

Comparing University Libraries of Different University Size

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The primary objective of comparing libraries is to make the top management of the libraries aware that the libraries are not functioning as expected and hence their request for funds and resources to improve performance should be supported. Since larger universities require larger libraries to satisfy higher demand, we concentrate on the comparison of university libraries of different university size in terms of the number of faculty and students. While it is different from the conventional constant ratio method, this approach allows for non-proportionality between the library size and

the university size. In other words, the library size need not increase at the same pace as the university. To compare the twenty-four university libraries in Taiwan, we developed a data envelopment analysis (DEA) model based on the concept of Pareto optimality to calculate a score for each library as the basis for comparison. Thus this study by taking into account the size of the university and non-proportionality yields a more informative and meaningful result than previous studies because very small or very large libraries do not have a disproportionate impact.

Introduction

A university library has primary responsibility for providing sufficient collections, facilities, and services to support the university's instructional needs and to facilitate the university's research programs. This has been clearly stated in many university library standards (Hendrickson 1989; Kania 1988; Lynch 1979, 1987). Performance measures based on these standards have also been discussed (Cotta-Schönberg and Line 1994; Ford 1989; Lines 1989; Naylor 1987; Rzasa and Baker 1972). While most standards are qualitative, a quantitative analysis is desired. The 1987 investigation of the Association of Research Libraries (ARL) revealed that quantitative standards are viewed much more positively by library directors because they can be used to evaluate their own library's performance and to justify a request for more resources from the university administrators to improve the areas where inadequacies exist.

Historically, size, a general term for resources and services provided by the library, has been considered as the sole indicator of the quality of a research library and has served as the determining factor in accrediting and ranking (ARL 1995; Dougherty 1991). The comparison of resources and services based on volume count favours large universities because large universities usually have more resources allocated to the library. Kania (1988) stresses that the size of the library collection should depend on the size of the student body in addition to other criteria. The "total-amount method" is useful only when the libraries being compared are part of universities of similar size (Ford 1989, Goodall 1988, Hendrickson 1989, Lynch 1979). When universities differ in size, a straightforward idea is to use ratios, in that the average amounts are calculated for different resources and services (John Minster Associates 1989; Lynch 1979; Richard 1992). This idea has been modified by the Association of College

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and Research Libraries (ACRL) to set a minimum size collection required for any library (ACRL 1986). As the number of students increases, the collections are expected to increase in a constant rate. However, due to the fixed amount of the minimum requirement, the ratio of the total amount to the number of students varies as the number of students changes. Suppose a minimum volume count of v_0 is required for a minimum university size of u_0 students and the increasing rate in volumes with respect to the university size is r . Let r_0 denote the ratio of v_0 to u_0 . The ratio of the expected volume count to the university size will decrease as the university increases in its size if r is smaller than r_0 . On the contrary, the ratio will increase if r is larger than r_0 (Detweiler 1986; Naylor 1987; and Daly 1995). Another factor to consider is whether the rate for increasing collections needs to be constant as the university increases in size. These factors make the comparison of libraries from different sized universities more complicated than expected.

In an attempt to solve these problems, we adopted the concept of the Pareto optimality (Ferguson and Gould 1980; Zeleny 1982) to calculate the expected resources and services (hereafter generalised as services) to be provided by the university libraries of different university sizes from sampled university libraries. The ratio of the observed amount of services to the expected amount of services shows the achievement of each library in providing the necessary services and therefore serves as a basis for comparison. In the following sections, we describe the concept of the Pareto optimality on which the model for comparing university libraries of different university size is built. The twenty-four university libraries in Taiwan are then evaluated using the developed model. Finally, the results are compared with those obtained from using the criteria of total volume count and average volume count.

Pareto optimality

An organisation, in which any change that makes some people better off makes some others worse off, can be called a Pareto optimal organisation (Ferguson and Gould 1980). This concept has been extended by T. C. Koopmans, the 1975 Nobel prize winner in economics, to represent a

state in which productive activity has been so organised that within the given limitations of resources and technology, there is no other way of producing more of some desired commodities without reducing the output of some other desired commodities (Baumol 1977; Zeleny 1982). Suppose within a set of organisations that each uses the same amount of input to produce two outputs (or to provide two kinds of services). For a particular organisation, if there is no other organisation, which produces more of one output and no less of the other output, then this organisation is a Pareto optimal organisation. By the same token, from the viewpoint of inputs, if there is no other organisation, which consumes less of one input and no more of the other input to produce the same amount of output, then this organisation is also a Pareto optimal organisation.

In comparing university libraries of different university size in terms of the number of students and faculty, the size of the university can be considered an input and the services provided by the library can be considered an output. The problem we are concerned with is the average amount of services shared by the users. A library will be Pareto optimal if no other library of smaller university size is providing more services. Note that as the size increases, the rate of increase in services need not be constant. The conventional ratio method (John Minster Associates 1989; Lynch 1979; Richard 1992) assumes a constant rate of increase, or constant returns to scale using the jargon of economic theory (Ferguson and Gould 1980). As a matter of fact, the assumption of constant returns to scale can be relaxed to a concept of decreasing and increasing returns to scale to account for more general cases. This idea can be illustrated by the following example.

Consider a case of five libraries using the number of volumes as the measure of services and the number of students as the size of the university. Table 1 contains some fictitious data and Figure 1 depicts the corresponding graph with students as the x -axis and services as the y -axis. Library A has the largest average number of volumes per student, namely, two units. Using the ratio method to determine the index for ranking, we divide the average number of volumes in each library by the largest average number of volumes. The results are shown in Table 1 under the heading "constant ratio." This method originated from

Table 1. Data and results of the example.

Library	No. Students	No. Vol.	Ave. Vol.	Const. ratio	ACRL ratio	Var. ratio
A	10	20	2	1	1	1
B	20	30	1.5	0.75	1	1
C	20	25	1.25	0.625	25/30	25/30
D	30	30	1	0.5	30/40	30/35
E	40	40	1	0.5	40/50	1

the concept of constant returns to scale, where, in this example, an extra student requires two more units of volumes to satisfy the demand from the students. The straight line *OA* passing through the origin and Library A in Figure 1 shows the expected amount of volumes for different sized universities. The observed number of volumes is compared with the expected amount to calculate the ratio. For Libraries A, B, C, D, and E, their expected number of volumes are 20, 40, 40, 60, and 80, respectively; therefore, their ratios are 1, 0.75, 0.625, 0.5, and 0.5.

In this example, using the idea stated in the ACRL (1986) *Introduction*, 20 units of volumes can be considered the minimum amount required for each library. For every extra student after the base amount of 10, one more unit of volumes (calculated as $[30-20]/[20-10]$) is required. The straight line *AB* shows the expected amount of volumes for different sized universities. The ratios shown in Table 1 under the heading "ACRL ratio" are the indices calculated based on this concept.

Under the concept of Pareto optimality, the ratio is allowed to vary in that piecewise line segments enveloping the observed data are sought. In this example, the line segments connecting A, B, and E represent the expected amount of volumes for different university size. Dividing the observed amount by the expected amount on the piecewise line segments yields the ratio for comparison. The ratios in the last column of Table 1 under the heading "variable ratio" are the indices calculated based on this concept. A decreasing return to scale is experienced. Since all observations lie below the straight line *OA*, the kinked line *OAB*, and the piecewise line segments *OABE*, they are called *frontiers*. The methodology for constructing the frontiers, known as data envelopment analysis (DEA), is the pioneer work of Charnes et al. (1978) using the assumption of constant returns to scale, later modified by Banker

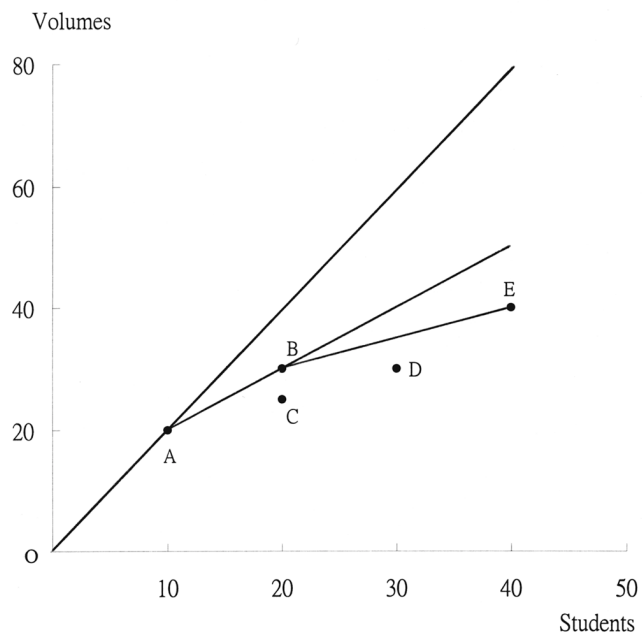


Figure 1. The expected number of volumes required by each library under different assumptions

et al. (1984) and Byrnes et al. (1984) to accommodate variable returns to scale.

Let T_i denote the amount of services and S_i the university size of the i th library. The ratio R_k of the k th library when compared with n libraries under the assumption of variable returns to scale can be calculated as:

$$\begin{aligned}
 R_k = \max. & \quad bT_k / (a + rS_k) \\
 \text{s.t.} & \quad bT_i / (a + rS_i) \leq 1, \quad i = 1, \dots, n \\
 & \quad b, r \geq 0, \quad a \text{ unconstrained in sign.}
 \end{aligned}$$

The rationale behind this model is as follows. Since different libraries may have different viewpoints concerning the increasing rate r and the minimum volume requirement v_0 , the DEA model allows each library to select the r and v_0 which are most favourable to them in calculating the ratio. Note that the denominator represents the expected amount of volumes for different size S_i . The minimal requirement v_0 for the minimal university size u_0 is replaced by a for university size 0, which is the intercept of a line (to conform to the conventional way of expressing lines). Parameter b in the numerator is a scaling factor for restricting the ratio of the observed amount to the expected amount to the range of 0 and 1. The constraints state that the parameters a , b , and r selected by the library being evaluated must not result in

ratios exceeding 1.0 when they are applied to all other libraries. No matter which library is to be evaluated, the constraints are the same, only the objective function is different.

In 1997, an attempt to compare the university libraries in Taiwan was initiated by the first author when he was the library director of National Cheng Kung University. The DEA methodology was adopted for making the comparison.

University libraries in Taiwan

Higher education in Taiwan has two tracks, one is academic and the other is occupational. After nine years of compulsory education, the academic track requires three years of high school education and four years of college education in general depending on the major, while the occupational track requires five years of professional training. Universities and independent colleges provide college education. A university must have at least three colleges each of which in turn must have at least three departments. An independent college is constituted by departments directly. Furthermore, independent colleges specialise in subjects such as medicine, engineering, business, and education, whereas universities provide a more comprehensive range of studies. In this sense, universities are more homogeneous in their objectives, regulations, and resources acquisition. In Taiwan, there are twenty-four universities and twenty-eight independent colleges, and we focus on the libraries of the twenty-four universities.

Kao et al. (1998) have ranked the twenty-four university libraries according to their total resources and services including collections, personnel, expenditures, buildings, and services. Each category is further divided into several sub-categories as follows.

- Collections: books, serials, microforms, audio-visual works, and databases.
- Personnel: staff and student assistants.
- Expenditures: capital expenditures, operating expenditures, and special expenditures.
- Buildings: area and seats.
- Services: range of services, communication channels, remote access, operating hours, attendance, circulation, amount of services, database searches, and secondary users.

Indicators have been devised for each category. To derive a composite index for each university library for ranking, Kao et al. (1998) asked the directors of the twenty-four university libraries to provide weights that represent the relative importance of each indicator. The observed value of each indicator is multiplied by its corresponding weight and summed over all the indicators to get a composite index for each university library. A standardisation that divides each value by the largest value in that indicator is applied to make different measures comparable. We call the value derived from the standardisation the service index because it represents the relative extent of services provided by the library. Table 2 shows the values of some important indicators and the service index for the twenty-four university libraries.

As far as university size is concerned, the major patrons that a university library is responsible to are the faculty and the students. The faculty is of two types: those who will give lectures, including professors, associate professors, assistant professors, and lecturers, and those who will not give lectures, including teaching assistants and laboratory technicians. We call the former faculty and the latter teaching assistants (TA).

Four types of students are categorised: doctoral students, master's students, undergraduate students, and students of extension programmes. Students of the last type have baccalaureate degrees. Table 3 lists the number of students and faculty of different types for the twenty-four universities. The weights representing the necessity of the library to each type of persons were solicited from the directors of the twenty-four university libraries. The undergraduate student is chosen as the numeraire, with a weight of 1. The averages of the weights calculated from the twenty-four directors are shown in the last row of Table 3. Multiplying the number of persons of each type by their corresponding weight and summing up over all types produces a number representing the number of undergraduate-equivalent (UE) students for each university. The number of UE students of each university is then divided by the largest value, i.e., 36886.2, which occurs at National Taiwan University, and then multiplied by 100 to obtain a standardised size index lying in the range of 0 and 100. The last two columns of Table 3 show the number of UE students and the size indices.

Table 2. Major services data of the twenty-four university libraries in Taiwan.

University	Volumes held	Current Serials (titles)	Perm. staff	Total expenditures (NTD \$1000)	Area (m2)	Attendance (persons/ week)	Service index
1. N Chi Nan U	55000	1302	5	11200	1267	207	21.27
2. N Dong Hwa U	48817	1124	7	18450	400	1500	19.72
3. N Kaohsiung Normal U	240984	2204	14	22175	6053	6165	26.11
4. N Yang Ming U	67112	974	8	14177	4212	2059	22.37
5. N Changhua U of Education	213740	1346	17	23613	10711	6327	32.81
6. N Chung Cheng U	316173	4217	20	76821	34128	5363	54.43
7. N Taiwan Ocean U	149862	1995	9	25915	6962	6050	26.90
8. N Sun Yat-Sen U	333105	3009	18	47176	17854	9202	38.68
9. Providence U	246128	1286	29	21465	7852	14546	36.61
10. N Tsing Hua U	424815	4520	24	72828	10648	18000	49.69
11. N Central U	365000	2760	19	43077	15000	7300	44.01
12. N Chung Hsing U	404231	3309	28	54045	18237	9778	44.99
13. N Chiao Tung U	385724	3293	11	51200	5941	9500	37.07
14. Soochow U	439808	2856	31	55790	8828	20692	42.74
15. Chung Yuan Christian U	249918	1986	21	33441	11294	9066	35.59
16. Tunghai U	360100	2157	32	33820	13435	20000	44.18
17. N Taiwan Normal U	960528	3026	46	18008	17800	5817	48.83
18. Feng Chia U	453439	2564	30	49210	13765	7950	48.87
19. N Cheng Chi U	1141861	6387	68	66706	24279	33333	68.37
20. N Cheng Kung U	741397	4023	47	87280	16500	19936	72.30
21. Fu Jen Catholic U	650852	2873	25	12254	17096	20115	43.99
22. Chinese Culture U	657980	872	25	*	3394	3702	36.64
23. Tamkang U	544780	3648	53	96923	24291	26949	59.10
24. N Taiwan U	1780185	11234	122	100217	30113	24078	97.51

* Data not available, the average from all other universities is used.

Table 3. Size indicators of the twenty-four universities in Taiwan.

University	Students				Faculty			UE Students	Size Index
	Doc.	Master	Under.	Ext.	Full-time	Part-time	TA		
1. N Chi Nan U	0	177	134	0	57	34	2	643.8	1.75
2. N Dong Hwa U	0	294	179	89	78	13	9	976.3	2.65
3. N Kaohsiung Normal U	81	290	2060	2396	220	83	33	4233.0	11.48
4. N Yang Ming U	312	498	1725	145	264	419	72	4570.2	12.39
5. N Changhua U of Education	94	223	3093	2543	297	83	15	5391.4	14.62
6. N Chung Cheng U	153	1068	2493	112	329	81	8	5827.1	15.80
7. N Taiwan Ocean U	86	723	3784	686	305	108	67	6474.7	17.55
8. N Sun Yat-Sen U	340	1364	2858	581	396	189	30	7655.6	20.75
9. Providence U	10	226	6400	3036	265	254	48	8767.0	23.77
10. N Tsing Hua U	823	1693	3490	0	484	190	12	10124.8	27.45
11. N Central U	460	1582	4711	0	431	247	70	10189.8	27.62
12. N Chung Hsing U	283	1512	5859	1769	633	193	72	11778.5	31.93
13. N Chiao Tung U	989	2254	4239	0	540	134	9	12442.7	33.73
14. Soochow U	67	655	8411	3719	361	726	114	12691.0	34.41
15. Chung Yuan Christian U	60	835	9433	2220	287	609	88	13242.8	35.90
16. Tunghai U	72	870	8951	3332	410	732	114	13650.4	37.01
17. N Taiwan Normal U	518	1167	5379	16184	709	311	120	16336.1	44.29
18. Feng Chia U	21	682	14131	2938	536	327	165	18135.0	49.16
19. N Cheng Chi U	598	2299	10249	1590	603	293	94	18443.4	50.00
20. N Cheng Kung U	809	2794	8055	2656	1036	255	142	19087.1	51.75
21. Fu Jen Catholic U	137	938	13728	4657	520	1005	179	19716.4	53.45
22. Chinese Culture U	91	926	14331	4471	586	1016	164	20279.8	54.98
23. Tamkang U	143	1618	14859	8114	628	571	205	23168.7	62.81
24. N Taiwan U	2231	4615	16586	1396	1840	981	255	36886.2	100.00
Weight	2.48	1.93	1.00	0.33	2.36	0.98	0.45		

Table 4. Rankings based on different assumptions.

University	Relative comparison		Absolute comparison		Ratio comparison	
	Score	Ranking	Service index	Ranking	Score	Ranking
1. N Chi Nan U	100.00	1	21.27	23	100.00	1
2. N Dong Hwa U	83.42	6	19.72	24	61.23	2
3. N Kaohsiung Normal U	61.31	18	26.11	21	18.70	4
4. N Yang Ming U	49.76	22	22.37	22	14.91	7
5. N Changhua U of Education	63.02	16	32.81	19	18.46	5
6. N Chung Cheng U	100.00	1	54.43	5	28.34	3
7. N Taiwan Ocean U	48.51	24	26.90	20	12.61	11
8. N Sun Yat-Sen U	67.87	13	38.68	14	15.32	6
9. Providence U	62.55	17	36.61	17	12.69	10
10. N Tsing Hua U	82.72	7	46.69	6	14.01	8
11. N Central U	72.64	9	44.01	11	13.10	9
12. N Chung Hsing U	71.83	10	44.99	9	11.62	12
13. N Chiao Tung U	58.23	20	37.07	15	9.06	18
14. Soochow U	67.14	15	42.74	13	10.22	15
15. Chung Yuan Christian U	55.02	21	35.59	18	8.16	20
16. Tunghai U	67.76	14	44.18	10	9.72	16
17. N Taiwan Normal U	70.98	11	48.83	8	9.06	17
18. Feng Chia U	68.49	12	48.87	7	8.19	19
19. N Cheng Chi U	95.13	5	68.37	3	11.29	14
20. N Cheng Kung U	99.19	4	72.30	2	11.53	13
21. Fu Jen Catholic U	59.93	19	43.99	12	6.76	23
22. Chinese Culture U	49.23	23	36.64	16	5.52	24
23. Tamkang U	75.25	8	59.10	4	7.75	22
24. N Taiwan U	100.00	1	97.51	1	8.07	21

There is a clear gap between the largest university and the second largest university, i.e., Tamkang University, which is 62.81% of the largest size. There are two very small universities, namely, National Chi Nan University and National Dong Hwa University, with less than five hundred students. This is because they are newly established and will grow rapidly in the next five to ten years. Figure 2 depicts the twenty-four university libraries with their size indices along the x-axis and their service indices along the y-axis.

The amount of services expected to be provided by the libraries of different university size are the line segments connecting Library 1, Library 6, and Library 24, called the service frontier because all observations lie below it. The observed amount of services of each university divided by its expected amount of services is a relative score for ranking university libraries. In contrast to an absolute score, a relative score takes into account the size of the university. The study of Kao et al. (1998) is an absolute comparison since it looks at the total amount of services provided by a university library without considering university size. By applying the DEA model introduced in Section 2 and multiplying the re-

sult by 100, we can calculate the relative score of each university library as shown in Table 4 under the heading “relative comparison: score.”

Three university libraries (National Chi Nan University, National Chung Cheng University and National Taiwan University) are Pareto optimal with a relative score of 100. Libraries of National Cheng Kung University and National

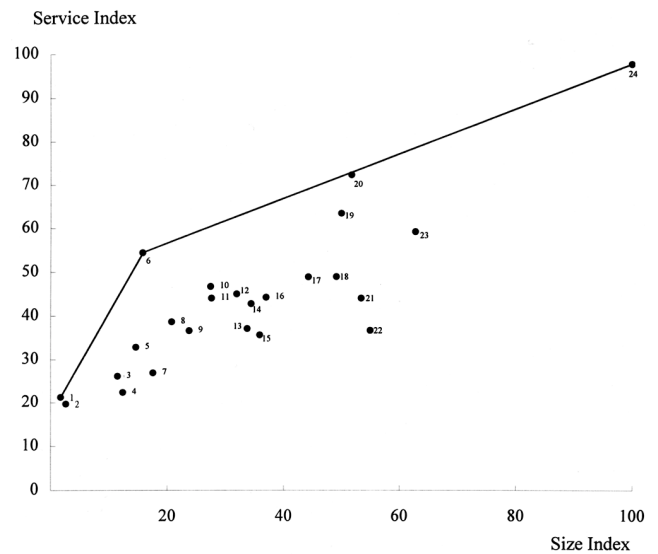


Figure 2. The service frontier of the twenty-four university libraries

Cheng Chi University have relative scores of 99.19 and 95.13, respectively, which are close to Pareto optimal. For the others, the scores are more or less evenly spread between 48.51 and 83.42.

The service frontier shows the amount of services that a university library should provide according to the current size of the university. As a university increases its size, the services provided by its library are expected to increase as well. However, from Figure 2 it can be seen that the rate of increase is decreasing. In other words, as the university increases its size, the additional amount of services required can be increased at a slower pace. In particular, as the university size increases from a size index of 0 to 1.75 – the size of National Chi Nan University – the service index increases from 0 to 21.27, with a rate of increase of $21.27/1.75$ or 12.16. When the size index increases from 1.75 to 15.80 – the size of National Chung Cheng University – the service index increases from 21.27 to 54.43. The rate of increase is $(54.43-21.27)/(15.8-1.75)$ or 2.36. Finally, when the size increases from 15.80 to 100 – the size of National Taiwan University – the service index increases from 54.43 to 97.51. The rate of increase is $(97.51-54.43)/(100-15.8)$ or 0.51. The rate of increase decreases from 12.16 to 2.36 to 0.51 respectively. This illustrates the well-known diminishing principle in economics. Initially a university library needs a fixed yet relatively large amount of collections, buildings, expenditures and the like to service its patrons. As the university increases in its size, the initial large amount of resources reduces the requirement for additional resources to service the increasing number of patrons.

Discussion

The major difference between this study and conventional studies in comparing university libraries lies in the fact that university size is being taken into account. Moreover, the rate of increase for the amount of services provided by the library as the university increases in its size is variable rather than constant. This makes comparison of university libraries from different sized universities more reasonable from the viewpoint of Pareto optimality, especially for very large universities.

The study of Kao et al. (1998) is an absolute comparison, in that the total amounts of services

are compared. Under such comparison, large universities are favoured because they have more resources allocated to the library. This effect can be seen in Table 4 which shows the service indices and the associated rankings of the twenty-four university libraries under the column titled “absolute comparison: ranking.” As expected, libraries of large universities, in general, have higher ranks. Note that the universities in Table 4 are arranged in ascending order of their size. On the other hand, the rankings of the libraries based on the idea of Pareto optimality as shown in the column titled “relative comparison: ranking” in Table 4 indicate that they are somewhat independent of the university size. A library need not affiliate with a large university to be Pareto optimal or close to Pareto optimal. This is very encouraging for libraries of small universities. Two prominent cases are the two smallest universities, namely, National Chi Nan University and National Dong Hwa University. Under absolute comparison, their ranks are 23 and 24, while under relative comparison their ranks are 1 and 6, respectively.

To compare university libraries of different sized universities, one method generally adopted is the ratio method used to calculate and rank the average amount of services shared by the patrons (John Minster Associates 1989, Lynch 1979, Richard 1992). In principle, this method is suitable only for universities of similar size. However, the word “similar” is vague semantically. Suppose this condition is neglected, then the ratio of the service index to the size index for the twenty-four university libraries can be calculated in a straightforward manner. To grasp some idea of the relative size of this ratio, each ratio is divided by the largest ratio and multiplied by 100 so that the resulting value lies between 0 and 100. This ratio of ratios, which is noted as the “ratio score” in Table 4, is then used for ranking.

Compared with the relative scores calculated from the DEA model of this study, the ratio scores are much smaller. This is because the concept of ratio score is equivalent to assuming the service frontier as a straight line passing through the origin and Library 1, National Chi Nan University Library, which is the library with the largest ratio score. Since this straight line is above the frontier constructed from the DEA model, the ratio scores are smaller than the relative scores. For universi-

ties with their size much larger than that of National Chi Nan University, the differences between the relative scores and the ratio scores become larger. Apparently, the ratio method disfavors libraries of universities with a size much larger than the university with the largest ratio score. For instance, the libraries of the four largest universities have the lowest ranks as shown in the last column of Table 4. In fact, the very small university, National Chi Nan University, has distorted this result. As mentioned earlier, for the ratio method to be used properly, the universities should be grouped according to their size. Using the size indices in Table 3 or the position of the twenty-four libraries in Figure 2, four groups emerge: the two smallest universities; universities 3-9 with size indices from 11.48 to 23.77; universities 10-16 with size indices from 27.45 to 37.01; and universities 17-23 with size indices from 44.29 to 62.81. Comparison of university libraries in the same groups will then be appropriate. The service frontier in this case will have a stair-step shape over all observations.

Conclusion

Evaluating university libraries is a very complicated task since many factors are involved. Simplifications and assumptions must therefore be made to make the task feasible. We use the composite index developed by Kao et al. (1998) from a weighted average of collections, personnel, expenditures, buildings, and services to represent the general services provided by the twenty-four university libraries in Taiwan. Since libraries of smaller universities have fewer patrons to serve, we can take university size into account to give the libraries a fair judgement. Moreover, we assume that the rate of increase for services with respect to university size is variable thus, giving the libraries of large universities a fairer judgement.

With these two factors taken into account, a DEA model based on the concept of Pareto optimality is developed to calculate the ratio of the observed amount of services provided by a university library to its expected amount of services estimated from the sampled libraries for comparison. The university size is represented by a weighted average of different types of faculty and students. Our empirical study of the twenty-

four university libraries in Taiwan reveals that the ranking based on the total amount of services provided by the library without considering the university size will understate the performance of the libraries of small universities. The rate of increase for services with respect to university size is found to be decreasing. Consequently, the ratio method based on the assumption of a constant rate of increase for services understates the performance of the libraries of large universities. The difference between 100 and the relative score calculated from the DEA model is the extent that the resources and services provided by a library need to be improved to reach Pareto optimality

To conclude, the comparison method that takes the university size into account is appropriate for libraries of small universities. It is also appropriate for libraries of large universities because it allows the rate of increase for services to decrease with respect to university size.

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