

**THE ECONOMICS OF
RESEARCH LIBRARIES**

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APPENDIX A

Economic Issues and Trends in Academic Libraries

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INTRODUCTION

Academic libraries manage and collect an ever-growing body of information for an ever-expanding number of users, despite financial constraints. They employ highly trained staff and use sophisticated automation techniques. This paper explores the economic aspects of their operation. It also focuses on current research in the economics of information for solutions to problems facing these libraries. The paper begins by examining long-term trends in the expenditures of colleges and universities and then compares that pattern to the one for college and university libraries.

Major portions of a library's budget are devoted to acquiring and processing materials, paying for personnel, developing and operating automated systems, and constructing new library facilities. Each of these areas is analyzed, with the goal of understanding its economic aspects.

OVERALL COSTS

Academic libraries operate within the framework of a college or university, and the financial framework of the larger institution has faced severe pressures over the past twenty years. Total expenditures by colleges and universities increased more than tenfold from 1961 to 1981, an escalation of close to \$36.8 trillion (Table 1).¹ Growth in the number of students attending colleges and universities and the effects of inflation both have made a significant impact on the funds available per student.

The number of full-time equivalent (FTE) students attending colleges and universities increased from 3.0 million in 1961 to 8.9 million in 1981. When total expenditures are adjusted for enrollment changes, the almost tenfold increase in total expenditures reduces to a modest 3.6-fold increase in current dollar expenditures per FTE student. And when current dollar expenditures per FTE student are adjusted for inflation there is almost no change in the amount of money spent per student from 1961 to 1981.

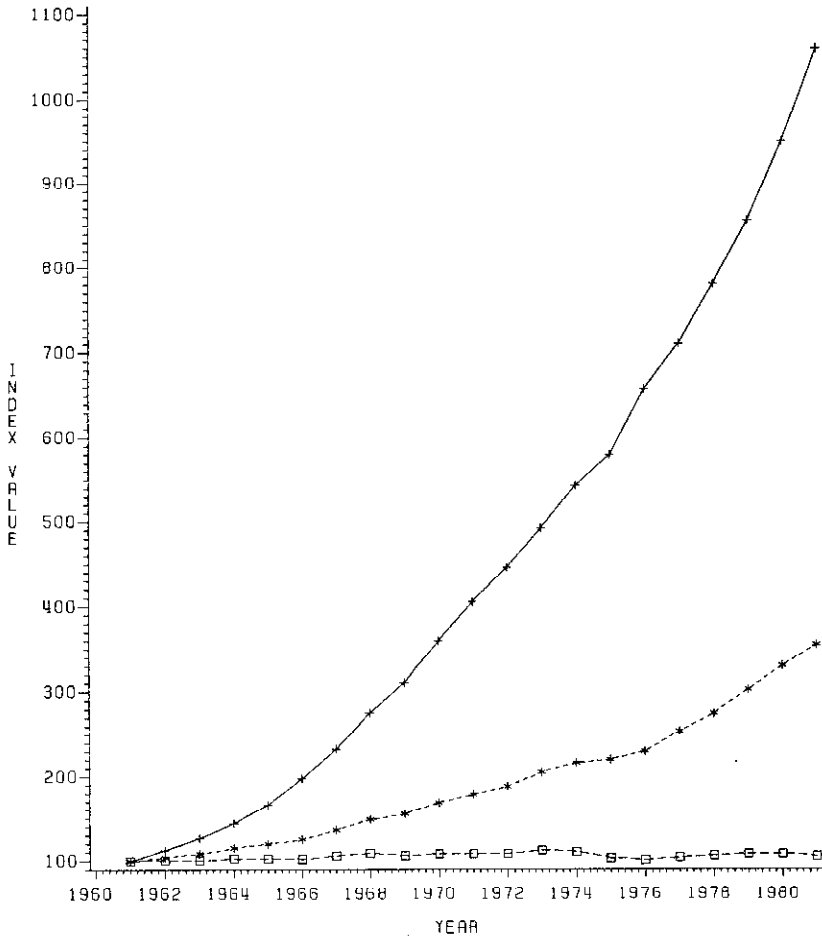
Figure 1 plots current dollar total expenditures and current and constant dollar expenditures per student. The appropriate columns of data from Table 1 are converted to index numbers, with 1961 used as the base year. Using Halstead's terminology,² the area between the total

TABLE 1
Expenditures and Enrollment
in Public and Private Colleges and Universities
1961-1981

Year	Total Expenditures (Millions)		FTE Enrollment (Thousands)	Expenditures per FTE Student	
	Current Dollars	Constant Dollars		Current Dollars	Constant Dollars
1961	\$ 3,820	\$ 4,916	2,995	\$ 1,275	\$ 1,642
1962	4,317	5,362	3,245	1,330	1,652
1963	4,850	5,795	3,505	1,384	1,654
1964	5,483	6,317	3,750	1,462	1,684
1965	6,370	7,039	4,179	1,524	1,684
1966	7,551	7,948	4,754	1,588	1,672
1967	8,889	8,889	5,126	1,734	1,734
1968	10,554	9,957	5,539	1,905	1,797
1969	11,873	10,489	6,024	1,971	1,741
1970	13,737	11,353	6,383	2,152	1,779
1971	15,516	12,047	6,791	2,285	1,774
1972	17,059	12,562	7,096	2,402	1,770
1973	18,825	13,174	7,187	2,619	1,833
1974	20,776	13,570	7,529	2,759	1,802
1975	22,163	13,335	7,887	2,810	1,691
1976	25,129	14,181	8,570	2,932	1,655
1977	27,197	14,413	8,407	3,235	1,714
1978	29,864	14,836	8,529	3,501	1,739
1979	32,738	15,094	8,485	3,858	1,779
1980	36,369	15,262	8,606	4,226	1,773
1981	40,580	15,377	8,937	4,541	1,721

Source: D. Kent Halstead, *Inflation Measures for Schools and Colleges*, National Institute of Education, U.S. Department of Education (Washington, D.C.: Government Printing Office, 1983). Data in columns 2, 3, 5, and 6 are from page 44; data for column 4 are from page 48.

expenditures curve and current dollar expenditures per student curve shows the enrollment effect over time. That is, it shows how expenditures have changed as a result of increasing enrollment. Likewise, the area between the two "expenditures per student" curves shows the inflation effect—how expenditures per student have been eroded by a 240 percent increase in the price of labor and materials used in colleges and universities.³ Figure 1 shows that the net effect of enrollment and inflation changes is almost no change in per student expenditures.

Figure 1—Total and per student expenditures in colleges and universities 1961–1981

Source: Table 1

Table 2 and Figure 2 give comparable data and comparable results for college and university libraries during the same period. In 1961, library expenditures were \$159 million, and by 1981 they had risen to \$1,759 million. After adjusting for changes in the number of students served, per student expenditure rose from \$53 in 1961 to \$197 in 1981. There were periods during those two decades when libraries did more than keep up with inflation and compensate for changes in enrollment—for example, in the late 1960s and early 1970s, constant dollar expenditures per student were almost 30 percent higher than in 1961. But by the late 1970s significant ground had been lost and the expenditures were almost back to the 1961 level.⁴

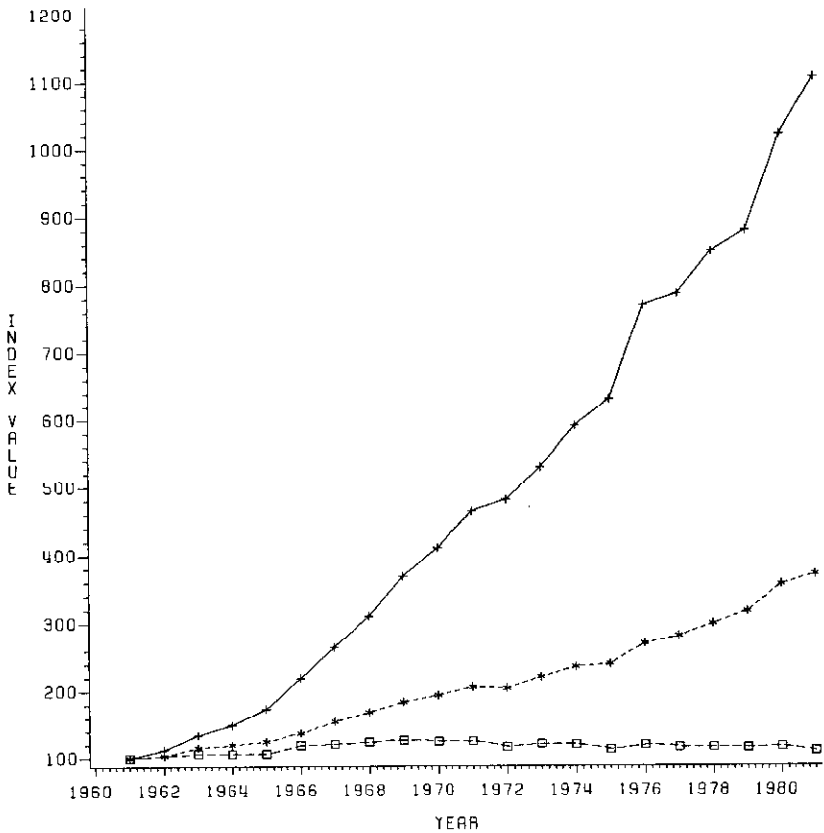
TABLE 2
Total and Per FTE Student Expenditures
by College and University Libraries
1961-1981

Year	Total Library Expenditures (in Thousands)	Expenditure Per FTE Student	
		Current Dollars	Constant Dollars
1961	\$ 158,900	\$ 53.06	\$68.29
1962	177,362	54.66	67.90
1963	213,000	60.77	72.69
1964	236,718	63.12	72.72
1965	275,000	65.81	72.72
1966	346,248	72.83	80.48
1967	419,757	81.89	81.89
1968	493,266	89.05	84.01
1969	584,847	97.08	85.76
1970	652,596	102.25	84.57
1971	737,533	108.61	84.46
1972	764,481	107.73	79.33
1973	840,727	116.98	81.80
1974	938,622	124.66	81.42
1975	1,001,868	127.03	76.43
1976	1,223,723	142.79	80.58
1977	1,250,314	148.72	78.81
1978	1,348,748	158.13	78.55
1979	1,426,614	168.13	77.51
1980	1,624,000	188.72	79.17
1981	1,759,000	196.83	74.59

Sources: Column 2, 1961-79, King Research, Inc., *Library Human Resources: A Study of Supply and Demand* (Chicago: American Library Association, 1983), 75. Column 2, 1980-81, *National Data Book and Guide to Sources: Statistical Abstract of the United States 1984* (Washington, D.C.: Bureau of the Census, 1984), Table 256. Column 3 is derived from column 2 divided by column 4 of Table 1. Column 4 is derived from column 3 adjusted by the Higher Education Price Index (see Halstead, *Inflation Measures*, 39).

Harvey and Spyers-Duran have looked at the problem in a slightly different manner, but have come up with comparable results.⁵ For 71 members of the Association of Research Libraries (ARL) between 1970 and 1981, they calculate that total library expenditures have declined 1.9 percent per year in constant dollars. Using National Center for Education Statistics data on U.S. college and university libraries for 1969 to 1979, they calculate that total expenditures have increased 0.1 percent per year in constant dollars.⁶

Figure 2—Total and per student expenditures in college and university libraries 1961–1981



Source: Table 2

The Baumol-Marcus Study

In 1973, Baumol and Marcus published an important study that analyzed growth rates, presented key ratios, and fitted regression equations to data on the operating characteristics of 58 ARL libraries.⁷ Their analysis covered 1951 to 1969, a period in which libraries enjoyed relative prosperity. When Harvey and Spyers-Duran⁸ compared the Baumol-Marcus results to those that occurred from 1970 to 1981 for 71 ARL libraries, there were major differences.

For example, during 1951 to 1969 the annual growth rate in number of librarians employed was 3.8 percent, while from 1970 to 1981 there was no growth (0 percent) per year. Support staff increased at an annual rate of 6.3 percent from 1951 to 1969 and 0.9 percent from 1970 to 1981. In salaries and wages, there was an annual increase of 7.9 percent per year from 1951 to 1969, but a decline of 2.7 percent per year during 1970 to 1981.

The figures on volumes added, book expenditures, total library expenditures, and expenditures per student suffered just as dramatic a change between 1951 to 1969 and 1970 to 1981. There was a 6.6 percent increase versus a 2.1 percent decrease in growth rates for volumes added, a 9.6 percent increase versus a 1.0 percent increase for book expenditures, an 8.7 percent increase versus a 1.9 percent decrease for total library expenditures, and a 4.3 percent increase versus a 9.0 percent decrease for expenditures per student.

All sources seem to lead to the same conclusion: There was a fundamental change in the funding of libraries between 1951-1969 and 1970-1981. The first was a period of relative prosperity for libraries, with reasonable increases in key variables. During the second period, an absolute dollar growth in expenditures occurred. After adjusting for inflation and increasing enrollments, library expenditures per student were almost constant. While the library fared no worse than its parent institution during the period, the results are still not positive. The numbers characterize a fundamental change in financial support for libraries—one that needs careful analysis and understanding. Halstead summarized the situation as follows: "Public higher education has been a constant input industry, with colleges and universities having exactly the same real dollar support year after year. Unlike most other industries, higher education has not received any additional dollars to improve quality even though it needs to make additional investments for modernization and to maintain competitive position."⁹

MATERIALS COSTS

Expenditures by libraries fall into four major categories: materials, labor, automation, and construction. Although library statistics do not report the proportion of money spent on automation or construction, Table 3 gives a comparison of the proportion of funds allocated to labor and materials. In 1963, academic libraries spent 59 percent of their budgets on salaries and wages and 36 percent on materials and binding. Very little change has occurred in these proportions in 18 years, with labor expenditures in 1981 amounting to 61 percent of the total and materials 30 percent.

While the proportion of total budgets spent on materials has remained constant, there have been major increases in the amount of money spent and the prices of materials purchased.

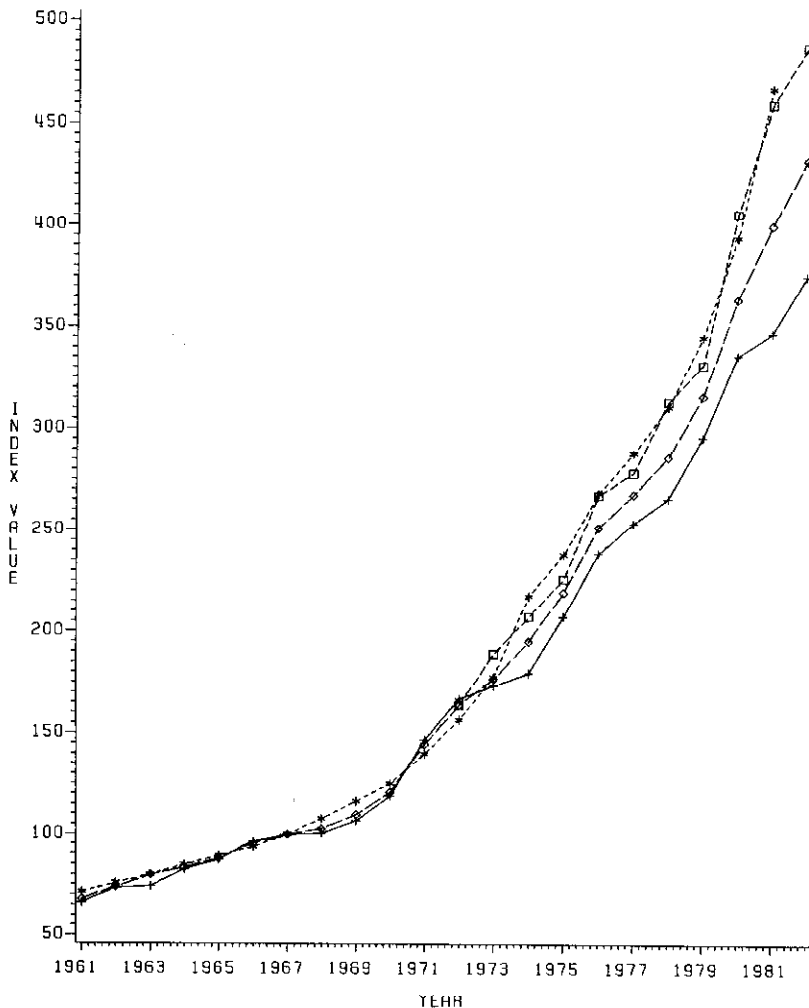
Total materials expenditures increased from \$62.6 million in 1961 to \$582.9 million in 1983, an average annual growth rate of about 4.8 percent per year (Table 4). However, adjustments for inflation bring the materials expenditures growth to only 1.5 percent per year.

The materials themselves have been increasing rapidly in price (Table 5). The average U.S. hardcover book cost \$5.24 in 1961 and in

TABLE 4
College and University Library Materials Expenditures 1961-1982
(in Thousands of Dollars)

Year	Total	Books	Periodicals	Audiovisuals	Microform	Binding	Unspecified
1961	\$ 62,600	\$ 56,400				\$ 6,200	
1962	72,000	65,000				7,000	
1963	88,000	79,000				9,000	
1964	100,000	90,000				10,000	
1965	122,500	111,000				11,500	
1966	147,000	134,000				13,000	
1967	170,000	156,000				14,000	
1968	203,000	188,000				15,000	
1969	230,400	212,900				17,500	
1970	248,000	230,000				18,000	
1971	267,000	247,000				20,000	
1972	281,000	260,000				21,000	
1973	273,643	104,070	\$ 53,033		\$ 4,678	17,586	\$85,355
1974							
1975	266,913	127,331	74,901	9,230	7,299	17,772	40,533
1976							
1977	358,355	126,257	81,777	10,269	7,384	16,004	29,761
1978							
1979	372,996	153,948	122,493	9,342	8,289	19,521	40,231
1980							
1981	535,389	174,600	154,551	9,932	8,654	22,112	47,637
1982	582,904	228,760	166,770	9,895	9,821	23,535	4,097

Sources: Data for 1974, 1976, 1978, and 1980 are not available. 1961-67: *The Bowker Annual of Library and Book Trade Information*, 14th ed. (New York: Bowker, 1969), 26. Table 4, 1968-72: *The Bowker Annual*, 19th ed. (New York: Bowker, 1974), 259. 1973: *The Bowker Annual*, 20th ed. (New York: Bowker, 1975), 236. 1975: *The Bowker Annual*, 22nd ed. (New York: Bowker, 1977), 263. 1977: *The Bowker Annual*, 24th ed. (New York: Bowker, 1979), 285. 1979: *The Bowker Annual*, 26th ed. (New York: Bowker, 1981), 278. 1981: *The Bowker Annual*, 28th ed. (New York: Bowker, 1983), 343. 1982: *The Bowker Annual*, 29th ed. (New York: Bowker, 1984), 388.

Figure 3—Library materials price indexes 1961–1982

Source: Table 5

One obvious approach is to diminish the rate of acquisition and/or reduce the number of duplicate copies of an item held. Decreasing purchases of new materials results in direct cost savings but also in narrower coverage of subject areas.¹⁰ Reducing the number of copies of an item limits availability of material.¹¹ It may be that lessening the length of loan periods would increase the availability of materials with less adverse impact than other solutions. However, if the cost of user time in obtaining the information is considered, this is a poor strategy.¹²

Another option available for controlling materials costs is to engage in resource sharing. Cooperative agreements that divide collecting re-

sponsibilities among libraries can have a beneficial effect. Some libraries negotiate such agreements on the basis of subject matter, some reach agreements about the shared use of expensive items, and others develop expeditious ways to exchange existing materials. These agreements are not without costs in that extensive coordination is required, union catalogs may be needed, and another layer of record-keeping may have to be added to the existing system.

By far the most common form of resource sharing is the use of interlibrary borrowing and lending of materials. The most recent comprehensive estimates of the magnitude and cost of interlibrary lending in the United States were developed by Palmour et al. in 1972.¹³ For the 1969 fiscal year, the study found that libraries received about 1.9 million loan requests (of which they filled 1.0 million) and they made 1.1 million requests for materials from other libraries (of which 0.7 million were filled).¹⁴ The average unit cost to lend an item was \$5.82, and the cost to borrow was \$7.61. Weighting these unit costs by the number in each category, the cost per transaction came to \$6.39.¹⁵ Adjusted by the Higher Education Price Index,¹⁶ the 1982 cost per transaction would be \$13.65.

The average price of a U.S. hardcover book in 1982 was \$25.48, and a U.S. periodical subscription was \$73.89 (Table 5). Given the estimated 1982 lending costs, about 1.9 requests for a book and 5.4 requests for a periodical would cover the direct purchase cost. Clearly, this is a simplified analysis in that the cost of making an item available on the shelf of a library includes considerably more than the item cost. Nevertheless, it points out the relative lending and borrowing costs as compared to raw material costs.

In summary, the economic significance of eliminating duplicate holdings, making fewer purchases of new materials, and sharing resources by means of interlibrary lending and other systems is not clear. It seems likely that materials costs could be more efficiently controlled through careful planning for new or expanded academic programs than by means of any of the strictly library-related solutions discussed above.

Federal Policy and Materials Costs

Federal resources have been used for many years to encourage and support basic and applied research in science and technology. Some of the funds from these projects have been used to support publication of research reports. National libraries and national research institutes also have produced and disseminated research reports, bibliographies, indexes, and databases.

Federal policies now suggest that information dissemination activities, when possible, be transferred to the private sector. Cummings¹⁷ argues persuasively that the effect of this policy is to increase the cost of

information originally produced with government support. The social benefits of a strategy that encourages private profits from publicly supported information production activities surely must be questioned. At a minimum, the aspects of information as a merit good¹⁸ argue strongly that information should be disseminated at the lowest possible cost, at least to students and researchers.

The implication of a change in federal attitude toward funding information activities has the long-term effect of increasing library materials costs. Reductions in grants to libraries also diminish the information dissemination programs of these institutions or force the users to incur increased direct or indirect costs to obtain information.

Preservation and Conservation

An important component of the cost of providing materials is maintaining them in a physical condition that allows them to be used. For the most part, the cost of preservation and conservation is one that is ignored or downplayed in library budgeting, but it should not be; and it is likely to require considerably increased funding in the future.¹⁹

A major factor in maintaining materials in usable condition is the length of time a binding will last. The binding in which a book comes from the publisher is roughly estimated to last through twenty circulations of the book. Commercial binders claim about 100 circulations for their bindings, and a reasonable figure for budgeting purposes might be 50 circulations. At a 1985 average direct cost of \$15 to bind one item, an average circulation of 85,848 items²⁰ per year for all academic libraries²¹ yields a binding bill of \$25,754. For a large academic library with an annual circulation of two million, the number is \$600,000.

Binding cost is but one of the problems of preservation and conservation. To reduce chemically induced deterioration, materials need to be stored in environments with controlled temperature and humidity. With construction and/or remodeling costs at \$60 to \$100 per square foot,²² such a facility is not inexpensive.

Library materials stored in controlled environments will have a prolonged life expectancy. Books that are not printed on acid-free paper may be subject to disintegration after 50 to 100 years. Newer books generally are made from paper with a shorter life, so the amount of material needing deacidification depends on the age of the collection.

Libraries embarking on their own or cooperative programs to build facilities to deacidify materials can expect it to be an expensive proposition. Recently, the Library of Congress received an appropriation of \$11.5 million for a facility to process 500,000 items per year. If the life of the facility is assumed to be ten years, the capital cost per volume processed would be \$2.30. Current estimates suggest direct labor and materials costs for processing an item through the facility to be \$3 to \$5 per volume, excluding transportation. With the addition of another \$1 to

\$2 per volume to select, obtain, and return books to the collection, the total deacidification cost may range from \$7.30 to \$9.30 per volume.

Much preservation and conservation work has fallen into the category of "deferred maintenance" (i.e., something that should be done but is deferred due to lack of funds). In the next few years, priority needs to be given to funding in this area; if not, the library book stock, a most precious resource, may be greatly reduced by physical deterioration.

LABOR COSTS

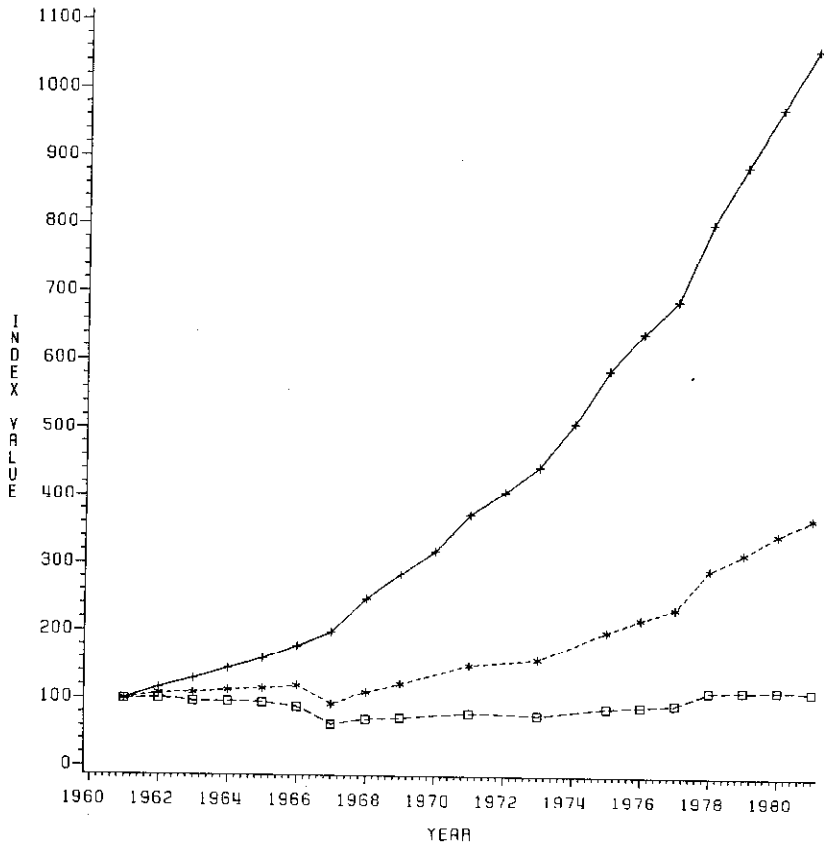
Approximately 60 percent of an academic library's budget is spent on labor. During the period 1961 to 1981 this expenditure increased from \$111.4 million to \$1.2 billion (Table 6). During the same period, salary and wages per employee rose from \$5,731 to \$21,140. Figure 4 shows that the effect of inflation and increased staff has been to make the compensation per employee essentially flat over the 21 years. The top line in the figure plots total library salaries and wages as an index number. The middle and bottom lines plot salaries and wages per employee in current and constant dollars, respectively. During the period 1966 to 1975, salaries actually lost ground to inflation, but have regained their loss since then.

Table 6
College and University Library Labor Expenditures, 1961-1981

Year	Total Salary and Wages (Thousands)	FTE Employees			Ratio of Professionals to Total	Salary and Wages per Employee	
		Total	Professional	Para-professional		Current Dollars	Constant Dollars
1961	\$ 111,400	19,500	9,700	9,800	50	\$ 5,713	\$8,268
1962	130,000	21,100	10,328	10,772	49	6,161	8,314
1963	145,000	23,300	11,200	12,100	48	6,223	8,050
1964	162,000	25,160	11,862	13,298	47	6,439	7,989
1965	178,500	27,000	12,500	14,500	46	6,611	7,875
1966	198,000	29,000	13,000	16,000	45	6,828	7,358
1967	222,000	41,720	18,285	23,435	44	5,321	5,321
1968	276,000	43,505	19,451	24,054	45	6,344	5,918
1969	317,300	45,150	20,149	25,001	45	7,028	6,133
1970	357,000						
1971	417,000	48,211	21,349	26,862	44	8,649	6,731
1972	455,000						
1973	497,000	54,432	23,513	30,919	43	9,131	6,421
1974	568,000						
1975	655,000	56,836	23,530	33,306	41	11,524	7,335
1976	716,000	56,852	23,104	33,748	41	12,594	7,633
1977	770,000	57,087	23,308	33,779	41	13,488	7,083
1978	895,676	53,344	19,904	33,440	37	16,791	9,449
1979	E 991,364	54,542	20,362	34,180	37	18,176	9,467
1980	E 1,087,053	54,822	20,412	34,410	37	19,829	9,588
1981	1,182,741	55,949	20,409	35,540	36	21,140	9,408

Sources: Column 2: Table 3. Columns 3, 4, and 5: Michael D. Cooper, "Projections of the Demand for Librarians in the United States," *Library Quarterly* 54, no. 4 (October 1984): 349; except column 5, 1978-81: King Research, Inc., *Library Human Resources: A Study of Supply and Demand* (Chicago: American Library Association, 1983), 38.

Note: E = Estimated by interpolation.

Figure 4—Total and per employee expenditures by college and university libraries 1961–1981

Source: Table 6

Table 7 presents several key labor price indexes. The library personnel salary index is a component of the Higher Education Price Index and reflects the change in library workers' salaries. Unfortunately, the index is based only on the salaries of head librarians,²³ so it should be used with caution. When compared to the overall Higher Education Price Index and electronic data processing (EDP) personnel salary index, the library personnel salary index has grown less rapidly than either one.

The aggregate data on expenditures for labor in academic libraries provide useful background information on how expenditures have changed since 1961. Future expenditures for salaries and wages will be influenced by a number of factors, including the supply and demand for library staff, the impact of unionization on salary levels, the effect of comparable worth settlements on library salaries, and the costs of educating and training library staff.

Table 7
Price Indexes

Year	Consumer Price Index	Higher Education Price Index	Library Personnel Salary Index	EDP Personnel Salary Index	EDP Hardware Index	CPI Residential Telephone Service Index	Producer Price Index
1961	90.5	77.7	69.1	76.0	95.7	104.3	93.7
1962	91.4	80.5	74.1	77.0	96.4	104.3	94.0
1963	92.4	83.6	77.3	78.0	97.1	104.5	93.7
1964	93.7	86.8	80.6	80.0	97.4		94.1
1965	94.9	90.5	86.7	86.0	98.5		95.7
1966	97.1	95.0	92.8	93.0	98.5		98.8
1967	100.0	100.0	100.0	100.0	100.0		100.0
1968	103.3	106.0	107.2	105.8	101.6	102.2	102.8
1969	108.3	113.2	114.6	113.0	101.6	103.5	106.6
1970	114.7	120.8	121.9	121.4	99.3	102.5	110.3
1971	120.7	128.6	128.5	126.8	98.5	107.5	113.7
1972	125.1	135.8	135.1	133.8	101.9	113.5	117.2
1973	130.0	143.0	142.2	142.6	105.2	116.5	127.9
1974	141.6	153.1	149.4	149.4	106.0	121.4	147.5
1975	157.4	166.2	157.1	156.4	110.4	125.3	163.4
1976	168.5	177.2	165.0	168.0	115.8	129.8	170.6
1977	178.3	188.7	171.1	173.9	118.0	131.3	181.7
1978	190.3	201.3	177.7	186.8	118.0	132.8	195.9
1979	208.1	216.9	192.0	205.6	118.0	132.4	217.7
1980	235.9	238.3	206.8	222.3	123.9	135.7	247.0
1981	263.1	263.9	224.7	245.8	147.5	147.7	269.8
1982	285.9	290.1	246.3	259.7	165.4	162.8	280.7

Sources: Columns 2 and 3: D. Kent Halstead, *Inflation Measures for Schools and Colleges*, National Institute of Education, U.S. Department of Education (Washington, D.C.: Government Printing Office, 1983), 15. Column 4: *ibid.*, 59. Columns 5 and 6: *ibid.*, 75. The 1970 and 1975-82 observations for column 7 are from *National Data Book and Guide to Sources: Statistical Abstract of the United States 1984*, 104th ed. (Washington, D.C.: U.S. Department of Commerce, Bureau of the Census, 1984), 482. Other years' observations for column 7 are from *Monthly Labor Review* as follows: 1961 and 1962 from *1962 Statistical Supplement*, 69; 1963 from *1963 Statistical Supplement Part I*, 25; 1968 from (December 1969), 102; 1969 from (December 1970), 84; 1971 from (December 1972), 100; 1972 from (December 1973), 108; 1973 from (December 1974), 105; and 1974 from (December 1975), 97.

Supply and Demand for Librarians

In recent studies, Cooper²⁴ and Van House²⁵ analyzed the library labor market, projecting supply and demand to 1990.²⁶ The results of that work indicate that in the early part of the projection period, there will be a slight oversupply of academic librarians, while in the period 1986 to 1990 the excess of supply over demand will reach 5 percent of the labor force.²⁷ Thus the balance between supply and demand is relatively close and library managers can expect neither shortages of librarians nor an extreme oversupply. While there is no quantitative data to support it, there is some reason to believe that the demand for paraprofessionals and clerical workers may be greater than supply because the wages paid by libraries are relatively low. In any event, future wage and salary expenditure levels are unlikely to be affected by supply and demand factors.

Comparable Worth

The most likely scenario under which professional labor costs will rise is as a result of the settlement of numerous comparable worth lawsuits. The concept of comparable worth has many dimensions and can be interpreted in many ways, depending on one's social or economic view. The major social question is whether individuals who are equal in one way should be treated equally in some other way.²⁸

A neoclassical economic analysis of the problem would state that wage rates are determined by market conditions and if wage differences exist it is because of the market. A more radical economic view would argue that the market system that determines wages is not truly competitive and that a number of barriers prevent free market operation.²⁹

A number of analytic studies across many occupations have found significant differences in the wages paid to women versus those paid to men for the same job.³⁰ Not only is this differential present today; the evidence suggests that the situation has not improved since the 1960s.³¹

Librarians have argued that they are being paid wages lower than other individuals with the same academic training (master's degree) and professional responsibilities. There have been some major settlements in this area recently and it seems likely that the trend will continue.³²

Unionization

The effect of unionization on salary levels has been surveyed by Parsley.³³ His summaries of twelve major studies measured the percentage difference in salaries and wages when an industry is or is not unionized. Managers are the only group in all studies who do not gain in salaries due to unionization. In one study sales people did not gain, but in another they did. One interesting finding pertained to salary differentials for teachers. Schmenner³⁴ found 12 percent to 14 percent salary gains for unionized teachers, but concluded that 7 percent to 9 percent of those gains were due to the formal bargaining process rather than the existence of unionization.

There have been several analytic studies on the effect of unionization on salary levels in public libraries, but little or no information on its effect in college and university libraries. The evidence from public library research suggests that there is a significant difference between the salaries of all types of library workers who are unionized and those who are not. For example, Getz³⁵ found that the presence of a collective bargaining unit was a significant variable in explaining the salary of a public librarian with five years' experience, as well as that of a person starting a clerical job in the library. The presence of a collective bargaining unit was not significant in explaining beginning librarian salaries.

Rosenthal³⁶ analyzed public library data from some of the central and north central states in the United States. She found that the pres-

ence of a union explained some of the variation in librarians' salaries, but not in clerical or department heads' salaries.

Faculty salaries in four-year colleges and universities were found to be higher in institutions where the faculty was represented by a union than where they were not. According to a report prepared by the American Association of University Professors in 1982, the average salary was \$26,980 in 168 colleges and universities where there was a collective bargaining unit, versus \$25,810 for 1,749 institutions where there was not. No tests of statistical significance of the results were reported.³⁷

There is no evidence that bears directly on academic libraries with respect to the effect of unionization on salaries. However, the results from public libraries suggest that there is a significant difference. The most likely scenario is that if there were to be more unionization in academic libraries, salaries would increase.

The relationship between unionization and productivity in public libraries has been analyzed by Ehrenberg et al.³⁸ The measures of productivity chosen for the study were the number of information requests per capita, borrowers per capita, interlibrary loans per capita, and circulations per capita. The authors found productivity gains in the libraries studied, but did not find a relationship between productivity and collective bargaining coverage. Nor did they find that wage rates were higher when the library employees were covered by collective bargaining agreements.³⁹

Education Costs

The commitment to a career as a professional librarian brings with it the usual requirement of obtaining a master's degree in librarianship. The educational requirements for paraprofessional and clerical positions vary widely and no generalization about them can be made. What are the costs to an individual of becoming a librarian, and what are the costs to the library of keeping librarians adequately trained after they are hired?

The standard approach to determining the cost of education is to measure the rate of return on an individual's investment in education. Van House⁴⁰ has done this for librarians and found economic disincentives for a person to become a librarian. Several factors are involved in her analysis. One is the length of the Master of Library Science (MLS) program (one or two years); another is whether calculations are based on net (post-tax) or gross (pre-tax) income. A third is the success of graduates in obtaining jobs after they complete their MLS degrees. By far the most important factor is whether the graduate is a man or a woman.

For men, obtaining an MLS can mean a *loss* in net lifetime income ranging from \$166,000 to \$199,000. Because women's salaries are lower, the corresponding loss for them is in the range of \$30,000 to \$60,000.

An important part of Van House's analysis was to determine how much salaries would have to rise in order for one to break even by investing in an MLS degree. She found that salaries would have to go up 54 to 70 percent for men and 11 to 30 percent for women for this to happen.

Training Costs

The other aspect of the education question pertains to the library's costs of keeping an employee's skills up-to-date. On this topic, there is little systematically collected information for librarians, but there is some information about training costs in public and private institutions as a whole.

Based on a survey of organizations with more than 50 employees, *Training Magazine*⁴¹ found that the average amount of money spent by each organization for training in 1984 was about \$20,000.⁴² The amount spent by institutions varies widely by the number of employees. For example, each organization with 50 to 99 employees spent about \$11,600 in 1984, while those with 100 to 499 employees spent \$21,660 each. These numbers are modest, but the total amount of money spent by all organizations in 1984 is not: \$4.2 billion. The largest percentage of all the money spent on training is for seminars and conferences, which amounts to 32 percent of the total. Expenditures for training hardware (audio-visual equipment, etc.), off-the-shelf materials (prepackaged training materials such as videotapes, books, and computer courseware), and outside services (printing, production services, and consultants not acting as trainers) each amounted to about 18 percent of total expenditures for training. Expenditures for custom-designed materials for training were 15 percent of the total.⁴³

When training costs are computed for each employee using the information *Training Magazine* provided, the numbers are relatively small. This can be explained in two ways: not all employees are being trained, and not much money is being spent on training. Available institutional data suggests that the proportion of money spent on training varies widely by job title of employee.⁴⁴ Managers and supervisors receive the largest number of hours of training in an organization, followed by professionals. Secretarial workers receive the least amount of training.

Lacking quantitative information about library expenditures on training, one can only conjecture about the amount spent per employee. One very large academic library reported to the author an average yearly expenditure of about \$1,500 per employee for training costs including trainer and trainee time, travel, course materials, and equipment.⁴⁵

Training expenditures are not itemized and are not given budgetary priority in many libraries. If one assumes that education is valuable, allows employees to be more effective and useful, and maintains and improves their skill levels, then training expenditures need to be given recognition as a worthwhile item and given budgetary priority.

ALLOCATION OF LABOR AND CAPITAL

There are several different avenues that can be taken to analyze the efficiency with which labor and capital are being used in a library. They include measuring the productivity of labor, measuring the substitutability of one type of labor for another, and analyzing the substitutability of capital for labor. Much of the work depends on developing measures of library output.

Output Measures

Improvement in the economic efficiency with which libraries operate depends on developing good measures of performance and using those measures to make sound operating decisions. One of the most important types of measures is output from library services. As the name implies, output measures record the quantity of various services provided by a library. Depending on the level at which one is analyzing a library, the measures vary. Public service activities generally include reference, online searching, interlibrary lending, and possibly circulation. Typical output measures are number of questions answered, searches performed, items lent to and borrowed from other institutions, and items circulated. Clearly, all these measures could be subdivided (e.g., by type of reference question).

Technical processing activities involve acquisition, cataloging, materials selection, serials management, document management, and handling gifts and exchanges. Each of these functions has associated output measures. If one were analyzing the output of a technical service department, these measures would be relevant. However, they are sometimes considered intermediate output and ignored in favor of what the library user sees as a final product—circulation, reference, etc.

Considerable work has been done in developing output measures for libraries,⁴⁶ but there is one neglected aspect of the problem: no serious attention has been focused on including a measure of *quality*. The literature of library user studies contains examples of studies that have tried to assess quality of, for example, reference service, but the results of these studies have not been incorporated into aggregate measures of output.⁴⁷

Labor Productivity

One of the major uses of output measures is in the evaluation of labor productivity. Productivity is normally defined as a measure of the efficiency with which output is produced with a given set of resources.⁴⁸ Measurement of productivity is important in investigating the economics of research libraries because it provides an important tool to help analyze library performance.

Why should we be interested in productivity measures for libraries? As internal measures, they are useful in helping to determine the efficiency with which labor is being utilized to produce desired output within an organization. They also give information on the relative performance of one institution versus another for the same output. Of course, the problem of comparability of output among institutions is difficult, but there has been significant work done on standardizing definitions of library output.⁴⁹

One of the few attempts at measuring productivity in libraries was performed by White.⁵⁰ As a measure of output on which to base his productivity analysis, he chose circulation. He calculated the growth rate in the unit cost of circulation and used that as a measure of public library service productivity. He compared that value to the full and service components of the Consumer Price Index. The results were mixed, depending on the time period used for comparison. In some cases, library service unit costs rose more rapidly than the CPI, and in others, less rapidly. He also analyzed labor productivity (i.e., output, as measured by circulation, divided by hours worked) and again found it less than output per employee hour for non-farm workers over the period 1951-1976.

There are many ongoing series of productivity measures for the private sector but, because of the conceptual difficulties of measuring output and quality and developing consistent series on wages and salaries, little has been done in the area of measuring productivity in libraries. This is an important area for future research and should have a significant impact in improving library effectiveness once the data are available.⁵¹

Labor Substitutability

Libraries use many different categories of personnel, such as managers, librarians, library assistants, clerks, and systems analysts. To what extent can individuals with one level of education and/or training perform the tasks of other individuals?⁵² Can clerks do the jobs of library assistants; can library assistants substitute for librarians?⁵³ Flexible allocation of workers to jobs means better staffing of facilities because individuals can fill in for others, better morale because individuals will be doing tasks that suit their education and training, and potentially lower labor costs for the institution since individuals will be doing tasks corresponding to the remuneration that they receive.

The obstacles to flexible substitution of one category of labor for another are great. For example, institutional regulations and professional standards may dictate that an individual must have a master's degree from an accredited library school in order to work in a job titled "librarian." Alternate paths to this job, such as work experience for a certain number of years as a paraprofessional, may or may not be accept-

able.⁵⁴ There may also be union regulations that prevent a person in one job classification from performing tasks in another classification.

These constraints aside (although they are not in the least negligible), there is the possibility of developing models to assist in the allocation of labor between tasks. Such models can be used to help decide whether one type of labor can be substituted for another type (e.g., library assistants for librarians in certain tasks). There are a number of factors that have to be considered in formulating the models: educational level, skills, and earnings of each category of worker; productivity of a particular worker performing a specific task; and specific mixtures of skills, education, and salary. As we have seen in the previous section, development of measures of productivity is not a simple task but, given the measures, models could help to optimize the allocation of staff with varying levels of skill and education to different tasks, given their productivity and earnings.⁵⁵

Labor-Capital Substitution

The major categories of reported library expenditures are materials and labor. There are significant uncategorized expenditures for automation and for remodeling and construction of physical facilities. One area of research in the economics of information has been to look at the productivity of a library and how that productivity can be improved by changing the mix of labor and capital used to produce a given level of output.

The most significant work in this area has been done by Hayes.⁵⁶ He used the Cobb-Douglas production function to analyze how public libraries allocate funds between labor and capital expenditures. He tested the model in public libraries in five states and in a set of the largest public libraries in the United States. Using his own estimates of capital expenditures, Hayes found the model to be a reasonable characterization of the mix between labor and capital used in these libraries.⁵⁷

Economies of Scale

There are important implications in knowing what the cost trends have been in academic libraries. But it is also important to know what the shape of the cost curve is for libraries. The issue to be addressed is whether the unit cost of providing a certain amount of service declines as the number of units provided increases. If it is possible to derive an average cost curve, then it is also possible to examine that curve and find out whether there is a level of output that minimizes the total cost of operating the library.

Determining whether there are economies of scale in library operations is difficult because there is no adequate measure of output that takes into account the complex mix of services that a library performs. As was discussed earlier, little work has been done to incorporate measures of quality into output metrics.

Given these limitations, several studies have been performed to analyze whether there are economies of scale in library operations. The earliest work in developing economies of scale models was performed by Black.⁵⁸ In a study of public libraries in California, Cooper⁵⁹ found that there were almost constant returns to scale. That is, the average cost of a unit of service remained constant as the amount of service increased. Feldstein, on the other hand, found some diseconomies of scale in her study of public libraries.⁶⁰ In a study of college and university libraries, Cooper⁶¹ found diseconomies of scale in two- and four-year public and in four-year private colleges and universities.⁶²

Analyzing large research libraries, Kantor⁶³ found almost constant returns to scale. Cooper's findings⁶⁴ used a number of different criteria to establish what constituted the largest academic libraries. His results showed that for the largest academic libraries there were definite and strong economies of scale.

There are methodological differences in all the economies of scale work that has been done. The results vary by sample and methodology, but the research is continuing and could have important implications for library managers. Knowing the correct scale at which to operate means making intelligent decisions about opening and closing new branches, purchasing or performing certain key services, and, in general, operating efficiently.

LIBRARY AUTOMATION

Few statistics are available to give a measure of the magnitude of current library expenditures on computer-related activities. It is apparent, even without the data, that computing is being used in all aspects of library operations. Public service staff use online public access catalogs as a replacement for the traditional card catalog; they use online search services, such as DIALOG, to locate materials in databases; they use the services of bibliographic utilities, such as OCLC and RLIN, for processing interlibrary lending requests; and they use online circulation systems to handle reports on circulation, overdues, hold placements, and reserves.

Technical processing activities have long taken advantage of computing in the areas of acquisitions and accounting for the purchase of materials; cataloging using locally developed systems or the bibliographic utilities described above; and serials control, including check-in, claiming, accounting, ordering, and binding.

Clearly, the use of computers in libraries is pervasive. This section discusses the costs of computing using both local and national systems and outlines some of the major factors in analyzing the economics of library automation.

tems as a whole, as well as central processing units, memory, and external storage devices.⁷¹ There is evidence to suggest that the trend will continue, with improved price/performance ratios for almost every type of computer component.⁷²

While the challenge of producing better, faster, and more reliable hardware at a lower price has been met, that has not been true for non-hardware computer components. Production of software is a labor-intensive effort, as is the maintenance of software and hardware systems. As the cost of hardware has declined, the proportion of total computer expenditures allocated to hardware has decreased to less than half the total. Future price *increases* are expected in software, in installing software and hardware systems in an organization, and in maintaining hardware and software.⁷³

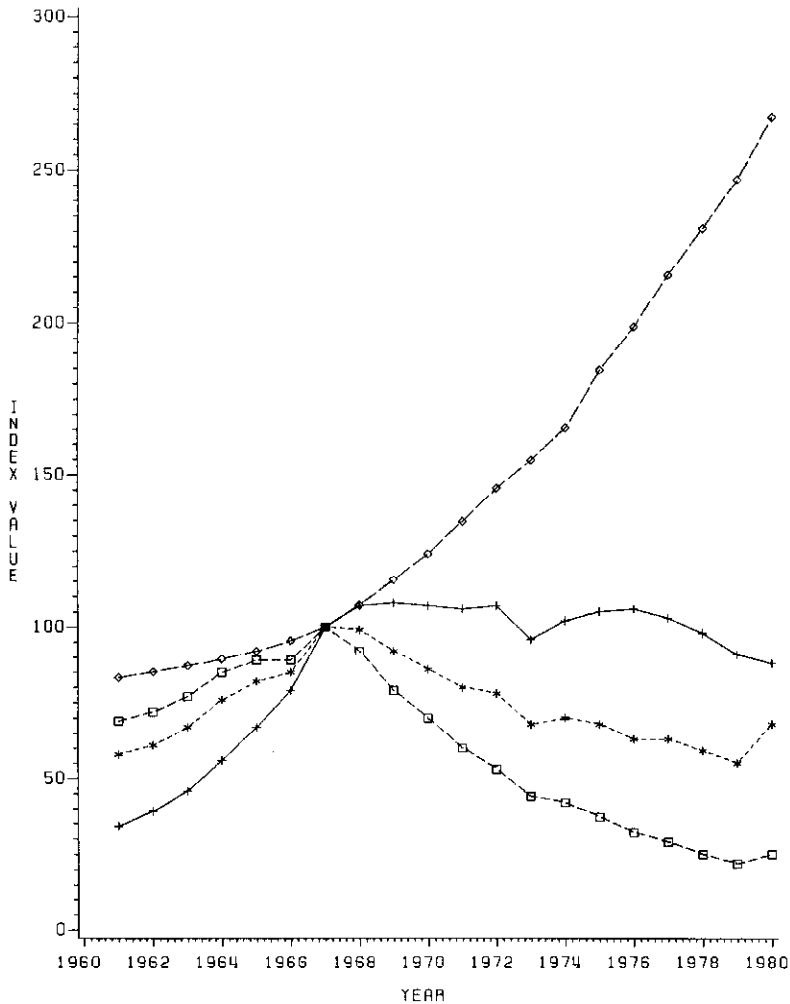
The number of vendors supplying library hardware and/or software packages is growing rapidly. It is unlikely that the cost of these packages will decline, since labor costs dominate their production. Libraries cannot expect to save money on their computer acquisitions as hardware costs decline.

Telecommunications Costs

As libraries place more reliance on distributed computing (such as through their interconnection to bibliographic utilities such as OCLC and RLIN, and to search services such as BRS, DIALOG, and ORBIT), telecommunications costs will play an important part in the overall costs of automated activities. There are other examples of the increased use of communications facilities: automated circulation systems connecting branch libraries require a complex of phone data lines, as do decentralized local technical processing and online public access catalog systems. The net effect of increased automation will be increased expenditures for telecommunications.

In the past, the rate of increase in residential telephone service prices has been modest compared to general price indexes (Table 7). While the Consumer Price Index increased about 3.1 times and the Producer Price Index 3.0 times between 1961 and 1982, the residential telephone price index increased only 1.6 times in the same period.⁷⁴

For most of the cost data that has been analyzed in this paper, there are few reasons to believe that past trends will not continue. The AT&T divestiture (or Modified Final Judgment)⁷⁵ has resulted in major changes in local and long-distance phone rates, and many more such changes lie ahead. One major bibliographic utility experienced a 74 percent rise in phone rates in one year,⁷⁶ and legislation has been proposed to limit phone rate hikes for libraries.⁷⁷ There is no doubt that significant increases have occurred in phone tariffs since divestiture. In 1983, according to one source,⁷⁸ there were 31 cases for residential rate increases pending that would increase the rates by about 84.3 percent over their

Figure 5—Total and per student building construction expenditures in colleges and universities 1961–1980

Source: Table 8

benefit. Eliminating purchase of more than one copy of an item reduces direct expenditures but reduces book availability, and thus increases user cost and frustration. Computerized techniques for assisting technical processing operations can improve quality and throughput, but are unlikely to reduce costs. Seemingly, the only method of rationally reducing a library's materials expenditures is evaluation of whether the library needs to collect a certain body of literature.

The largest single category of academic library expenditures is salaries and wages. Supply and demand analyses for librarians show that the labor market is close to equilibrium, with a slight oversupply of librarians. Economic theory dictates that given this condition, salaries are unlikely to rise. This appears to be the case and, in fact, there has been little increase in real wages (above inflation) for librarians in the past two decades.

There are several issues that could have a major impact on the wage rates paid to librarians and could cause salary expenditures to increase. One is settlement of comparable worth claims. Librarians argue persuasively that, given their skills and training, they are being paid at a significantly lower rate than individuals in other occupations with similar skills and training. One major public library case has been settled in librarians' favor.

Another issue is the effect of collective bargaining on salaries and wages. Most analyses show that wages are higher when individuals operate under a collective bargaining agreement. It is not clear whether the frequency of these agreements will increase in libraries, but, if they do, pay scales are likely to rise.

There are two major activities that libraries apparently have not had the resources to deal with effectively. One is preservation and conservation of the physical library collection and the other is ongoing training of library staff. There is general recognition that both these activities are essential, but other financial pressures seem to prevent major investments in them.

The use of computers in libraries has increased significantly for both technical processing and public service activities. As a result of increasing the use of these machines in libraries, there has been no significant decline in the cost of library operations, but rather an improvement in the level and quality of service. The trends in computer hardware pricing make it easy to believe that the overall cost of computing should decline for libraries, but when taken in combination with telecommunication costs, software costs, maintenance costs, and programmer and analyst salaries, the cost trend is upward.

Bibliographic utilities have become firmly established in libraries as an important tool to aid in cataloging and other technical processing activities. With rapidly rising telecommunication costs and improving price/performance ratios for small versus large computers, the economics of using utilities is becoming less attractive. Given the changing economic environment, it seems likely that the type of service offered by utilities will have to change, or the utilities will be in financial jeopardy.

Online searching presents other types of dilemmas. As publishers put more of their materials into computerized databases, it is easy to imagine that computer terminals will be an increasingly relied-on alternative to books as information sources. For the library, there are numer-

ous problems with this approach. For example, should the library divert its materials budget into this form of information? On the one hand, it is a legitimate type of information, but on the other, it is tailored to one person, without the social benefits that books have.

In summary, academic libraries are at a difficult juncture. There are many areas that need financial resources and there are severe limitations on available funding. The notion of computing technology as a solution to some of the financial problems facing libraries has proved to be incorrect. Quality of service has improved, but costs have not been reduced. The economic dilemma for academic libraries remains.

Notes

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1. There are major differences in the patterns between public and private institutions, but they are not discussed here.
2. D. Kent Halstead, *Inflation Measures for Schools and Colleges*, National Institute of Education, U.S. Department of Education (Washington, D.C.: Government Printing Office, 1983).
3. An important contribution to our ability to understand and interpret time series data on educational finances has been made by Halstead. He has developed an equivalent to the Consumer Price Index to adjust education time series data. Unless otherwise stated, this paper uses his Higher Education Price Index (HEPI) to convert current dollar values to constant dollar equivalents. See Halstead (note 2).
4. Given that a library's purpose is to serve its clients (students), the ratio of library expenditures per student seems a better measure to analyze than the more frequently used ratio of expenditures per volume held or added.
5. John F. Harvey and Peter Spyers-Duran, "The Effect of Inflation on Academic Libraries," in *Austerity Management in Academic Libraries*, ed. John F. Harvey and Peter Spyers-Duran (Metuchen, N.J.: Scarecrow Press, 1984), 16, 18.
6. The adjustment for inflation in their paper is made by using the Consumer Price Index rather than the Higher Education Price Index used in this paper.
7. William J. Baumol and Matityahu Marcus, *Economics of Academic Libraries* (Washington, D.C.: American Council on Education, 1973).
8. Harvey and Spyers-Duran, "Effect of Inflation," 1-42.
9. Halstead, *Inflation Measures*, 47.
10. To a certain extent, libraries lack control over material expenditures. Literature is published at a certain rate and, assuming that the material published is of suitable quality and/or subject interest, once the library is committed to collect in that area, it may be obliged to buy the material.
11. Michael K. Buckland, *Book Availability and the Library User* (New York: Pergamon Press, 1975).
12. Nancy A. Van House, "A Time Allocation Theory of Public Library Use," *Library and Information Science Research* 5 (Winter 1983): 365-84.

13. *A Study of the Characteristics, Costs, and Magnitude of Interlibrary Loans in Academic Libraries*, comp. Vernon E. Palmour et al. Prepared for the Association of Research Libraries by Westat Research, Inc. (Washington, D.C.: ARL, 1972).
14. *Ibid.*, 34.
15. *Ibid.*, 22.
16. Halstead, *Inflation Measures*, 15.
17. Martin M. Cummings, "The Effect of U.S. Policies on the Economics of Libraries," *Bulletin of the Medical Library Association* 73 (January 1985): 1-8.
18. Michael D. Cooper, "Charging Users for Library Service," *Information Processing and Management* 14 (1978): 419-27.
19. I am indebted to Barclay Ogden, Head of the Conservation Department, University Library, University of California, Berkeley, for the information contained in this section.
20. Comparable circulation figures for four-year public and four-year private academic libraries are 193,468 and 47,300, respectively.
21. Michael D. Cooper, "Economies of Scale in Academic Libraries," *Library Research* 5 (Summer 1983): 207-19.
22. See this paper's section on construction costs for details.
23. Halstead, *Inflation Measures*, 63.
24. Michael D. Cooper, "Projections of the Demand for Librarians in the United States," *Library Quarterly* 54 (October 1984): 331-67.
25. Nancy A. Van House, "Projections of the Supply of Librarians," *Library Quarterly* 54 (October 1984): 368-96.
26. *Library Human Resources: A Study of Supply and Demand*, prepared for the National Center for Education Statistics and the Office of Libraries and Learning Technologies by King Research, Inc. (Chicago: American Library Association, 1983), 117.
27. The study did not analyze non-library, information-profession jobs available to library school graduates. Those jobs could easily absorb the excess supply.
28. Thomas A. Mahoney, "Approaches to the Definition of Comparable Worth," *Journal of Library Administration* 4 (Summer 1983): 90.
29. *Ibid.*, 90-91.
30. Ronald G. Ehrenberg and Robert S. Smith, "Comparable Worth in the Public Sector," Working Paper No. 1471 (Cambridge, Mass.: National Bureau of Economic Research, September 1984).
31. George Johnson and Gary Solon, "Pay Differences Between Women's and Men's Jobs: The Empirical Foundations of Comparable Worth Legislation," National Bureau of Economic Research Working Paper Series (Cambridge, Mass.: NBER, September 1984).
32. See *American Libraries* 16 (June 1985): 368-70, for information about a settlement in Los Angeles County, California.
33. C. J. Parsley, "Labor Union Effects on Wage Gains: A Survey of Recent Literature," *Journal of Economic Literature* 18 (March 1980): 1-31.
34. Roger W. Schmenner, "The Determination of Municipal Employee Wages," *Review of Economics and Statistics* 55 (February 1973): 83-90.
35. Malcolm Getz, *Public Libraries: An Economic View* (Baltimore: Johns Hopkins University Press, 1980), 69-71.
36. Mary Rosenthal, "The Impact of Unions on Salaries in Public Libraries," *Library Quarterly* 55 (January 1985): 52-70.
37. See *The Chronicle of Higher Education* 24 (July 7, 1982): 1.
38. Ronald G. Ehrenberg, Daniel R. Sherman, and Joshua L. Schwarz, "Unions and Productivity in the Public Sector: A Study of Municipal Libraries," *Industrial and Labor Relations Review* 36 (January 1983): 199-213.
39. The authors found an illogical relation between interlibrary loans and unionization, which they agree should be ignored.

40. Nancy A. Van House, "The Return on the Investment in Library Education," *Library and Information Science Research* 7 (January-March 1985): 31-52.
41. "Training Magazine's Industry Report, 1984," *Training* 21 (October 1984): entire issue.
42. This is my own calculation from figures supplied in *Training Magazine* (*ibid.*, 13, 26).
43. The numbers in *Training Magazine* should be treated with some caution because of a bias in the sample toward large institutions. First, only organizations with more than 50 employees were included in the sample; second, the proportion of organizations actually in the sample with 50-99 and 100-499 employees was substantially different than what is known about the population as a whole.
44. "Training Magazine's Industry Report," 39.
45. No indirect salary costs were included in the estimate, only direct costs.
46. Ernest R. DeProspero, Ellen Altman, and Kenneth E. Beasley, *Performance Measures for Public Libraries* (Chicago: Public Library Association, 1973); Vernon E. Palmour, Marcia C. Bellassai, and Nancy V. DeWath, *A Planning Process for Public Libraries* (Chicago: American Library Association, 1980); Vernon E. Palmour, Donald W. King, and R. Boyd Ladd, "Public Library Services," in *Productivity Improvement Handbook for State & Local Government*, ed. George J. Washnis (New York: John Wiley & Sons, 1980), 1446-64.
47. The aspect of quality is problematic when measuring the effectiveness of reference service. See Ronald R. Powell, "Reference Effectiveness: A Review of Research," *Library and Information Science Research* 6 (January-March 1984): 3-19, for a survey of the literature in this area. Also see Childers' and Kantor's articles on evaluating reference service: Thomas Childers, "The Test of Reference," *Library Journal* 105 (April 15, 1980): 924-28; Paul B. Kantor, "Quantitative Evaluation of the Reference Process," *RQ* 21 (Fall 1981): 43-52.
48. Jerome A. Mark, "Concepts and Measures of Productivity," in *The Meaning and Measurement of Productivity*, Bulletin No. 1714 (Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics, September 1971), 7.
49. *Library Data Collection Handbook*, ed. Mary Jo Lynch, prepared for the National Center for Education Statistics under contract OE-300-80-0058 with the U.S. Department of Education (Chicago: American Library Association, May 1981).
50. Lawrence J. White, *The Public Library in the 1980s: The Problems of Choice* (Lexington, Mass.: Lexington Books, 1983), Chapter 10.
51. A number of papers have dealt with the problems and methods of measuring productivity in the public sector. See Donald M. Fisk, *Measuring Productivity in State and Local Government*, Bulletin No. 2166 (Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics, January 1984); Jerome A. Mark, "Progress in Measuring Productivity in Government," *Monthly Labor Review* 95 (December 1972): 3-6; Albert Rees, "Improving the Concepts and Technics of Productivity Measurement," *Monthly Labor Review* 102 (September 1979): 23-27; Charles Ardolini and Jeffrey Hohenstein, "Measuring Productivity in the Federal Government," *Monthly Labor Review* 97 (November 1974): 13-20. A survey of the application of the techniques in libraries is discussed in Thomas J. Waldhart and Thomas P. Marcum, "Productivity Measurement in Academic Libraries," in *Advances in Librarianship*, ed. Melvin J. Voigt and Michael H. Harris (New York: Academic Press, 1976), 54-78.
52. Table 6 shows that substitution of library assistants for librarians has been going on for some time. In 1961 there were an equal number of each category employed in academic libraries. By 1981, 36 percent of the total staff were librarians.
53. See Charlotte Mugnier, *The Paraprofessional and the Professional Job Structure* (Chicago: American Library Association, 1980), for a discussion of the types of tasks library assistants regularly perform.
54. I am not arguing for or against the maintenance of such standards; rather, I am describing them as factors that affect resource allocation decisions.

55. There are a number of studies of labor substitutability. Bowles has outlined the major conceptual problems in analyzing the problem: Samuel Bowles, *Planning Educational Systems for Economic Growth*, Harvard Economic Studies, vol. 133 (Cambridge, Mass.: Harvard University Press, 1969). The following have developed models and empirically analyzed certain micro- and macro-level substitution problems: George Psacharopoulos, "Substitution Assumptions Versus Empirical Evidence in Manpower Planning," *De Economist* 121 (1973): 609-25; Hirsch S. Ruchlin, "Education as a Labor Market Variable," *Industrial Relations* 10 (October 1971): 287-300; Edmund H. Mantell, "Discrimination Based on Education in the Labor Market for Engineers," *Review of Economics and Statistics* 56 (May 1974): 158-66; George Psacharopoulos and Keith Hinchliffe, "Further Evidence on the Elasticity of Substitution Among Different Types of Educated Labor," *Journal of Political Economy* 80 (July/August 1972): 786-92.
56. Robert M. Hayes, "The Management of Library Resources: The Balance Between Capital and Staff in Providing Services," *Library Research* 1 (Summer 1979): 119-42.
57. Several other papers have dealt with the use of the Cobb-Douglas function to model the information sector of the economy, but not libraries. See Robert M. Hayes and Timothy Erickson, "Added Value as a Function of Purchases of Information Services," *The Information Society* 1 (1982): 307-38. See also Braunstein's generalization and extension of Hayes and Erickson's work: Yale M. Braunstein, "Information as a Factor of Production: Substitutability and Productivity," *The Information Society* 3 (1985): 261-73.
58. Stanley W. Black, "Library Economics," Appendix F-2 in *Libraries at Large: Tradition, Innovation, and the National Interest*, ed. Douglas M. Knight and E. Shepley Nourse (New York: R.R. Bowker, 1969), 590-96.
59. Michael D. Cooper, "The Economics of Library Size: A Preliminary Inquiry," *Library Trends* 28 (Summer 1979): 63-78.
60. Kathleen Foley Feldstein, "The Economics of Public Libraries" (Ph.D. diss., Massachusetts Institute of Technology, 1976).
61. Cooper, "Economies of Scale in Academic Libraries."
62. The results for two-year private colleges and universities show diseconomies, but the fit of the equation to the data was not strong.
63. Paul B. Kantor, "Cost and Productivity in Library Operations," in *Productivity in the Information Age, Proceedings of the 46th ASIS Annual Meeting*, vol. 20, ed. Raymond F. Vondran, et al. (White Plains, N.Y.: Knowledge Industry Publications for the American Society for Information Science, 1983).
64. Michael D. Cooper, "Economies of Scale in Large Academic Libraries," *Library and Information Science Research* 6 (July-September 1984): 321-33.
65. Schedules of rates for services provided by the bibliographic utilities change frequently. They can be obtained from the vendors.
66. Martha E. Williams, "Electronic Databases," *Science* 228 (April 26, 1985): 445-56.
67. Michael D. Cooper and Nancy A. DeWath, "The Cost of On-Line Bibliographic Searching," *Journal of Library Automation* 9 (September 1976): 195-209.
68. See also Michael D. Cooper and Nancy A. DeWath, "The Effect of User Fees on the Cost of On-Line Searching in Libraries," *Journal of Library Automation* 10 (December 1977): 304-19, which compared the cost of searching when the service was free, versus when the user had to pay for it.
69. Martha E. Williams, "Highlights of the Online Database Field—Statistics, Pricing and New Delivery Mechanisms," in *National Online Meeting Proceedings—1984*, New York, April 10-12, 1984 (Medford, N.J.: Learned Information, 1984), 1.
70. Cooper and DeWath's study was based on a small sample. Williams' numbers appear to be summaries of reports prepared by the search service vendors themselves.
71. See, for example, Phillip Ein-Dor, "Grosch's Law Re-Visited: CPU Power and the Cost of Computation," *Communications of the ACM* 28 (February 1985): 142-51; and

- E. G. Calc, L. L. Gremillion, and J. L. McKenney, "Price/Performance Patterns of U.S. Computer Systems," *Communications of the ACM* 22 (April 1979): 225-33. Hardware prices for comparable machines (see Halstead, *Inflation Measures*, 73) have increased at about the same rate as telephone services (Table 7).
72. *The Microelectronics Industry: Future Information Processing Technology—1983*, ed. Peg Kay and Patricia Powell, Institute for Computer Sciences and Technology, National Bureau of Standards, NBS Special Publication 500-103, Computer Science and Technology series (Washington, D.C.: Government Printing Office, August 1983).
 73. *Ibid.*, 162-63.
 74. Use of residential phone rates as a basis for analyzing telecommunications costs in libraries is the best approximation available, since there is no published time series data on business phone rates. In general, business rates have increased more rapidly than residential rates.
 75. *United States v. AT&T*, 552 F. Supp. 131 (1982), *aff'd sub nom. Maryland v. United States*, 103 S Ct. 1240 (1983).
 76. See *OCLC Newsletter*, no. 151 (March 1984); and "OCLC on Telecommunications Cost Threat," *Library Journal* 109 (May 1, 1984): 839.
 77. See "Senator Spotlights Libraries as Phone-Tariff Victims," *American Libraries* 15 (March 1984): 128-29; and "Twenty-Seven Senators Ask FCC to Ease Library Phone Charges," *American Libraries* 15 (June 1984): 362.
 78. Walter G. Bolter, et al., *Telecommunications Policy for the 1980s: The Transition to Competition* (Englewood Cliffs, N.J.: Prentice-Hall, 1984), 171.
 79. *Ibid.*
 80. Bette-Lee Fox, "Library Buildings in 1984," *Library Journal* 109 (December 1984): 2224-33.
 81. The square-foot costs are not presented in the article but are derived by the author from the data in Fox (*ibid.*, 2233). They are based on the listings of construction in Fox and are not a representative sample of library construction costs, but the best available.
 82. Halstead, *Inflation Measures*, 110.
 83. Fox, "Library Buildings."