



Library performance management in Rio de Janeiro, Brazil

Library
performance
management

Applying DEA to a sample of university libraries in 2006-2007

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Abstract

Purpose – This paper intends to illustrate an application of data envelopment analysis (DEA) to assess library performance from an efficiency standpoint.

Design/methodology/approach – DEA modeling was applied to a convenience sample of 37 libraries affiliated to a federal university in Rio de Janeiro. Data were collected from the university's managerial database and refer to three inputs – number of employees, area and number of volumes – and four outputs – consultations, loans, enrolments and (user) traffic. Markovian analysis of transitions between efficient and inefficient states along time allowed a long-term distribution between those states to be computed.

Findings – The retained DEA model provides a list of estimated scores that quantify efficiency status for each library unit and from which both rankings and operation plans can be determined for each unit to assist managers in their quest for library efficiency. In fact, (re)allocative measures, expressed as operation plans, indicate that, for each unit, some input(s) may be decreased and nonetheless some output(s) will increase. Those indicators may also be used to further or avoid either promised or planned changes.

Originality/value – As long as the efficiency principle is accepted the paper provides a three-step procedure whereby any set of library units may be simultaneously assessed and ranked in relative terms and a set of quantitative operation plans may be used to (re)direct inefficient units toward efficiency. Whenever historical (e.g. annual) data are available, more adequate long-term efficiency profiles will be computed, as well as some (e.g. yearly) durations relating to time spent in or before visiting (in)efficiency states. This model, combining short- and long-term assessment, may be seen as a novelty contributed by the paper.

Keywords Library management, Performance assessment, Performance appraisal, Efficiency analysis, Data envelopment analysis, Academic libraries, Brazil

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1. Introduction

When one considers the characteristics of the decision-making process in the so-called managerial public administration model, it can be concluded that:

- in terms of managing by results, the extent to which efficacy varies may be taken as an indicator of organizational adaptation to change; and
- this adaptation can be measured in terms of the evolution of both social efficacy and efficiency scores along time.

Therefore, systematic performance assessment, through monitoring and evaluation, contributes to improved management since it produces the information needed to understand the reasons for success and failure.

In this paper, efficiency scores for the years 2006 and 2007 are first calculated and compared for a sample of 37 academic libraries pertaining to a public university in Rio de Janeiro. In order to reach the research objective one more step is accomplished in order to determine which quantitative actions might be proposed to managers so that a library eventually classified as “inefficient” could be displaced towards the group of efficient units.

The text is organized in to five sections. In the second section the elements composing the analytical framework on which the research is grounded are presented, followed by the methodology adopted, in the third section. Results are presented in the fourth section, whereas some conclusive comments are gathered in the last section.

2. Background

2.1 Performance management in public organizations

The definition and maintenance of a system of efficiency and efficacy indicators for public organizations present challenges and difficulties associated with three traits that characterize such organizations and that, at the same time, illustrate the complexity of their study, namely:

- (1) Public organizations use multiple inputs and work under budget constraints, so that it makes full sense to evaluate the use of resources that are both diversified and limited.
- (2) Public organizations provide services for which “market prices” seldom exist that would signal “optimal” allocations of resources.
- (3) Public organizations are multi-purpose and multi-product endeavours, so that there are not only difficulties for result measurement, but also for tackling the issue of suboptimization due to coordination gaps.

In day-by-day public administration all those complexities often converge as to intimidate managers to the extent that their belief in the possibility of a satisfactory analytic approach to support performance assessment for public organizations becomes doubtful. Accordingly, those managers end up succumbing to the seduction of macro arguments, then forgetting their own managerial needs in meso or micro terms (Vakkuri, 2003).

2.2 Performance management in public libraries

Public libraries – including general, university and school libraries across government levels – present the same three traits previously highlighted:

- (1) They use multiple inputs – such as employees, collections of printed or audiovisual material, and a physical area – and operate under budget constraints.
- (2) In general, “market prices” do not exist for some of the multiple products and services provided, in spite of the enormous development experienced for some years now by sectors producing “informational services”.
- (3) They are multi-purpose organizations, with their mission including themes of high social meaning, beside typical micro-organizational questions.

Successive reforms on educational systems have never prioritized reading or libraries. Hence, in spite of the full social meaning of libraries, it is evident that not even its prominent role was enough to justify an appropriate allocation of resources. Up until the time he wrote, Suaiden (2000) argued, there were no indicators proving the efficiency of public libraries in Brazil. As far as efficacy is concerned, he points out (Suaiden, 2000, p. 56), it was only in the 1970s that user research gained momentum. Stressing the idea that proximity was the basic requirement for library use in many countries, one of the answers to non-use took shape in the slogan “In each municipality a library”. So what should be done in the case of demographic and territorial characteristics such as those prevailing in Brazil?

In technical jargon, services, products and collections have quite specific characteristics in the case of public academic libraries. Due to these specific characteristics and spatial scope, the objective of this paper is much simpler management of public academic libraries. In Brazil, the recognition of academic libraries’ importance is not new and today it is practically unanimous, even in institutional terms (see, e.g. Lemos, 2001, p. 1). However, in spite of their much more specific attributes, public academic libraries are also confronted with the aforementioned three analytical issues. In fact, there persist both micro- and macro-organizational questions. Even though these managerial challenges are much more restricted in scope, they are far from trivial, even for academic libraries in developed countries. For example, Cullen and Nagata (2008, p. 163) state that, in Japan, notwithstanding being well-equipped and recognized as an important support to national research capability, academic libraries still reflect, in several ways, the strongly bureaucratic culture of that country.

Following international trends (see, e.g. Balagué, 2007), focus on efficacy is also much more common in Brazil, both in what refers to user studies (see, e.g. Cullen, 2001; Aabo, 2005), as well as to quality research (Amboni, 2002; Rebello, 2004; Valls and Vergueiro, 2006).

According to Favret (2000, p. 341), in the UK there exists a long tradition of efficiency measurement and assessment in public libraries, especially in terms of the so-called benchmarking approach, presented and discussed by the Favret himself and by Laeven and Smit (2003). In Brazil, in contrast to international trends, research on efficiency assessment in public libraries is scant. The benchmarking approach, although previously reviewed by Suaiden and Araújo (2001), only came to be effectively applied later (Maciel Filho *et al.*, 2004). In addition to benchmarking, the international literature includes other alternatives for organizational performance analysis (Aabo, 2005; Holt, 2007; Maciel Filho *et al.*, 2007).

As long as the public manager is concerned, those approaches mostly suffer from an extremely perverse limitation: because of their focus on each separate organizational unit, they hinder systemic comparison among organizational units.

Stemming from a long (see Emrouznejad *et al.*, 2008) but much ignored analytical tradition, the pioneer Mary Susan Easun (1992, 1994) and later Chen (1997a, b), and Vitaliano (1998) can be considered the precursors in the application of DEA to library assessment. Ever since the international literature has kept growing, especially in the case of academic libraries (Reichmann and Sommersguter-Reichmann, 2006; Stancheva and Angelova, 2004). In the Brazilian case, only a single application of DEA to library assessment has been identified, due to Pereira and Bueno (2005).

2.3 Efficiency as an organizing principle

In association with the efficiency principle there corresponds an approach to organizational analysis whose basic feature refers to “optimally using resources to produce goods or services”. In this simple framework it is equally accepted as virtuous any productive process allowing the production of more output with the same resources or the production of the same output with less resources. This is the basic principle of efficiency, undeniably attractive for any organization having to employ limited resources, particularly for public organizations.

3. Method

3.1 Data envelopment analysis

The efficiency of productive units can be calculated by means of a deterministic production frontier whose construction process is implemented by formulating and solving a linear programming problem (Coelli *et al.*, 1998). This procedure, known as data envelopment analysis (DEA), was initially introduced in the literature by Charnes *et al.* (1978) and later modified by Banker *et al.* (1984). The most important difference between those two models is the possibility of treating scale economies. The Banker, Charnes and Cooper model (BCC model), used in the present paper, allows the calculation of a deterministic production frontier with variable returns to scale, whereas the Charnes, Cooper and Rhodes model (CCR model) assumes constant returns to scale.

DEA may be applied under varied forms, but it is always used to assess productive efficiency of individual decision making units (DMUs) that use multiple inputs to obtain multiple outputs. Therefore it has been particularly used to evaluate several types of public organizations, such as schools, hospitals and military units or systems, with each unit being properly understood as an example of “complex organizations” (Emrouznejad *et al.*, 2008). This flexibility in the use of DEA comes from the fact that no previous definition of a functional form for the production function is needed, which is in contrast to parametric approaches to library assessment (Vitaliano, 1997).

Among DEA features that are of interest for the assessment of public organizations operating under budget constraints one may highlight the flexibility of the method. It is worth pointing out that the direct use of flexibly measured inputs and outputs discards the need to define or redefine “performance indicators” such as those frequently found in the literature.

The computed efficiency values are not absolute, as they take into account the relative positions among several DMUs. By so doing DMUs located in the frontier will be “relatively more efficient” and the extent to which an inefficient unit deviates with respect to that empirically observed frontier would in turn be its inefficiency measure. In this paper version 2.1 of DEAP® – Data Envelopment Analysis (Computer) Program was used to calculate the production frontier by means of DEA. The computed models also provide production targets – to be called operation plans – to be reached by inefficient productive units in order to become efficient (Marinho, 2001).

Since two years of observations were available, it was possible to investigate the temporary evolution of the evolutionary process that separates the efficient units from the inefficient ones. Assuming the Markovian hypothesis (Kemeny and Snell, 1972), expressed as the transition matrix between “efficient” and “inefficient” states along the two years, and using the concept of equilibrium distribution, the long-term percentage distribution of the units between these two states can be determined (Kemeny and Snell, 1972, p. 131).

3.2 Data collection

The population is formed by the group of units composing an integrated system of libraries in a public university in Rio de Janeiro. Access and time issues associated with data collection led to the consideration of a sample of 37 libraries, representing some 90 per cent of the universe.

Data were collected from the managerial database created and maintained in the university as an integrated system with the purpose of monitoring performance. Following Pereira and Bueno (2005) and considering available data, two years were chosen – 2006 and 2007 – for data collection. For each year, three inputs – namely, Number of employees, Area (in square meters) and Volumes – and four outputs – Consultations, Loans, Enrolments, and User Traffic – were considered. Furthermore, some demographic data were collected (for instance, library’s age in years or geographical location).

4. Results

4.1 Library classification according to efficiency

The main results of the paper, empirically supporting all the others, appear in Table I with the efficiency scores, for each library and each year, computed from a product-oriented, variable returns to scale DEA model. Since by definition the efficient scores are all equal to 1, Table I shows only the inefficient scores in some of the two years, decreasingly ordered for 2006. According to the theoretical model, scores equal to 1 represent (relatively) efficient units. The (relatively) inefficient units receive scores below 1. Table I also displays the time change in efficiency, indicating, on the one hand, that there were both efficient (16) and inefficient (14) units that stayed in the same state along the two years. On the other hand, there were changes from one condition to another between 2006 and 2007: four efficient units in 2006 turned into inefficient in 2007, whereas three units went the opposite way in the same period.

If one considers “efficient” and “inefficient” as two possible states for any library and then makes use of the data in Table I, the matrix P of (yearly) transition probabilities between states can be written. Adopting the Markovian hypothesis that, over time, the transition probabilities between states depend only on the previous state,

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Table I.

Scores and efficiency
ranking – 2006 and 2007

Unit	Scores 2006	Rank 2006	Scores 2007	Rank 2007
18	0.807	23	1.000	1
22	0.680	25	1.000	1
34	0.626	27	1.000	1
13	1.000	1	0.945	20
31	1.000	1	0.921	21
11	0.384	33	0.863	22
20	1.000	1	0.820	23
5	1.000	1	0.679	24
32	0.548	28	0.650	25
24	0.847	21	0.646	26
25	0.466	31	0.624	27
30	0.775	24	0.574	28
35	0.543	29	0.560	29
6	0.640	26	0.506	30
4	0.401	32	0.381	31
15	0.328	34	0.370	32
28	0.319	35	0.320	33
7	0.496	30	0.241	34
19	0.842	22	0.121	35
2	0.145	36	0.115	36
26	0.010	37	0.017	37

we can compute the long run percentage distribution of the libraries in each of the two states (Kemeny and Snell, 1972, p. 131). The long run distribution is the line vector π whose elements add to 1 and satisfying the matrix equation $\pi P = \pi$, so that:

$$\pi_E \text{ (percent of efficient)} = 46.9\%; \pi_{NE} \text{ (percent of inefficient)} = 53.1\%.$$

4.2 Efficient operation plans

The yearly allocative changes that allow to movement of each inefficient unit to an efficient position are shown in Table II for the year 2006; the case for 2007 is identical.

It is worth pointing out that there are many indications of change in the amounts of inputs, which suggest the optimality of reducing them while increasing efficiency; this kind of conclusion would hardly be reached in the absence of a DEA model. Staff reductions prevail in the table; in the public service this may simply mean that it is sufficient to relocate employees and increase output all the same. In order to get rid of public managers' eventual discomfort in such situations, it is worth reminding that this relocation can be internal, given that not all internal activities are related to the production of the four services here adopted as outputs. Another outstanding feature of the tables is that there are many ways whereby output increase is possible.

Indications of volume decrease, technically called disposal, deserve attention because disposals are not a simple matter of numerical decrease since there are collections that just cannot be broken or interrupted, as well as there being volumes and titles that must be maintained for some specific reason. Anyway, the findings point to the fact that managers need be alert and perhaps more proactive in their disposal initiatives.

UNIT	ENROLLMT_2006	LOANS_2006	CONSULT_2006	TRAFFIC_2006	EMPLOY_2006	AREA_2006	VOLUMES_2006
2	1156	3470	7334	57638	-1	0	0
4	2027	21821	16189	79024	0	-1996	-11160
6	1440	8752	9687	54047	0	-19	-48235
7	1265	2866	5346	29325	0	0	-55046
11	1584	4200	6263	55316	-3	0	0
15	504	2979	7247	14416	-1	-98	0
18	108	264	551	14868	0	0	-1705
19	322	918	2043	4498	0	0	-7740
22	855	2910	4907	23276	-6	0	0
24	386	1297	9298	16247	0	0	-12400
25	905	3817	12086	66410	0	0	-10612
26	1408	4135	24122	49026	0	0	-22759
28	1228	4661	12370	74643	0	-21	0
30	369	2589	2869	18800	-6	0	0
32	879	2544	5889	87109	-3	-134	0
34	620	1039	2684	51074	-2	-458	0
35	609	1447	5548	41238	0	-523	-5012

Table II.
Operation plans – 2006

The comparison with actual data for 2007 shows that the adoption of input changes consistent with the signalling from computed operation plans was practically nonexistent. Actually there were many cases of a significant increase between the two years, very likely thwarting the search for efficiency.

5. Conclusions

First, note that computed scores may be deemed as relatively “benevolent”, since there are as many efficient units (20 and 19, in 2006 and 2007) as inefficient ones (17 and 18, in 2006 and 2007). This conclusion might have been made clearer if more contextual information had been gathered or introduced. For instance, if the sample includes some very singular units –, e.g. a research library that does not make loans – then it is very likely that any other library providing loans would be ranked as efficient relative to the singular one. Anyway, although the exclusion of units from a sample of DMUs could improve the consistency of the exercise, it surely should not happen without the consent of the involved manager. In addition, to the extent that singular and non-singular might be competing for the same budget, then the mix should be kept.

On adopting the Markovian hypothesis and computing the long-term percentage distribution of libraries in each of two efficiency states, it can be concluded that there is a slight movement towards the increase of systemic inefficiency, if no initiative is taken in managerial terms.

Data and results reveal a high potential of overall increase in output. As argued by Pereira and Bueno (2005), the appropriateness of changes prescribed in optimal operation plans is guaranteed as they have been computed from actual data relating to observed performance of sampled units, as opposed to being based on either external data or proposals of intended action.

The allocative indications contained in the efficient operation plans were practically ignored in the sampled units. In comparison to observed data, there were no changes in inputs that might be considered similar to the signalling from computed plans. On the contrary, there were many cases of significant increases between the two years. Those results show that managers need to be alert to such perverse results.

The existence as well as the seemingly persistence of technical inefficiency among sampled libraries indicates the need for more studies tackling the issues of volume disposal and replacement, of developing and renewing collections and, especially, of human resource management both at the unit and the system levels. The use of DEA revealed a potentially useful instrument to support managers in the ranking and classification of libraries according to their performance, while, at the same time, supplying quantitative targets for performance improvement in each unit pertaining to the system of public libraries in the selected university. Admittedly, the present case served only as an empirical excuse so that no special difficulty is to be expected in terms of hindering its replication in other organizational systems in the public sector.

In terms of Brazilian literature and of national practices prevailing in the library sector, the present study confirmed the conclusion of Pereira and Bueno (2005), who stated that academic references to and practical evidences of modern performance management models are still lacking in public libraries, in contrast to actions and intentions of an essentially bureaucratic nature. In other words, it is likely that Brazilian public libraries remain linked to the paradigm of bureaucratic management, while still awaiting the implementation of genuinely managerial mechanisms and procedures.

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