

Economics of Information: A Review

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Abstract

Economics of information has emerged as a subject in its own right. The abundance of literature in the field bears testimony to this fact. It is an area of interest to both economists and library and information professionals. Naturally, the literature to the subject emanate from both the disciplines. However, the approaches of these two groups are divergent. In this review also, the two stream approach is followed. Since the literature from Economics provide the theoretical background, the significant contributions right from 1960s are covered. From among the contributions from the Library and Information side also only selected studies which are representative in nature and published in the present century are included in the review, lest it may become too long. The studies in the field of Library and Information Science are mostly evaluative in nature. They are categorized under the headings reviews, general studies, academic libraries, university libraries and public libraries. The evaluative studies were found to be more in the field of public libraries.

Key words: Economics of Information; Data Envelopment Analysis; Evaluation Studies; Information Economy; Public Libraries; University Library; Review

1. Introduction

Information Economics or Economics of Information is an integral part of the Information Science paper of the Library and Information Science all over the world. This topic deals with the economic aspects of information. However, in library schools the application of pure economic theory related to information products and services is not emphasized. On the other hand, the economic, social, political and legal aspects of information as a resource are dealt with. A typical example is the subthemes taught in the Information Economics course taught at the University of Pretoria (Ponelis & Britz, 2004). The study themes adopted there are:

- i. Origins of the information society and the information economy.
- ii. Information as an economic good.
- iii. Pricing and packaging of information goods.
- iv. Economics of intellectual property.
- v. Information exchange to facilitate relationships in an information economy.

In the critical study of information, Machlup and Mansfield (1983) have identified, apart from economics, contributions from other disciplines including psychology, sociology, linguistics, communication, engineering, computer science, cognitive science, artificial intelligence, and cybernetics. But issues discussed in the field also border with additional fields like philosophy, political science, governance, and policy studies. The subfield 'economics of information' emerged as several distinct strands of research and theory in economics that dealt with very different aspects of the concept of information.

Economics of information first evolved as a distinct field of inquiry in the 1960s as a result of the growing awareness of the drastic changes taking place in world economies triggered by the increasing application of computer technology and communication technology. In fact, the raw material handled by these technologies is information. But the changes brought about by these technologies in the handling of information began to alter the

economic condition of the societies resulting in the coining of the term information society.

The contributions of Machlup (1962) and Boulding (1966) bear testimony to the interest evinced by scholars in the economics of information. The statistical framework offered by Porat (1977) for analyzing trends in the information sector strengthened the research activities in the sector.

2. Two Perspectives

Though Machlup and Mansfield have identified many fields that have contributed to economics of information, two disciplines stand out. They are Economics and Library and Information Science. Many reviewers in the field have acknowledged this fact. It is quite natural that researchers, from the field of economics and library and information science approach the economics of information from different perspectives. Economists have tended to study the nature of decision making, the distribution of information, imperfect knowledge, the flow of information, and the role of the "information sector" in a market context. Library and information scientists who considered information as their primary "commodity," have attempted to look at notions of what information is and at information products as items bought, sold, used, copyrighted, made public, or provided, particularly in libraries. Both sets of researchers attempt to refine models to account for price, costs, benefits, values, and economic impacts.

In this review also, the two stream approach mentioned above is followed. Since the literature from Economics provide the theoretical background, the significant contributions right from 1960s would be covered. But as far as the contributions from Library and Information Science is concerned, only significant contributions in the 21st century are included since many of the earlier studies aimed at the evaluation of libraries and information centres are less valuable in the modern context.

3. Contributions from Economics

From the point of view of Economics, information

economics is a division of microeconomic theory that examines the relationship between information, time, and decision making. One fundamental assumption of economics, perfect information, is observed to be illusive, and the study of information asymmetry is still in the elementary stage of development. Since the invention of the internet, the exchange of information has accelerated at a pace much faster than ever before. The revolutionary changes taking place in the field of communication of information are rendering some of the earlier theories of information economics infructuous. Anyway, this is not the point of discussion here.

As already mentioned Machlup (1962) was a pioneer in carrying out studies about the economic significance of information and knowledge. His seminal work *Production and distribution of knowledge in the United States* marked the beginning of the study of post-industrial society. While noting that economists have tended to ignore the process of information, especially time factors, in market models, he goes on to identify features of information as process (becoming informed) and as content. In fact, *Production and distribution of knowledge in the United States* is a synthesis of Machlup's own works produced prior to the publication. First, he had focused his research on the patent system (as back as 1933), but he came to realize that patents were simply one part of a much bigger "knowledge economy." He then expanded the scope of his work to evaluate everything from stationery and typewriters to advertising to presidential addresses--anything that involved the activity of telling anyone anything. This analysis revealed the new and startling shape of the U.S. economy. The work is a synthesis of ideas from four disciplines or fields of research -- Philosophy (Epistemology), Mathematics (Cybernetics), Economics (Information) and National Accounting.

The compilation of a bibliography and commentary on the literature of the economics of information by Olsen (1971) shows that there is abundant literature on the topic before 1970. In fact, it is

in the form of a report. The report consists of (i) a short section on the economists' framework for analysis, (ii) a table that divides the pertinent literature into categories, briefly defines each category, and explains why it is important to information activities, (iii) a brief commentary on the state of this literature and (iv) a selected bibliography of over 300 items.

In 1977, Porat (1977), who was later joined by Rubin, wrote a 9-volume dissertation that measured and estimated the size of this economy, and described this emerging sector as the "information economy". His work has since then been widely quoted and cited as the first major use of the term "information economy". Porat categorizes the information sector into the primary and the secondary. The "primary information sector" workers are those who are almost wholly concerned with creating or handling information, like scientists, writers, librarians, etc. The "secondary information sector" workers are those who work mainly on non-information items but whose work involve information work as a secondary aspect. They are the workers in non-information firms and industries who produce information for internal use in the production of agricultural or industrial (i.e. non-information) goods. The significance of the works of Porat lies in the fact that the OECD (Organization for Economic Cooperation and Development) adopted Porat's definition in its studies on the nature, size, and growth of information economies.

One of the earliest contributors in the field of economies of information in 1980s is Stigler (1961), the American economist and recipient of Nobel Prize in Economics. The continuous analysis of American economy and the contribution of information and knowledge to its development prompted Machlup to come out with a multi-volumed set entitled *Knowledge: Its creation, distribution and economic significance* starting from 1981. Volume 1 -- *Knowledge and Knowledge Production* presents the conceptual framework for this inquiry and falls into three parts:

Types of Knowledge, Qualities of Knowledge, and Knowledge as a Product. Volume 2 -- *The Branches of Learning* examines the parts of intellectual knowledge that have been considered worth teaching in institutions of higher learning. It was absolutely needed because to judge what to teach, it was necessary to classify knowledge. Volume 3 -- *The Economics of Information and Human Capital* presents in clear and elegant prose the roles of knowledge and information in economics.

But the most prolific contributor to the field of economics of information, of course, is Stiglitz. Stiglitz is one of today's most distinguished and controversial economists. He was awarded the Nobel Prize in Economics in 2001 for his work on asymmetric information and is widely acknowledged as one of the pioneers in the field of modern information economics and more generally for his contributions to microeconomics. He occupies the top most position in the capacity of single author or joint author. The earliest publication of Stiglitz (1982) provides the foundations of a general theory of information and the capital market. It shows that in a pure gambling market, even with asymmetric information, there cannot exist an equilibrium with trade with rational individuals.

The paper by Stiglitz (1985) published in *Brazilian Review of Econometrics* shows how developments in the Economics of Information can provide insights into economic relations in less developed countries, and how they can provide explanations for institutions which, in neoclassical theory, appear anomalous and/or inefficient. Sharecropping and other tenancy relationships in the rural sector and wage determination and urban unemployment are both investigated within this perspective. Greenwald and Stiglitz (1987) in their paper describes how imperfect information in both capital and labor markets can, in a context of maximizing firms and perfectly flexible prices and wages, give rise to cyclical variations in unemployment whose character closely resembles that of observed business cycles.

The choice between public and private provision of goods and services is considered by Sappington and Stiglitz (1987). In practice, both modes of operation involve significant delegation of authority, and thus appear quite similar in some respects. In the research paper 'Incentives, Information, and Organizational Design' Stiglitz explores the interaction between incentives, information, and organizational design. It provides an explanation, for instance, why in times of economic crisis (such as wars) most economies abandon reliance on market mechanisms.

The paper by Repo (1989) reviews and analyzes research performed by economists, accounting researchers and management scientists in the field of economics of information. The main emphasis is on approaches taken to describe and measure the value of information. Economists define information as a phenomenon to reduce uncertainty and it is usually studied in terms of exchange values. Information markets and products, as well as information as a public good, are described. The approaches to the value of information favored by economists are (1) statistical decision theory approach, (2) equilibrium theory approach, (3) multidimensional value approach, and (4) cognitive approach. These approaches are discussed and concluded with cost-benefit and value considerations of information.

Lamberton (1994), a key figure in the development of the information economics points out that the division of labor involved in information processing—the way in which processes are broken up into small pieces for handling—may be the most fundamental form of the division of labor. Awareness of this has led to the use of models of an "information production chain" as a way of identifying the different points at which value is added and as a means by which information commodities can be distinguished from each other.

A text book of standing directly dealing with information economics in the 21st century is that of Inés Macho-Stadler, Ines and Pérez-

Castrillo (2001). The book, written for advanced undergraduates first-year postgraduates covers, the consequences for the character and efficiency of the interaction between individuals and organizations when one party has more or better information on some aspect of the relationship. This is the condition of asymmetric information, under which the information gap will be exploited if, by doing so, the better-informed party can achieve some advantage.

The first volume of the selected works of Stiglitz (2008) includes a number of classic papers which helped to form the foundations for the field of the economics of information. This volume sets out the basic concepts underlying the economics of information. In the volume Stigler states that the economics of information has constituted a revolution in economics, providing explanations of phenomena that previously had been unexplained and upsetting longstanding presumptions, including that of market efficiency, with profound implications for economic policy. The selected works are planned to be brought out in six volumes. In the paper 'the Revolution of Information Economics: The Past and the Future' Stiglitz (2017) puts into perspective nearly a half century of research, including recent advances in understanding the implications of imperfect information for financial market regulation, macro-stability, inequality, and public and corporate governance; and in recognizing the endogeneity of information imperfections. It explores the consequences of recent advances in technology and the policy challenges and opportunities they present for competition policy and policies regarding privacy and transparency. The paper notes the role that information economics played in stimulating other advances in economics, including contract theory and behavioral economics. It reinvigorated institutional economics, showing how institutions mattered, in some cases explaining institutional features that could not be well-understood in the conventional paradigm.

There are critics of the theory of economics of

information. The latest in the series are Fedoseeva, Herrmann and Nickolaus (2017). The economics of information approach suggests that as online retailing matures, information asymmetry will enforce the reduction of price dispersion online as providers will operate in conditions close to perfect competition. Using the example of online marketing they establish that all the predictions or theories may prove to be true.

4. Contributions from Library and Information Science

Before proceeding to the review, let us examine the key areas identified by the American Library Association (n. d.) where libraries, mainly public libraries, make economic impact in the society.

The important areas are:

- Library partnerships have value
- Libraries have value to neighborhoods
- Proximity to the library has value
- The technology for use in the library has value.
- Services of the library have value.
- Libraries imparts value to the stakeholders
- Monetized impacts and other benefits from public library annual operations
- Value of Public Library Reference Transactions
- Value of Public Internet Computers at the Library
- Value of Non-adult/juvenile Public Library Circulation
- Value of Juvenile Public Library Circulation
- Value of Adult Public Library Circulation
- Value of Adult Public Library Programs
- Value of Young Adult Public Library Programs
- Value of Children's Public Library Programs.

There has been drastic changes in the functioning of all sorts of libraries, mainly due to the influx of information and communication technology. ICT has made drastic changes in the collection, services and service delivery

mechanisms. Naturally the methods adopted for assessing the impact, economic as well as social, of libraries. Therefore, for the purpose of this review, literature that evolved in the present century only is taken into consideration. It is only a review of selected documents. The review is divided into five sections: Reviews, General, Public Libraries, Academic Libraries in General, University Libraries and Public Libraries.

4.1 Reviews

Ko, Y. M. & Shim, W. (2011) present a comprehensive review of literature on economic valuation of the library based on a total of 89 studies conducted over the last quarter-century. Research on library valuation began in the mid-1990's with the formal exploration of the value of public libraries from a theoretical point of view. In the 2000's, various theories and methodologies were reviewed and put into actual measurement studies. This comprehensive review and analysis point to the need for the development of consistent and reliable set of methods, which will facilitate further application of methods and comparison of results.

A review of literature on the assessment of the economic value of public library collections and services is available from the site <http://www.libsci.sc.edu/metaweb/valuationstudies.html>. (Assessing the Economic Value of Public Library Collections and Services: Review of the Literature and Meta-Analysis, n. d.). It contains select bibliographies on the topics (1) valuation studies of American public libraries (2) valuation studies of international public libraries (3) valuation methodologies (4) value of libraries in a recession and (5) META Project Bibliography as of 3/1/2013.

Imholz and Arns (2007) review numerous library valuation studies, with emphasis on how libraries have used them to demonstrate their value in their communities. The studies include cost benefit analysis, economic impact and social returns on investment.

4.2 General studies

A highly acclaimed textbook on economics of information written from the point of view of library professionals is that of Knigma (2001). It is designed for those with little or no prior experience in economics. It provides students, librarians, and information professionals with a useful introduction to economics and cost-benefit analysis, and it helps them make better financial and management decisions. The topics covered are cost analysis of information goods and services, benefit analysis, information as a public good, information externalities, intellectual property and monopolies, uncertainty and risk, pricing information, opportunity costs, access versus ownership, and the economics of the Internet and digital libraries.

The paper by Koenig and Manzari (2009) examines the levels and influence factors on efficiency of public libraries in metropolitan cities. The result of this study shows that: (1) the main source of technical inefficiency is pure technical inefficiency rather than scale inefficiency; (2) it is positive effect environmental factors on the efficiency that the population, the dummy variable of capital area.

Aabo (2009) has carried out the first meta-analytical review of library studies reporting a return on investment figure. Meta-analysis is a quantitative analysis of findings of previous studies, conducted to infer general findings and lessons from prior empirical research. The dataset is 38 library valuation studies reporting a return on investment figure or cost-benefit ratio. Of the 38 studies, 32 are of public libraries. The meta-analysis indicates that the patterns in the findings are consistent with expectations regarding the benefit types that are included in the ROI figure, the methods used, and the scope of the study. A critical review of valuation studies to identify frameworks in library services was made by Kim (2011). The selective review evaluated various characteristics, including methods, subjects, and reporting media, in order to identify theoretical

frameworks to aid in understanding trends in library services.

Application of data envelopment analysis (DEA) to assess library performance from an efficiency standpoint was illustrated by de Carvalho, F. A., Jorge, M. J., Jorge, M. F., Russo, M. & de Sá, N. O. (2012). DEA modeling was applied to a convenience sample of 37 libraries affiliated to a federal university in Rio de Janeiro. Data were collected from the university's managerial database and refer to three inputs – number of employees, area and number of volumes – and four outputs – consultations, loans, enrolments and (user) traffic. Markovian analysis of transitions between efficient and inefficient states along time allowed a long-term distribution between those states to be computed. Corral (n. d.) investigated the intangible assets that academic libraries are exploiting to compete in the digital age and methods that libraries can use to assess intangible assets.

4.3 Academic Libraries

Saunders (2003) examines 88 academic member libraries of the Association of Research Libraries (ARL) to determine their relative cost efficiency, using stochastic frontier regression and data envelopment analysis (DEA) methods. Both methods give average ARL cost efficiencies of around 80 percent. This places academic ARL libraries in the same range of efficiency as other institutions, including for-profit and non-profit institutions. Many libraries are above 80 percent efficiency. For those below, some speculation is given for the lower efficiency. The study shows that research libraries with expenditures between \$10,000,000 and \$20,000,000 are operating at the most efficient scale. Since the methods used are outside the repertoire of most LIS research, a conceptual explanation is provided.

Shim (2003) applied an analytical technique called Data Envelopment Analysis (DEA) to calculate the relative technical efficiency of ninety-five academic research libraries that are members of the Association of Research Libraries. The study

also reviews the applications of DEA technique in the library environment. The article by Osiewalski, J. & Osiewalska, A. (2004) presents the main assumptions and results of the research which the authors have undertaken since 1998. The paper summarizes microeconomic foundations of the cost efficiency analysis, stochastic frontier cost model from the econometrics literature, the choice of variables for the library cost function, the short presentation of statistical details and the empirical results for academic and public libraries in Poland.

Noh (2012) provides an input-output analysis of electronic resources in academic libraries by verifying evaluation indicators and applying them to the digital library environment. This study measures the performance of electronic resources in academic libraries in Korea. To measure the efficiency of the input-output ratio, evaluation indicators were divided into inputs and outputs. Inputs refer to the e-resource use environment as well as the acquisition of e-resources such as web DB, e-books, e-journals, and so on. Outputs quantify the use of each resource. The results of this study show that a large share of academic library budgets is spent on e-resource purchases and e-resource environment improvement for better use.

Shahwan and Kaba (2013) explore and measure the relative efficiency of the academic libraries within the GCC countries in terms of their abilities to transform their allocated resources into a specific level of outputs using a non-parametric frontier method – data envelopment analysis (DEA). Among the 11 academic libraries analyzed, five libraries are rated fully efficient whereas inefficiency of the other six libraries is attributed to pure technical inefficiency rather than scale inefficiency. The results also shed light on the area of improvement required for inefficient libraries.

4.4 University libraries

Application of Data envelopment analysis in order to measure the efficiency of University Libraries was made by Stancheva and Angelova (2004). The panel data of five University Libraries

for years 2002 and 2003 has been estimated. For the study six inputs and three outputs were identified. The input variables were staff, print edition expenses, electronic edition expenses, building space, wages, library technical equipment and output variables were number of registered readers, number of customers served and number of borrowed items. The study also recommends a benchmark model for inefficient units.

The paper by Reichmann (2004) analyses the technical efficiency of 118 randomly selected university libraries from German-speaking countries (Austria, Germany, Switzerland) and English-speaking countries (the United States, Australia and Canada) using Data Envelopment Analysis (DEA). DEA efficiency scores are calculated using library staff, measured in full-time equivalents, and book materials held as inputs, and the number of serial subscriptions, total circulations, regular opening hours per week, and book materials added as out-puts. Among the 118 university libraries analyzed 10 are rated fully efficient. The paper of Reichmann & Sommersguter-Reichmann (2006) proposed a framework for assessing the technical efficiency of 118 university libraries from Australia, Austria, Canada, Germany, Switzerland and the United States. The flexible non-parametric approach of data envelopment analysis has been chosen to analyse the performance differentials of university libraries. The study also investigated whether the institutional settings affect the degree of library efficiency. The findings of the intercountry efficiency comparison revealed that almost one-third of the university libraries are technically efficient. In the study published in 2010 by Reichmann & Sommersguter-Reichmann analyzed performance differences across university libraries from different countries from a cross-section and a longitudinal perspective. The authors used the Malmquist index approach to disentangle environmental efficiency from technical efficiency (TE) to highlight performance differences. In the cross-section analysis, it was found that North American (NA) libraries are more

productive at higher input levels than the European libraries from Germany and Austria.

Another study which applied data envelopment analysis was that of Noh (2011). The paper seeks to rediscover the most suitable efficiency evaluation variables (input and output variables) for digital libraries and to employ the data envelopment analysis (DEA) model to measure the resource utilization efficiency of university libraries. The results showed that the efficiency of university libraries varied significantly according to whether or not electronic resources were included in the evaluation. In addition, the findings confirmed decision making units (DMUs) have a 100 percent efficiency rate and a low efficiency rate as well as proposed benchmarking DMUs for inefficient DMUs and a direction for future improvements.

The aim of the paper of Jeevan (2015) is to suggest performance evaluation of university libraries in India using qualitative and quantitative parameters provided by librarians to be collected, analysed and disseminated by a national agency apart from LibQual user surveys. The framework for performance evaluation of university libraries is presented in three heads: parameters, players and procedures. The performance framework suggested when implemented every year by university libraries present the qualitative and quantitative outcome of their functioning and reveal their worth in the university landscape. This may also aid in planned and organized development of university libraries in the country.

4.5 Public libraries

The relative efficiency of public library services by examining the relationship between library inputs and library outputs in multi-outlet library systems is assessed by Hammond (2002). Differences in the size of the area and population served are reflected in differences in the number of outlets and mix of outlet types. Using a Data Envelopment Analysis, which controls for the accessibility of library resources, this study derives technical and overall efficiency scores for 99 UK Public Library Systems.

Worthington (2002) makes use of a sample of one hundred and sixty-eight New South Wales local government libraries is used to analyze the efficiency measures derived from the non-parametric technique of data envelopment analysis. The study also analyses the posited linkages between comparative performance indicators, productive performance and non-discretionary environmental factors under these different model formulations. The results indicate that the presence of exogenous factors and scale effects account for a major portion of the differences in observed efficiency between different groups of local governments.

A classical study in the assessment of the economic impact of library is the one carried out by Pung, Clarke & Patten (2004). The subject of study was British Library. Assessing the British Library's contribution to the national economy is a complex matter, requiring consideration of a number of different dimensions. Traditionally, attempts to assess these benefits have taken the form of qualitative case studies—telling good stories, but failing to provide a comprehensive evaluation. But in the present study a technique supported by the Nobel Prize winning economists, Kenneth Arrow and Robert Solow which permits a coherent quantitative evaluation of the total benefit to the nation of publicly funded institutions and programmes was adopted. The study demonstrates that the Library generates value of around 4.4 times the level of its annual public funding of £83m. This study uses the 'Contingent Valuation' technique for the first time to derive a figure for the overall economic impact of a national or major research library.

To determine the economic benefit of public libraries for South Carolinians and to what extent they feel the public library contributes to their overall economic wellbeing was the purpose of the study of Barron, Williams, Bajjaly, Arns, & Wilson (2005). The study techniques have generally involved analysis of surveys of users/non-users of public libraries, analysis of use statistics collected

by the libraries, and a combination of the two techniques. The study revealed that for every \$1 spent by state and local governments on South Carolina public libraries, the return on investment is \$2.86. Also, the total direct and indirect return on investment for every \$1 expended on the state's public libraries by South Carolina state and local governments is \$4.48—almost 350%!

The paper by Hemmeter (2006) tries to use public libraries to analyze public sector cost-efficiency. The growth of large bookstores and the Internet in recent years may have motivated libraries to behave in a more cost-efficient manner. Alternatively, monitoring of libraries may have decreased as patrons shift away from library use, increasing inefficiency. Using a stochastic cost frontier, the level of cost-inefficiency is estimated and analyzed. The results suggest that competition, regardless of the source, does not have a large effect on cost-efficiency. Local government spending decreases inefficiency in smaller libraries, consistent with the monitoring role governments can have on public spending.

Jang (2009) analyzed 565 public libraries in Korea. He classified these public libraries into three categories (Group 1—large size, Group 2—middle size, and Group 3—small size libraries) and calculated their relative efficiency by means of AHP (Analytic Hierarchy Process) and DEA Models. The average efficiency of these three groups of libraries was 0.89, 0.72 and 0.60 respectively.

The paper of Miidla & Kikas (2009), sets out to describe the results of a four-year-long study into the efficiency of Estonian central public libraries. The study uses data envelopment analysis (DEA), a non-parametric linear programming-based tool to determine the relative efficiency of 20 central public libraries of Estonia. The study finds that 40 per cent of the libraries investigated used their resources effectively. Efficiency scores of the rest of the libraries varied from 0.74 to 0.98, with staff expenditure slack being the main inefficiency factor for half of inefficient libraries.

Restructuring of local authority services provides an opportunity to assess the effect of organizational change on the technical efficiency of library services. Hammond (2009) used longitudinal data set to estimate efficiency scores using a time varying, multi-output stochastic distance function, which is estimated using maximum likelihood methods. Overall, there is little apparent difference in the efficiency of library systems, whether restructured or not. More detailed analysis shows that initially efficiency was reduced, but the scores change over time and higher relative efficiency is implied in subsequent periods.

The levels and influence factors on efficiency of public libraries in metropolitan cities are analyzed by Lee and Han (2010). For this purpose, in the first stage, the efficiency score analysis of 129 sample public libraries has been undertaken. In the second stage, the efficiency scores obtained from the first stage are regressed on environmental factors. The result of this study shows that: (1) main source of technical inefficiency is pure technical inefficiency rather than scale inefficiency; (2) it is positive effect environmental factors on the efficiency that the population, the dummy variable of capital area.

The purpose of the paper of Lee & Han (2011) is to estimate public libraries efficiency using not only non-parametric test but parametric. For this, the technical efficiency of 527 public libraries was measured by both DEA (Data Envelopment Analysis) and SFA (Stochastic Frontier Analysis). The result showed the average operating efficiency scores was higher by SFA than DEA. And the conclusion was drawn which the technical efficiency of public libraries was higher in big cities than small and medium-sized, in the capital area than non-capital area. Besides, public libraries were managed more efficiently by local government than education office in- local.

The economic value of public libraries for local residents in Korea was measured by Ko, Shim, Pyo, Chang & Chung (2012). An economic-value

measurement model that enables the estimation of diverse types of public library services was designed, using a conditional-value measurement method. Benefits were taken as the value of the main services provided by public libraries, such as accessibility to informational materials, facilities, and programs. Costs included the total amount of expenses at libraries such as personnel expenses, materials purchasing expenses, and other operational costs. Data were collected from 1220 users from 22 public libraries in the province of Seoul/Gyeonggi-do and the other seven Korean provinces. The return on investment (ROI) was calculated to be 3.66.

Data Envelopment Analysis is used by del Barrio & Herrero (2014) to evaluate museum efficiency. This approach enables to create a relative efficiency measure for each museum. The main findings indicate that at least half the museums chosen operate efficiently, with the major cause for inefficiency being inadequate resource management. Only few museums evidenced significant inadequate scaling problems. Major progress, mainly due to improvements in internal efficiency, is evident in the museum system ratios when analysing productivity evolution using the Malmquist Index. By contrast, technological change has less impact, proving that cultural heritage is less receptive to new technologies as compared to other cultural industries.

How well the public libraries in each state of USA combine their resources to support the largest amount of possible services to the community is investigated by Li & Yang (2014). Data envelopment analysis (DEA) technique is employed for this research purpose. BCC model is utilized in order to consider the size effect. The DEA results indicate that all states operate fairly efficiently on the whole although there is still a little room for improvement. The analysis also provides the set of target values for improvement for those states that were found inefficient so that the inefficient states can reach the best practice frontier.

Payment mechanism is an important issue in the process of the elicitation design. Hajek & Stejskal (2015) employs various payment mechanisms in modelling public library value using the contingent valuation method. The study found that the main determinants of public library value (in the case of the Municipal Library of Prague) include available income of the households, frequency of use of the services, and alternative costs.

The research study of Noh (2016) was designed to measure the level of contribution public libraries in Korea have made to digital inclusion in their communities. The study compared the degree of contribution to digital inclusion by Korean libraries with that by US libraries. From a systems perspective, Korean public library computers and Internet infrastructure surpassed those of their counterparts in the United States in terms of quality but the diversity of technologies, equipment, and technology-related services and the proportion of technology-related services provided were higher in the United States. In terms of educational content, libraries in both countries informed the public about diverse subjects but US libraries offered more, and more diverse, services than Korean.

The purpose of the paper by Vrabková and Friedrich (2017) is to identify gaps in performance of city libraries from the Czech and from the Slovak Republic engaged in the project Benchmarking of Libraries. The subject of research consists of input and output performance variables of selected 51 city libraries for the period of 2011-2015 and their mutual dependence and influence. Findings reveal that besides others the significant gap in performance was represented by library additions, which means the renewal of library collections. Performance differences were also found between city libraries in the Czech Republic and those in the Slovak Republic. This paper also evaluates gaps in the performance on representative sample of city libraries.

In Italy, public state libraries are multi-product organizations preserving ancient books of great

historical relevance for future generations, and providing divisible services to the public. Hence, they may undertake different activities for conservation and use, which together constitute a network. The paper of Calogero, G. C., Mignosa, A. and Rizzo, I. (2018) shows the importance of considering multi-process interactions in evaluating the overall performance of public state libraries and focuses on library operations and their sub-processes. It uses a network two-stage Data Envelopment Analysis (DEA) approach to examine the relationship between the libraries' basic inputs, intermediate outputs and final outputs. The main result is that Italian public state libraries generally perform better in the first stage of conservation, but score poorly in the second stage of use. Some policy advice to improve the decision-making process follow.

5. Conclusion

The review of literature related to Economics of Information is presented in two streams. The first group contains the works by economists which deal with the concept of information and its influence purely from the economist's angle. Here, only the classical works are considered for review. The second course is from the angle of Library and Information Science. Here also, the studies included are very selective. Majority of the studies were found to be evaluative studies, mainly aimed at assessing the economic impact of libraries. A number of studies were found to be concentrating on evolving evaluation methodologies suitable for different categories of libraries. While there is an overabundance of evaluative studies elsewhere, the contributions from India in the line are woefully lacking. This shows our lack of enthusiasm to project the Returns on Investment given by the libraries. It is high time that LIS professionals in the country rise to the occasion to highlight the economic and social significance of the libraries through empirical studies.

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