis G. Liu, 2002), cost-benefit studies of library operations, services, and databases (e.g., Bruce Kingma, 1998; Gary W. White & Gregory Alan Crawford, 1998), cost and planning models of libraries (e.g., William J. Baumol & Matityahu Mar-

cus 1973; Charles McClure et al., 1995), and data envelopment analysis of library operations (e.g., Tser-yieth Chen, 1997; Donald F. Vitaliano, 1998; Andrew Worthington, 1999; Kehm R Sharma et al., 1999); economics of scholarly publishing and communication (e.g., H. C. Peterson, 1992; G.A. Chressanthis & J. D. Chressanthis, 1994; Richard E. Quandt, 1996; Roger G. Noll, 1996; Carol Tenopir & Donald W. King, 1997; Andrew M. Odlyzko, 1999; Mark J. McCabe, 2000); financial management of libraries and information services (e.g., Stephen A. Roberts, 1985, 1998); outputs, performance measures, and evaluations of libraries and information services (e.g., D. W. King & F. W. Lancaster, 1969; F. W. Lancaster, 1977, 1993; Paul Kantor, 1984; Nancy A. Van House et al., 1987, 1990; J. C. Bertot, C. R. McClure, & J. Ryan, 2001);¹ economics of networks (e.g., M. L. Katz & C. Shapiro, 1985; N. Economides, 1996) and economics of the Internet (e.g., J. K. MacKie-Mason & H. R. Varian, 1995); information as a public good versus information as a commodity and free information versus fee-based information (e.g., Ellen Gay Detlefsen, 1984; Roger McCain, 1988; Charles W. Robinson, 1989; Maribelle M. Davis, 1991; Anne Goulding, 2001); and economics of intellectual property and copyright protection (e.g., S. M. Besen & S. N. Kirby, 1989).

This list is by no means exhaustive. It intends to highlight some important research areas in economics of information and libraries. Some of these areas have been studied by both economists and library and information science scholars. Other areas have been only the concerns of economists. While this issue does not cover all the above areas due to the time limit to complete this issue and limited pages allowed, the contributions cover a wide range of issues related to economics of libraries and information services and can be classified into four broad categories: economics of academic libraries, public libraries, library cooperation, and financial management of libraries. They not only reflect the new research trends but also reflect the continuation of this body of research literature from the past.

ASYMMETRY OF INFORMATION

Many economists study economics of information in terms of asymmetric information, adverse selection, and moral hazard. They examine how possession of information or dispossession of information affects the market system. This body of research literature has been developed solely by economists. Some important theories are represented by the works of three economists, George A. Akerlof, A. Michael Spence, and Joseph E. Stiglitz, who have recently received Nobel prizes for their work in this area.

The notion of asymmetric information was illustrated by George A. Akerlof (1970) with a seemingly simple observation: in a market transaction, sellers know something that buyers do not know and buyers know something that sellers do not know. When asymmetric information exists between buyers and sellers, market failure occurs. An example given by

Akerlof was the used car market where the buyer does not know which used cars are good ones and which used cars are bad ones. The seller is motivated to mislead the buyer. And the buyer expects that and discounts the price of the used car he or she tries to buy. Since the sellers of good-quality cars are less willing to sell their cars at discounted prices, bad cars eventually drive good cars out of the market. Such a downward discounting effect is called *adverse selection*. A. Michael Spence (1974) explored asymmetric information in the labor market. He observed that job applicants tend to “signal” their ability to potential employers through costly education. Since potential employers cannot directly observe job candidates’ ability, they screen job candidates by examining their educational credentials and records. Joseph Stiglitz and Michael Rothschild (1976, 1977) investigated the effects and economic policy implications of asymmetric information in the insurance market. Stiglitz explained how insurance companies use the screening process to identify high-risk insurers and use various price structures, such as deductibles and premiums to classify insurers by their risk levels.

A fairly large body of research literature on asymmetric information and its effects on a wide range of markets has been generated since the initial research. A keyword search in *EconLit*, a primary index to the economic literature, retrieved over 1,700 records, indicating the magnitude of this body of research and the influence of this research orientation on economists. More importantly, this body of knowledge in economics has posed serious challenges to the wisdom of traditional economics that believes that the market is perfect (although sometimes it is believed to be less than perfect) and the “invisible hand” will be at work and eventually solve all the supply and demand problems. Through this body of research, it is now known that many markets are imperfect and that asymmetric information exists between buyers and sellers and therefore affects behaviors of individuals and organizations. Stiglitz’s recent article (2000) provides a comprehensive review on research on asymmetric information and its contribution and role in the field of economics.

Research on asymmetric information provides useful policy guidances. To correct market imperfection, government intervention can be necessary. The recent series of events related to corporate corruptive behaviors, such as falsifying accounting records to hide financial losses, have further exemplified the notion of asymmetric information and prompted the Bush administration to impose new laws and regulations to curb corporate mischief and to restore the investors’ confidence in the stock market. This line of research can be applied to the library and information service industry to examine how asymmetric information affects this particular market. Information can be misrepresented by information providers such as publishers to information consumers such as libraries. So far, little systematic research has been conducted on this market.

MICROECONOMIC STUDIES OF LIBRARIES

Microeconomic studies on libraries can be classified into a number of categories: economic theory of libraries, economies of scale using production functions and cost functions, data envelopment analysis, cost-benefit analyses, cost modeling, and performance measures.

Economic Theories of Libraries

Theoretical works on economics of libraries are also lacking. While the nonprofit nature of libraries is well recognized, little effort has been made to specifically differentiate libraries from other nonprofit organizations. As a result, no economic theoretical work on libraries has been developed. Theoretical works are important since they are tested and universally accepted principles that govern the behaviors of organizations and individuals and can be used to predict future behaviors of organizations and individuals. Economic theories of libraries help to explain why libraries seek certain goals and behave in certain ways and provide guidance for policymakers.

In this issue, Lewis G. Liu's first article looks at the economic behavior of academic research libraries and how they maximize their utilities given budget constraints. He argues that academic research libraries, like some other nonprofit organizations, seek prestige as opposed to seeking profits. Unlike other nonprofits, academic research libraries seek to maximize their utilities by expanding the size of their collections. He examines the relationship between the size of collections and prestige of universities. The findings show that library collections account for a significant portion of the variance in university prestige.

Bryce Allen examines the economic theory of public choices in the context of public libraries. High quality of public library services and high levels of demand for such services are believed to correlate with high level of public funding. The findings show a marginal relationship between the use and funding of libraries and no association between public opinion and levels of funding. Allen concludes that noneconomic factors may play a role in funding for public libraries.

Robert M. Hayes applies the economic game theory to library cooperative environments in terms of resource sharing, cooperative acquisitions and automation, cataloging and storage sharing, preservation and access, and digital library development. Library consortia or other kinds of library networks may find this article useful for guiding their collaborations.

Economies of Scale, Production Function, and Cost Functions of Libraries

Lewis G. Liu's second article deals with economies of scale of academic research libraries. He points out that libraries in general and academic research libraries in particular are multiproduct and multiservice information provision institutions. (Previous studies on economies of scale of librar-

ies using the Cobb-Douglas production function ignored that very nature of libraries and used a single output variable for estimating economies of scale of libraries.) He formulated a cost function incorporating a wide range of output variables into the cost function. The output variables used in the cost function reflect a variety of library products and services. The findings indicate that academic research libraries have slight economies of scale.

In fact, economies of scale studies on libraries can be traced back to as early as the 1960s when economist William J. Baumol and his colleagues published a report commissioned by the National Advisory Commission on Libraries in 1969 (*Libraries at Large*, p. 168) and entitled *The Costs of Library and Information Services*. Since then, many economic studies have been conducted to examine libraries as organizations or economic entities in terms of the production process of libraries. This body of research literature treats libraries as decision-making units (either as a group or as a single unit) in terms of how libraries can maximize their services and minimize costs given limited resources.

In the same year, Stanley W. Black (1969) developed an economic model for public libraries using the Cobb-Douglas production function. He used circulation as the dependent variable and library staff and book stock as the independent variables. This production function permitted him to estimate scale economies of public libraries. Given the high multicollinearity between the labor and capital variables, he assumed that constant returns to scale existed. With that assumption, he was able to figure out the coefficients for labor and book stock variables. Black's study on public libraries, particularly the econometric methodology he used, has a far-reaching influence on the later studies.

Since Black's empirical study, several studies on scale economies and management of libraries have been conducted by economists as well as library science researchers. Some used production functions (Haynes C. Goddard, 1973, Robert M. Hayes, 1979). Others used general cost functions (Michael D. Cooper, 1979, 1983; Paul Kantor, 1981; Lewis G. Liu, 2002). Still others used translog cost functions (Larry DeBoer, 1992; Christopher J. Hammond, 1999). This body of research literature is small in number but covers a variety of libraries and utilizes quite diverse econometric models. It covers public libraries, scientific and technological libraries, private and public college and university libraries. Some were interested in scale economies of libraries only. Others examined scale economies of libraries as well as input substitution elasticities. These studies tend to specify inputs, outputs, labor, capital, and costs associated with these variables, and attempt to find whether economies of scale exist in various libraries, particularly public libraries. The economic reasoning is that consolidating smaller-sized libraries can lead to cost savings.

Data Envelopment Analysis (DEA)

Wonsik Shim provides a detailed discussion on the DEA model and the calculation of the relative technical efficiency of ninety-five academic research libraries. According to his findings, a number of academic research libraries have lower scores, indicating that they do not operate as efficiently as many of their counterparts. As Chen (1997) pointed out, there are no quality measures built in to DEA. To know more about library operations, it is important to use both DEA and site visits.

Data envelopment analysis is a mathematical programming method that incorporates multiple inputs and multiple outputs to evaluate the relative efficiency of an organization, a project, or a program. Although it is mathematically complicated, it is essentially an output-to-input ratio. If this ratio is 1, then it can be concluded that the organization operates efficiently since its inputs produce the same amounts of outputs. The extent to which the organization is considered efficient depends on how close its efficiency scores are to 1. This body of literature in the past was exclusively generated by economists. DEA was originated by Charnes et al. in 1978, mostly for nonprofit organizations (William F. Bowlin, 1998, p. 1) whose goals are not for making profit, and whose performance is not evaluated based on profit criteria. This method enables researchers and managers to evaluate efficiencies of organizations. Since for-profit organizations also need to improve efficiencies of their operations, this method has been quickly applied to a wide range of business, industry, and service sectors.

Only in recent years, have economists started examining efficiencies of libraries using DEA. In 1997, Tser-yieth Chen investigated the efficiencies of twenty-three university libraries in Taiwan. He found that about half of the libraries under investigation are relatively efficient. A few libraries are highly efficient. But a few libraries managed their resources poorly. In 1998, Donald F. Vitaliano studied 184 public libraries in New York using DEA. He found that 67 percent of the libraries evaluated were efficient and attributed inefficiencies to long opening hours. Two studies using DEA in 1999 were conducted by Andrew Worthington and Kehm R Sharma et al. Andrew Worthington (1999) looked at 168 New South Wales local government libraries in Australia. The findings show that about 67.2 percent of the libraries met various efficiency criteria. Sharma et al. (1999) looked at the efficiencies of forty-seven public libraries in Hawaii. They found that only about 30 percent (fourteen of the forty-seven) libraries are technically efficient.

There are advantages and disadvantages of using DEA. Traditionally, economists use regressions such as the production function and various forms of cost functions (translog cost function and general cost functions) to evaluate efficiencies of organizations. They normally take the advantage of log transformation to calculate the function coefficient. The function coefficient (which can be either the production function coefficient or the cost

function coefficient) is used to determine whether or not an organization operates efficiently. The regression techniques can also help economists to formulate models for predicting future demand for labor and materials.

But regression techniques have limitations. The first limitation is that in order to use regression techniques, there must be enough data points to achieve statistical significance. In many cases, it is impossible to run a meaningful regression with limited data points. For example, Chen's study on the efficiency of academic libraries in Taiwan would not have been possible using the regression technique simply because there were only twenty-three libraries. That number is not sufficient enough to run a successful regression. The use of DEA is perfectly suitable for this small sample of data. The second limitation is that the regression using the production function only permits one output variable. DEA allows a number of output variables. Libraries are multiproduct and multiservice information provision institutions. Using only one output variable ignores that very nature of libraries. The third limitation is that regression techniques are not able to identify sources (inputs and outputs) and specify the amounts of inefficiencies related to these sources. DEA is able to identify sources and specify the inefficiency amounts (William F. Bowlin, 1998).

The disadvantages of DEA are mostly the advantages of using regressions. They include the following: no statistical significance is tested for DEA; lack of predicting power; and difficult to calculate, although some software programs have been developed for DEA. Chen also pointed out that DEA lacks quality measures and suggested that researchers visit libraries to gain a better understanding of the quality side of services provided by libraries. He recognized that the complexity of the method makes it difficult to communicate with library administrators (p. 79).

Cost and Benefit Analyses, Cost Modeling, and Performance Measures

Traditional economic cost and benefit analysis calculates present value of a stream of cost items and present value of a stream of benefit items in monetary terms. If the total present value of costs outweighs the total present value of benefits, the project is not worth pursuing. Bruce Kingma (e.g., 1998) applied cost-benefit analyses to access, ownership, and interlibrary loan service. Cost and planning models are developed and used to predict future costs based on a given level of labor, capital, services, and outputs. William J. Baumol and Matityahu Marcus (1973) developed cost and planning models for academic libraries. Charles R. McClure et al. (1995) developed Internet cost models for public libraries. F. W. Lancaster (1977, 1993), Nancy Van House et al. (1987, 1990), and J. C. Bertot, C. R. McClure, and J. Ryan (2001) developed performance measures for various libraries and information services.

In this issue, Donald W. King, Peter B. Boyce, Carol Hansen Montgomery, and Carol Tenopir provide a cost-benefit analysis of library electronic

collections and services. As libraries, particularly academic libraries, are increasingly moving toward digital libraries, it is critical for libraries to have a better understanding of the nature of electronic collections and services, how they affect library policies toward print collections, and what optimal choices are available during the transition period from print to digital libraries. King, Boyce, Montgomery, and Tenopir present an analytical framework for comparing electronic journal collections and services with their print counterparts using a number of measures including inputs, outputs, performance, usage, cost effectiveness, and outcomes. They demonstrate the use of these measures by applying them to a number of library settings. The framework they have developed is multidimensional and certainly contributes to our better understanding of measuring the performance of library services.

Glen E. Holt and Donald Elliott provide a cost-benefit analysis framework for public libraries. Although their empirical research is still in process, the methodology to be used in their investigation can be useful for those who intend to do similar projects.

As more and more information is available on the Web and more and more people use the Web, many academic libraries, public libraries, as well as special libraries have started providing digital reference services including email reference service and e-chat service. Since digital reference service requires staff time and technical support it is important to know how efficiently and effectively this service is provided. R. David Lankes, Melissa Gross, and Charles R. McClure discuss two types of standards (utilization standards and technical standards) for calculating costs, gathering statistics, and developing measures for digital reference services. Utilization standards consist of two broad measures: quality measures and performance measures. Both quality and performance measures contain a number of subcategories to reflect user satisfaction level, service scope and service quality, staff time, and costs. Technical standards consist of question interchange, profile, and knowledge base. Both types of standards provide useful guidelines for helping library administrators make decisions as to how to plan, implement, and evaluate digital reference services.

ECONOMIC STUDIES ON THE SCHOLARLY PUBLISHING INDUSTRY

This area of research tends to focus on the demand and supply of information in the scholarly publishing industry. Researchers explore questions like: What factors affect costs and prices of journals, books, databases, library computer hardware and software and storage, Internet information services, and other information services, what role publishers play, and how libraries respond to these price changes. Since scholarly journals play a crucial role in scholarly research and communication and prices of scholarly journals have been escalating year after year, this issue has

drawn a great deal of research attention from library and information science researchers and economists.

There has been a long struggle between libraries and publishers about prices of scholarly journals. Libraries have limited budgets but are faced with increasing prices of journals to the extent that many libraries have to cancel some of their journal subscriptions and cut book purchases to keep up with such increases and to protect their core journal collections. Some reasons given for escalating journal prices are increases in journal production costs, fluctuations in currency exchange rates, decreases in journal circulations, and so on. But libraries are not convinced that these are the only sources of increasing journal prices. Instead, they believe that commercial publishers “reap monopoly profits.” To investigate the causes for rising prices of journals, the Association of Research Libraries (ARL) contracted Economic Consulting Services to conduct a study on serials prices offered by four major commercial publishers in 1988 (Economic Consulting Services, 1989). The findings show that the increases in journal prices charged by four major commercial publishers cannot be totally explained by the increasing production costs of these journals. A 1997 study on U.S. scientific journals by Carol Tenopir and Donald W. King also pointed out that the increases in journal prices were higher than increases in cost factors, such as inflation, the increased size of journals, capital, labor, and other costs. They believed that pricing policies of publishers accounted for “the majority of the remaining increases” and the sharp decline of individual subscriptions led publishers to increase prices of institutional subscriptions. Publishers were able to impose discriminatory prices on institutions because of relative price inelasticity of demand for journals by institutions (Tenopir & King, 1997, p. 52).

While libraries tend to blame publishers for reaping monopoly profits, some have not been convinced that publishers are the only ones to blame (Henderson, 1998; Mobley, 1998). Others questioned the accuracy of the calculations of profit margins of publishers (Noll & Steinmueller, 1992). Albert Henderson argued that at least part of the serials crisis was attributable to libraries’ parent institutions: universities. He pointed out that libraries have been increasingly receiving less and less share of university spending for decades (p. 2). Canceling journal subscriptions by libraries drove up the average costs of journals and therefore the journal prices. This is because the budget problem was created by universities that invested their revenue surpluses in real estate, equity, and fixed-income markets instead of investing in library collections (p. 4). He also pointed out that the important role of science libraries in supporting research and information dissemination is also neglected by various government agencies and called for reforming the current federal “indirect cost” policies on information resources and for strengthening financial support for research libraries (p. 6).

Emily R. Mobley (1998) also argued that publishers are not the only

ones that caused the problem. Many factors contributed to the current serials crisis. Federal funding for research programs has been shrinking as a result of domestic policy shifts, and corporate downsizing has also impacted libraries in the commercial sector. She maintained that it is not unusual for commercial publishers such as Reed-Elsevier to seek dominant control of the publishing industry since it behaves no differently from corporations in other industries. She believed that it is too easy for faculty to give up their copyrights and too easy for faculty sitting on editorial boards to approve price increases or policies that later lead to price increases, such as increases in page numbers to provide more opportunities for their colleagues who are faced with the "publish or perish" situation. She argued that scholarly societies also play a role in this crisis. Although increases in journal prices of scholarly societies are lower than those of commercial publishers, they are still higher than general inflation (p. 5) and they charge libraries higher prices than they do individual members. She further argued that university administrators are not helping the crisis. Instead, they push libraries to solve the problem through cooperations with other libraries and consortia agreements.

In this issue, Richard E. Quandt discusses the issue of the economics of traditional publication media and digital media for scholarly publications, provides a comprehensive review and in-depth analysis of the research literature related to the phenomenon of journal price increases, and identifies the causes of these increases. He discusses this important issue in the macroeconomic context as well as the context of the scholarly publishing industry and explains why computer applications in the 1960s through 1980s did not contribute to economic growth in general and to solving the problems of scholarly communication in particular during that time period. He then focuses on the economics of scholarly publishing in terms of costs of producing, distributing, archiving, and using print and electronic scholarly materials. Finally, he discusses issues related to pricing of scholarly journals and bundling scholarly materials and explains why price discrimination exists for scholarly journals. He concludes that commercial publishers will still control electronic scholarly publishing media at least in the near future. His article certainly sheds new light on the current debate over scholarly publishing and will help library administrators and librarians gain more insights into this important research topic.

FINANCIAL MANAGEMENT OF LIBRARIES

Financial management of libraries is the process of managing financial resources of libraries, including financing, planning, accounting, budgeting, controlling, and so forth. While financial management is an important part of library administration, the research literature on financial management of libraries is small.

In this issue, Jennifer Ellis-Newman's article deals with cost accounting

in academic libraries. She specifically explains the advantages of using activity-based costing (ABC). ABC is a management tool of identifying and assigning indirect costs to library products and services based on the factors that are most relevant to them. She has analyzed and classified cost drivers commonly used in libraries. These cost driver classifications can help library managers look at relevant cost data and make accurate cost estimates and good decisions to improve efficiencies of libraries. Cost accounting of libraries is part of the financial management of libraries and provides a cost basis for economic analyses, such as the relationship between average cost and marginal cost. Using irrelevant cost data can cause miscalculation of average cost and therefore affects accurate evaluation of efficiencies of libraries. ABC is certainly a useful management tool for library managers.

Stephen A. Roberts discusses the issue of financial management of library and information services from a macroperspective. He examines the impact of the macroeconomic environment on the library information service industry and observes that business management models have been increasingly applied to library management. He presents a number of criteria for library and information service management based on Maurice Line's work and develops objectives for financial management of library and information services. It is a useful article for library administrators to understand the issues related to financial management of libraries.

SUMMARY AND CONCLUSION

In this *Library Trends* issue some articles have addressed issues that have not been explored before. Others have followed the existing line of research but have broken new ground. Still others have integrated a vast body of research literature, and provided in-depth analyses and valuable insights into the issues under investigation. Measuring and evaluating performance of library operations and services are still major research concerns. Some microeconomic and managerial accounting tools, such as the cost functions, DEA, ABC, and CBA have been used to measure operating efficiencies of libraries. The focus is on academic libraries. Another main research concern is managing electronic resources and services as a result of their increasing applications in libraries in recent years. New paradigms, standards, and analytical frameworks have been developed to guide and measure electronic or digital collections and services. Scholarly publishing is also a key issue. We have to wonder why, as costs of digital communications, computation, and networking are increasingly falling, and as producing, organizing, bundling, and distributing digital information are becoming increasingly inexpensive and digital information can be even reproduced at zero marginal cost, prices of scholarly journals are still high—high enough for many academic libraries to cancel them in order to protect their core journal collections. Some answers to this puzzle can be found from articles in this issue. Given the current technological, political, and economic envi-

ronments, cooperation among libraries and library consortia in terms of sharing resources and services are not uncommon. Descriptive articles on library cooperations are many, but few offer theoretical insights into cooperative activities. This issue provides theoretical guidance for cooperative decision-making and reflects the continuing research interest in library cooperation. More efforts in theoretical works need to be made. The unique nature of libraries as one kind of nonprofit organization needs to be further explored.

It is our hope that contributions in this issue provide useful, practical guides, research tools, and the latest research findings for library administrators and researchers to better understand issues and problems related to the economics of libraries.

NOTE

1. While much of the performance and measurement literature tends to focus more on statistical measures of various library services and operations than on economic analyses, it provides quantitative tools for economic analyses, and in some cases, it does consider cost factors.

REFERENCES

- Akerlof, G. A. (1970). The market for 'lemon': Quality uncertainty and market mechanism. *Quarterly Journal of Economics*, 84(3), 488-500.
- Baumol, W. J. & Marcus, M. (1973). *Economics of academic libraries*. Washington, DC: American Council on Education.
- Baumol, W. J. et al. (1969). The costs of library and informational services. In Knight, D. M. & Nourse, E. S. (Eds.), *Libraries at large* (pp. 168-227). New York: R.R. Bowker.
- Bertot, J. C., McClure, C. R., & Ryan, J. (2001). *Statistics and performance measures for public library networked services*. Chicago: American Library Association.
- Besen, S. M. & Kirby, S. N. (1989). Private copying, appropriability, and optimal copying royalties. *Journal of Law and Economics*, 32, 255-280.
- Black, S. W. (1969). Library economics. In Knight, D. M. & Nourse, E. S. (Eds.), *Libraries at large* (pp. 590-598). New York: R.R. Bowker.
- Bowlin, W. F. (1998). Measuring performance: An introduction to data envelopment analysis. *Journal of Cost Analysis*, 1-25.
- Charnes, A., Cooper W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operations Research*, 2, 429-444.
- Chen, T. (1997). A measurement of the resource utilization efficiency of university libraries. *International Journal of Production Economics*, 53, 71-80.
- Chressanthis, G. A. & Chressanthis, J. D. (1994). A general econometric model of the determinants of library subscription prices of scholarly journals: The role of exchange rate risk and other factors. *Library Quarterly*, 63(3), 270-293.
- Cooper, M. D. (1979). The economics of library size: A preliminary inquiry. *Library Trends*, 28(1), 63-78.
- Cooper, M. D. (1983). Economies of scale in academic libraries. *Library and Information Science Research*, 5, 207-219.
- Davis, M. M. (1991). The invisible hand: economic reality: Free vs. fee-based library service. *Public Library Quarterly*, 11(4), 3-11.
- DeBoer, L. (1992). Economies of scale and input substitution in public libraries. *Journal of Urban Economics*, 32(2), 257-268.
- Detlefsen, E. G. (1984). User costs: Information as a social good vs. information as a commodity. *Government Publications Review*, 11, 385-394.
- Economic Consulting Services. (1989). *A study of trends in average prices and costs of certain serials over time*. Washington, DC: Association of Research Libraries.

- Economides, N. (1996). The economics of networks. *International Journal of Industrial Organization*, 39(2), 667-704.
- Goddard, H. C. (1973). Analysis of social production functions: The public libraries. *Public Finance Quarterly*, 1(2), 191-204.
- Goulding, A. (2001). Information: Commodity or social good? *Journal of Librarianship and Information Science*, 33(1), 1-4.
- Hammond, C. J. (1999). The technology of library service provision: A cost function analysis of public library systems in the United Kingdom. *Information Economics and Policy*, 11(3), 271-295.
- Hayes, R. M. (1979). The management of library resources: The balance between capital and staff in providing services. *Library Research*, 1, 119-142.
- Henderson, A. (1998). Science in the twilight zone; or, Are science libraries related to science? *Issues In Science & Technology Librarianship*, 20, 1-12.
- Kantor, P. (1981a). Levels of output related to cost of operation of scientific and technical libraries: Part I. Techniques and cumulative statistics. *Library Research*, 3, 1-28.
- Kantor, P. (1981b). Levels of output related to cost of operation of scientific and technical libraries: Part II. A capacity model of the average cost formula. *Library Research*, 3, 141-154.
- Kantor, P. (1984). *Objective performance measures for academic and research libraries*. Washington, DC: Association of Research Libraries.
- Katz, M. L. & Shapiro, C. (1985). Network externalities, competition, and compatibility. *American Economic Review*, 75(3), 424-440.
- King, D. W. & Lancaster, F. W. (1969). Cost, performance, and benefits of information systems. *Proceedings of the American Society for Information Science*, 6.
- Kingma, B. (1998). The economics of access versus ownership: The costs and benefits of access to scholarly articles via interlibrary loan and journal subscriptions. *Journal of Library Administration*, 26(1/2), 145-57.
- Lancaster, F. W. (1977). *The measurement and evaluation of library services*. Washington, DC: Information Resources Press.
- Lancaster, F. W. (1993). *If you want to evaluate your library* (2nd ed.). Champaign, IL: University of Illinois Graduate School of Library and Information Science.
- Liu, L. G. The cost function and scale economics in academic research libraries. *College & Research Libraries*, 63(5), 407-420.
- MacKie-Mason, J. K. & Varian, H. R. (1995). Pricing the Internet. In Kahn, B. & Keller, J. (Eds.), *Public Access to the Internet* (pp. 269-314). Cambridge, MA: MIT Press.
- McCabe, M. J. (2002). Academic journal pricing and market power: A portfolio approach. *American Economic Review*, 92(1), 259-269.
- McCain, R. (1988). Information as property and as a public good: Perspectives from the economic theory of property rights. *Library Quarterly*, 58, 265-282.
- McClure, C. R., Bertot, J. C., & Beachboard, J. C. (1995). *Internet costs and cost models for public libraries: Final report*. Washington, DC: U.S. National Commission on Libraries and Information Science.
- Mobley, E. R. (1998). Ruminations on the sci-tech serials crisis. *Issues in Science and Technology Librarianship*. Retrieved November 5, 2002, from <http://www.istl.org/98-fall/article4.html>.
- Noll, R. G. (1996). *The economics of scholarly publications and the information superhighway*. Brookings Discussion Papers in Domestic Economics, No. 3.
- Noll, R. G. & Steinmueller, W. E. (1992). An economic analysis of scientific journal prices: preliminary results. *Serials Review*, 19, 32-37.
- Odlyzko, A. (1999). The economics of electronic journals. In Ekman, R. & Quandt, R. E. (Eds.), *Technology and Scholarly Communication*. Berkeley, CA: University of California Press.
- Peterson, H. C. (1992). The economics of economics journals: A statistical analysis of pricing by publishers. *College & Research Libraries*, 53, 176-181.
- Quandt, R. E. (1996). A simulation model for journal subscription by libraries. *Journal of the American Society for Information Science*, 47(8), 610-617.
- Roberts, S. A. (1985). *Cost management for library and information services*. London: Butterworths.
- Roberts, S. A. (1998). *Financial and Cost Management for Libraries and Information Services* (2nd ed.). London: Bowker-Saur.

- Robinson, C. W. (1989). Free or fee based library in the year 2000. *Journal of Library Administration*, 11(1/2), 111-118.
- Rothschild, M. & Stiglitz, J. (1976). Equilibrium in competitive insurance markets: the economics of imperfect information. *Quarterly Journal of Economics*, 90(4), 630-649.
- Sharma, K. R., Leung, P., & Zane, L. (1999). Performance measurement of Hawaii State public libraries: An application of data envelopment analysis (DEA). *Agricultural and Resource Economics Review*, 28, 190-198.
- Spence, A. M. (1974). *Market Signaling: Informational Transfer in Hiring and Related Processes*. Cambridge: Harvard University Press.
- Stiglitz, J. E. (1977). Monopoly, non-linear pricing and imperfect information: The insurance market. *Review of Economic Studies*, 44(3), 407-430.
- Stiglitz, J. E. (2000). The contributions of the economics of information to twentieth century economics. *Quarterly Journal of Economics*, 115(4), 1441-1478.
- Tenopir, C. & King, D.W. (1997). Trends in scientific scholarly journal publishing in the United States. *Journal of Scholarly Publishing*, 28(3), 135-170.
- Van House, N., Lynch, M. J., Zweizig, D. L., & Rodger, E. J. (1987). *Output measures for public libraries: A manual of standardized procedures* (2nd ed.). Chicago: American Library Association.
- Van House, N. A., Weil, B. T. & McClure, C. R. (1990). *Measuring academic library performance: A practical approach*. Chicago: American Library Association.
- Vitaliano, D. F. (1998). Assessing public library efficiency using data envelopment analysis. *Annals of Public and Cooperative Economics*, 69(1), 107-122.
- White, G. W. & Crawford, G. A. (1998). Cost-benefit analysis of electronic information: A case study. *College and Research Libraries*, 59(6), 503-510.
- Worthington, A. (1999). Performance indicators and efficiency measurement in public libraries. *Australian Economic Review*, 32(1), 31-42.