DEVELOPING A COMBINED QUANTITATIVE BENCHMARKING SYSTEM FOR THE PERFORMANCE OF LOCAL HEALTH AUTHORITIES: THE CASE OF THE TUSCANY REGION IN ITALY

Sabina Nuti, Cinzia Daraio, Chiara Speroni, Milena Vainieri
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Sabina Nuti*, Cinzia Daraio°, Chiara Speroni*, Mile na Vainieri*

* Laboratorio Management e Sanità (MeS) - Scuola Superiore Sant'Anna di Pisa

° University of Bologna, CIEG Department of Management, Bologna

Corresponding Author’s address:
*Laboratorio Management e Sanità - Scuola Superiore Sant'Anna,
Via S. Francesco, 18 56127 PISA – Italy
Tel. (39 +) 050 88 3871/3878/3864
Fax: (39 +) 050 883890
Email: direzionemes@sssup.it
Web site: http://www.meslab.sssup.it/_sito/

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Please quote this way:
Abstract

This paper proposes an integrated quantitative benchmarking approach for the measurement of the performance of Local Health Authorities (LHAs). It is based on a sound balanced scorecard approach developed and implemented in the Tuscany Region by the Management and Health Laboratory of Sant'Anna School combined with a bias corrected measure of technical efficiency, estimated using a bootstrap based Data Envelopment Analysis. The empirical results show that the typical LHA in Tuscany experienced 14% bias-corrected inefficiency in 2007. Using correlation analysis and mapping quadrants, the paper shows the relationships among technical efficiency and quality and appropriateness as well as analyses the impact of organizational factors on the performance of LHAs. Finally, this combined benchmarking approach is illustrated as a useful and important managerial tool both for regional and local authorities.

JEL Classification: C, I.

Keywords: appropriateness, bias correction, data envelopment analysis, local health authorities, performance evaluation system
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Introduction and new contribution

It is widely believed that costs of the Health care sector in most developed countries have greatly increased during the last decades. Hence, the measurement of the performance and the management of the efficiency of Local Health Authorities (LHAs) has become more and more crucial in the present period of economic recession that imposes budget constraints asking at the same time for appropriate and qualitative services, in order to achieve the mission of the health care system.

On the one hand, during the last twenty years, several performance evaluation systems have been developed and applied to the evaluation of the health care system, extending the balanced scorecard proposed by Kaplan (1992, 1996).

On the other hand, the efficiency analysis literature has grown in the last years and has addressed the empirical measurement of efficiency in health care institutions around the world: recent surveys include Hollingsworth (2003) and Worthington (2004).

In particular, Worthington (2004) notes that only 5% of the studies searched in the literature are based on teaching hospitals or on Local Health Authorities (LHAs). Moreover, the literature has been essentially concerned with US, UK and Northern European institutions, whilst only few empirical studies have analysed the Italian Health care system, and most of them have focused on hospitals as decision making units, DMU, (see e.g. Cellini, Pignataro, Rizzo, 2000; Barbetta, Turati and Zago, 2007). In addition, to the best of our knowledge, none of the studies in the literature have analysed LHAs integrating their technical efficiency within managerial tools used by regional health policy makers. Finally, there is a lack in the literature of papers that deal both with balanced scorecard systems and technical efficiency methods.
One exception is Banker et. al. (2004) that analyses the telecommunication industry in US.

The contribution of the paper is twofold. Firstly, from a methodological point of view, the paper overcomes the following traditional problems of DEA that consist in its ‘deterministic’ nature (meaning that all deviations from the efficient frontier are due to inefficiency and no consideration for noise and bias is allowed) and its ‘curse of dimensionality’ (shared by most nonparametric methods, that requires a lot of observations in order to characterize with statistical precision the efficient frontier). At this purpose the paper applies the bootstrap to estimate bias corrected DEA efficiency scores (Simar and Wilson, 1998), putting the DEA in a statistical framework, facing its deterministic nature; and it uses a factorial approach to aggregate the outputs and then to face its curse of dimensionality (Daraio and Simar, 2007). Finally, the paper integrates the bias corrected technical efficiency scores of LHAs within a sound balanced scorecard system (Nuti, 2008) using correlation analysis and mapping quadrants.

Secondly, from an empirical point of view, the paper adopts an original way to select the input/output framework, based on the discussions held with the CEO of the LHAs, addresses the specificity of the measurement of efficiency in health care and illustrates the trade-off that clearly exists between appropriateness and quality of care and technical efficiency. Ultimately, the paper sheds some lights on the role of organizational aspects -very often neglected in DEA applications- in the process of performance improvement given the crucial importance of the “organizational readiness for change” in the health care sector, as pointed out by Weiner, Amick and Lee (2008).

As a matter of fact, the main research questions addressed in the paper are:
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a) the measurement and comparison of the (bias corrected) technical efficiency scores of the Tuscan LHAs using a sound DEA approach that overcomes some of its limitations.

The efficiency analysis approach, using quantitative methods, offers a synthetic measure of the performance (the technical efficiency scores) related produced volumes, however it does not provide information about the fulfilment of the mission and the quality or appropriateness of the supplied services; for that reason we combine this quantitative approach with other indicators monitored by the comprehensive Tuscan performance evaluation system, using correlation analysis and mapping quadrants and address the following further questions:

b) the investigation on the relationships among technical efficiency scores and the indicators monitored by the comprehensive Tuscan performance evaluation system, including quality and appropriateness;

c) the investigation on the existence of any correlation between technical efficiency and organisational factors that characterize health institutions.

The paper unfolds as follows. In the next section we introduce the Tuscan health care system and its performance evaluation system. After that we introduce DEA and the bootstrap based approach followed to estimate the technical efficiency of the Tuscan LHAs. Then we report the empirical results of the analysis carried out and the final section concludes the paper.

The Tuscan performance evaluation system

The Tuscany Region in Italy, with its 3.6 millions of inhabitants, spends in public healthcare about 6.1 millions of Euro, more than the 70% of the global regional expenditure in 2007.
The regional government works through a network of sixteen public health authorities among which four are teaching hospitals, integrated with the Universities of Florence, Pisa and Siena (two in Florence, one in Pisa and one in Siena) and twelve are Local Health Authorities (LHAs). LHAs are responsible for providing services to the population living in their area regarding:

- prevention, including the fields of veterinary care, public health and hygiene, sports medicine, and legal medicine;
- district healthcare, including primary care and paediatrics, diagnostic and outpatient activities, as well as all services coordinated by the districts (Drug department, Handicap, adults’ and children’s mental health …);
- Hospital services, including community hospitals, hospices, rehabilitation and long care hospitals.

In its last Regional Health Plan the Tuscany Region lays down the objectives, values and operative principles of the Tuscan health Service, irrespective of their social class. The plan proposes the following main qualifying points:

- Quality evaluation through measurable health outcomes and outputs;
- Proactive programmes in primary care to assure equity to assure equity and care for chronic disease;
- Empowerment of local communities, citizens and patients;
- Efficiency and productivity to allow financial sustainability.

To achieve these goals, in order to sustain, assess and improve the action of its health authorities, since 2002 the Tuscany Region has been planning a system to monitor their performance in order to reach the regional strategic objectives.
The Tuscan performance evaluation system took inspiration by the balanced scorecard introduced in Ontario since 1998 (Baker & Pink, 1995; Pink et al., 2001; Baker et al., 1999). It was developed by using principles expressed in the Regional Health Plan of Tuscany of 2004-2004 and its following re-releases.

The system consists of 50 measures, made up of more than 130 indicators, classified in six dimensions of assessment:

– Population health outcomes;

– Regional strategy, to guarantee that strategic regional goals are pursued in the time and manner indicated;

– Quality, appropriateness, effectiveness, clinical risk management and managing supply to match demand;

– Patient satisfaction, the patients’ experience and level of satisfaction with health services;

– Staff satisfaction, results of surveys on the satisfaction level of staff with their working conditions and management;

– Financial performance.

The system is now patented in Europe\(^1\). It is applied also to specific pathways such as the maternity one (Nuti et al. 2009), and also, since 2008, in other 3 Italian Regions (Piedmont, Liguria and Umbria). Since 2005, when the system was implemented in all Tuscan LHAs, it has been used as an important managerial tool both for the regional and local level. It highlights through benchmarking the best practices and the critical issues for each Local Health Authority and it is integrated with the CEO rewarding system.

\(^1\) European patent n° 0001358839 Multidimensional performance evaluation system, released on 10 April 2009.
Table 1 shows the scores of the Tuscan Performance Evaluation system.

In the following Figure 1 two targets of LHAs (LHA 8 on the left, LHA 1 on the right) are illustrated. Note that in Figure 1 'Red' is the more external circle whilst 'Dark green' is the central circle.

Figure 1 LHA8 (on the left) and LHA1 (on the right) targets

In this context the efficiency analysis approach may effectively be combined with the detailed and comprehensive performance evaluation system implemented at the Tuscany Regional Government.

The two approaches, in fact, are complimentary.

The Regional Performance evaluation system (using an high number -around 130- of quantitative indicators) gives an in-depth high
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level of details on the multidimensional aspects of the performance achieved by the regional health care system. The efficiency analysis approach (using quantitative methods) offers a synthetic measure on the whole performance and is able to shed light on the factors which are most correlated to the technical efficiency by using mapping quadrants which show clusters of LHAs, according to their patterns and the external environmental variables included in the analysis. That is why, from a methodological point of view, we propose the introduction of the technical efficiency measure within the performance evaluation system. This combined approach is followed in the empirical application section, whilst in the next section we describe the efficiency analysis approach applied to estimate the technical efficiency scores.

Measuring the technical efficiency of LHAs: a bias corrected DEA approach

The main aim of the efficiency analysis literature is to estimate an efficient frontier (a kind of frontier of the best practice) that characterizes the multi-input multi-output process of a group of DMU and then measuring the distance of each DMU from this estimated frontier. Within this literature, the nonparametric approach has received a considerable amount of interest because it is based on few assumptions and it does not require the specification of a functional form for the frontier. Especially Data Envelopment Analysis (DEA, Charnes, Cooper and Rhodes, 1978) is among the most known and applied nonparametric method for measuring efficiency in production and services activities.

DEA constructs a non parametric envelopment frontier and being nonparametric does not require any assumptions on the functional form of the frontier. The activity of a DMU is characterized by a set of inputs
used to produce a set of outputs $y_k \in \mathbb{R}^q_+$. In order to estimate the efficient frontier we assume that the set $\psi$ of technically feasible combinations of $(x,y)$ exists, is free disposable and convex$^2$. It is defined as$^3$:

$$\psi = \{(x, y) \in \mathbb{R}^{p+q}_+ \mid x \text{ can produce } y \}$$

DEA involves the measurement of efficiency for a given unit $(x,y)$ relative to the boundary of the convex hull of the observed sample of units $X \{(X_i, Y_i), i=1, n\}$:

$$\hat{\psi}_{DEA} = \{(x, y) \in \mathbb{R}^{p+q}_+ \mid \sum_{i=1}^n \gamma_i Y_i \geq y, \sum_{i=1}^n \gamma_i X_i \leq x, \text{ for } (\gamma_1, \ldots, \gamma_n), \text{ s.t. } \gamma_i \geq 0, \ i = 1, \ldots, n\}$$

where $\gamma_i \geq 0$ are the intensity variables over which the maximization is made. Following Farrell (1957) we measure the technical efficiency in the input direction. Hence, the technical efficiency is defined as the ratio of the minimum (optimal) amount of inputs on the actual inputs level of a DMU for a given level of outputs, keeping the inputs proportions constant. In this paper we assume that the technology exhibits constant returns to scale at the regional level$^4$. For a DMU operating at level $(x_0, y_0)$ the technical efficiency score $\hat{\theta}(x_0, y_0)$ is obtained, through linear programming, as follows:

$$\hat{\theta}(x_0, y_0) = \inf \left\{ \theta \mid (x_0, y_0) \in \hat{\psi}_{DEA} \right\}$$

$^2$ Free disposability means that it is possible to “destroy goods without cost”, i.e. it is possible to spare resources and producing the same amount of outputs using more inputs of what observed in the sample, but it is not possible to produce more outputs using less inputs than what observed in the sample; convexity instead means that if two combinations of input-output $(x,y)$ are feasible, then also any linear combination of the two is also feasible.

$^3$ Here the notation follows Daraio and Simar (2007).

$^4$ This is because increasing or decreasing returns to scale may be at place if the unit of analysis is the hospital, but it is not very meaningful to consider the regional system as a whole operating under increasing or decreasing returns to scale when the unit of analysis is the LHA.
A DMU is considered as efficient if it lies on the efficient frontier and its technical efficiency score is equal to one, otherwise it is inefficient if its efficiency score is less than one; if a DMU operates with an efficiency score of 0.75, it means that it could reduce its inputs usage of 25% (1-0.75), keeping the same level of outputs produced.

However, it is well known\(^5\) that the DEA estimator of technical efficiency described above is biased. For that reason, in the application we have used the bootstrap approach proposed by Simar and Wilson (1998) to estimate the bias and provide a bias corrected measure of technical efficiency as well as confidence intervals for the efficiency scores\(^6\). Another problem of DEA is its curse of dimensionality that requires a lot of observations to avoid wide confidence intervals and imprecise estimation of the efficiency scores. The curse of dimensionality implies that working in smaller dimensions tends to provide better estimates of the efficient frontier. For that reason, in the application we have followed the factorial approach described in Daraio and Simar (2007, p. 148 ff) to aggregate the outputs, in this case very useful given the small size of the sample analysed and feasible given the high correlation (higher than 97%) found among the outputs.

Compared with other industries, measuring efficiency in the health sector is complicated by specific characteristics of health and health services where “volumes” of outputs produced can’t be the only good to be considered. This explains why it is necessary to adapt and modify efficiency concepts and evaluation techniques in the study of health care efficiency. Efficiency measures compare resources used against the provision of services and, for that, are different respect to what is

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\(^5\) See e.g. Daraio and Simar, 2007, that introduce the bootstrap and its application in the efficiency analysis in Chapter 3.

\(^6\) The computations have been done using the open source package FEAR (Frontier Efficiency Analysis with R) downloaded from the web page of Paul W. Wilson: http://business.clemson.edu/Economic/faculty/wilson/Software/FEAR/fear.html.
intended as `efficient' in the health care sector. Of course, the achievement of health outcomes is not necessarily consistent with the concept of `technical efficiency', as service outputs may not be appropriate for the resulting health outcomes. For instance, a costly medical procedure may represent a high level of service output but may offer little health benefits in terms of disease treatment.

In the next section we introduce the data used and the results of the application done on the Tuscan LHAs.

**Empirical results**

With regard to specification of inputs and outputs, both can be proxy by using various variables. The number of physicians, the administrative and nursing personnel are often used as a proxy of labour inputs, while the number of hospital beds or the plant assets are often used as a proxy of capital inputs. On the inputs side, specifying costs in not simple because of the presence of many cost-contributing categories in terms of human resources or other cost categories that can be taken into account.

The output measures most commonly used are the number of discharges or impatient days adjusted by case-mix, in order to take into account the severity of cases. Many other variables could be used, for example the number of day-hospitals, emergency room treatments or the number of laboratory tests. Of course, the choice of output strictly depends on the kind of health institutions analyzed.

The data used in this paper come from a detailed dataset built by the Tuscan performance evaluation system and owned by the Management and Health Laboratory. The unit of analysis, the decision making units considered are the 12 Tuscan LHAs.
Interestingly, the choice of variables to be taken into account in this paper involved all the 12 LHAs CEOs. The process of identification and coherence between input and outputs last three years, the whole period of the research project length. At the end the CEOs agreed that the input/outputs identified and reported below, are the best available measures to characterize the activities of LHAs.

The input variable is the total costs related to services provided to population that lives in the municipalities of each LHA.

The outputs are: No. of physicians; No. of hospitalization services; Pharmaceutical services and No. of outpatient services. This last output is the more innovative because includes services from primary care and prevention services.

The first output No. of physicians is the sum of No. of general practitioners and paediatricians; No. of physicians for duty doctor; No. of physicians of the emergency and ambulance services.\(^7\)

The second output, Hospitalization services, is the sum of No. of hospitalizations for resident population in the LHA corrected by the average weight of DRG and No. of non self-sufficient residents cared into residential facilities.

The third output, Pharmaceutical care, is represented by the No. of DDD (Defined Daily Dose) used out of hospital.

The fourth output, No. of outpatient services, is the sum of the No. of outpatient services (outpatient clinics and diagnostics, for resident population in LHAs); No. of visits at home (for integrated domiciliary care); No. of rehabilitation services (i.e. for resident population in LHAs); No. of thermal services (for resident population in LHAs); No. of vaccines (flu for elderly people and measles, German measles, mumps vaccines); No. of screenings (breast, cervix, colon); No. of accesses at

\(^7\) The number of physicians, generally considered as input, here is put as output. That is because it regards only particular physicians that work on primary care which is financed on the number of patients and not on the number of visits.
Emergency Department and No. of inspections for safety and security at work. As recalled above, these outputs were aggregated to face the curse of dimensionality.

As shown in Table 2, the average LHA in Tuscany sustain a total cost (input) of 503,670,353 millions of Euro to offer, on average, to its community, the service of 435 physicians for duty doctor (first output), 61,292 hospitalization services (second output), 909 Defined Daily Doses (DDD) used out of hospital (third output) and 4,893,900 outpatient services (fourth output).

We can also observe that there is an high variability of the services provided by LHAs. E.g. the total cost goes from a minimum of 265,693,131 to a maximum of 1,357,171,836 Euro; only the third output about pharmaceutical care doesn’t show such an high difference between min and max values.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Stand. dev</th>
<th>Min value</th>
<th>Max value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input (thousands of Euro)</td>
<td>503,670</td>
<td>272,434</td>
<td>265,693</td>
<td>1,357,171</td>
</tr>
<tr>
<td>First output (No. of physicians)</td>
<td>435</td>
<td>206</td>
<td>247</td>
<td>1,081</td>
</tr>
<tr>
<td>Second output (No. of Hospitalization services)</td>
<td>61,292</td>
<td>34,379</td>
<td>33,461</td>
<td>170,009</td>
</tr>
<tr>
<td>Third output (No. of DDD)</td>
<td>909</td>
<td>80</td>
<td>682</td>
<td>1,002</td>
</tr>
<tr>
<td>Fourth output (thousands of outpatient services)</td>
<td>4,893</td>
<td>2,572</td>
<td>2,571</td>
<td>12,258</td>
</tr>
</tbody>
</table>

Table 2 Input and outputs values

The first research question of the paper was to measure and compare the technical efficiency of Tuscan LHAs.

In Table 3 are shown the results of the efficiency analysis carried out on the 12 LHAs in Tuscany, considering data for the year 2007\(^8\): Technical Efficiency is the efficiency score estimated with DEA as

\(^8\) The results for the years 2005 and 2006, not reported here to save space, were very similar to those of 2007 reported in Table 2.
described above; Tech Eff. Bias Corrected is the efficiency score corrected for the bias; Bootstrap std is the standard deviation of the bootstrap estimate; CI Lower bound (Upper bound) is the 95% lower (upper) bound of the confidence intervals on the efficiency score computed by applying the bootstrap proposed by (Simar and Wilson, 1998).

<table>
<thead>
<tr>
<th>LHA</th>
<th>Technical Efficiency</th>
<th>Tech. Eff. Bias Corrected</th>
<th>Bias</th>
<th>Bootstrap Std</th>
<th>CI Lower Bound</th>
<th>CI Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1.000</td>
<td>0.979</td>
<td>0.021</td>
<td>0.018</td>
<td>0.937</td>
<td>0.999</td>
</tr>
<tr>
<td>1</td>
<td>0.953</td>
<td>0.934</td>
<td>0.022</td>
<td>0.019</td>
<td>0.893</td>
<td>0.953</td>
</tr>
<tr>
<td>7</td>
<td>0.928</td>
<td>0.909</td>
<td>0.023</td>
<td>0.019</td>
<td>0.869</td>
<td>0.928</td>
</tr>
<tr>
<td>2</td>
<td>0.912</td>
<td>0.893</td>
<td>0.023</td>
<td>0.020</td>
<td>0.854</td>
<td>0.911</td>
</tr>
<tr>
<td>11</td>
<td>0.904</td>
<td>0.885</td>
<td>0.023</td>
<td>0.020</td>
<td>0.846</td>
<td>0.903</td>
</tr>
<tr>
<td>5</td>
<td>0.893</td>
<td>0.875</td>
<td>0.024</td>
<td>0.020</td>
<td>0.837</td>
<td>0.893</td>
</tr>
<tr>
<td>3</td>
<td>0.873</td>
<td>0.856</td>
<td>0.024</td>
<td>0.021</td>
<td>0.818</td>
<td>0.873</td>
</tr>
<tr>
<td>4</td>
<td>0.851</td>
<td>0.834</td>
<td>0.025</td>
<td>0.021</td>
<td>0.797</td>
<td>0.851</td>
</tr>
<tr>
<td>9</td>
<td>0.851</td>
<td>0.834</td>
<td>0.025</td>
<td>0.021</td>
<td>0.797</td>
<td>0.851</td>
</tr>
<tr>
<td>8</td>
<td>0.847</td>
<td>0.829</td>
<td>0.025</td>
<td>0.021</td>
<td>0.793</td>
<td>0.846</td>
</tr>
<tr>
<td>6</td>
<td>0.794</td>
<td>0.778</td>
<td>0.026</td>
<td>0.023</td>
<td>0.744</td>
<td>0.794</td>
</tr>
<tr>
<td>10</td>
<td>0.692</td>
<td>0.678</td>
<td>0.030</td>
<td>0.026</td>
<td>0.648</td>
<td>0.692</td>
</tr>
</tbody>
</table>

Table 3 Technical efficiency results

For making a correct interpretation we have to look at the efficiency scores bias corrected and take into account the confidence intervals on the efficiency scores. According to our investigation, the typical LHA in Tuscany has a bias corrected efficiency score of 0.86 that implies that it could produce the same level of services to its community by using the 14% less of resources (input) used. However, there is a variability among the technical efficiency of the Tuscan LHAs as the efficiency score bias corrected varies from a minimum of 0.68 to a maximum of 0.98. It is worth to notice that even the best performer LHA in terms of technical efficiency may further improve its results by reducing its input usage of 2%; the average bias estimated over the group is of 0.024 with a min value of 0.021 and a max value of 0.030.

The technical efficiency score uses inputs and outputs expressed in volumes. Thus in order to analyze the global performance of the
health system it is necessary to consider also indicators that concern quality and appropriateness. Hence, the second research question of this paper is to investigate the relationships among technical efficiency scores and the indicators of quality, appropriateness, equity and economic sustainability.

The investigation has been carried out throughout mapping quadrants. Using them it is easy to locate clusters of LHAs and discover patterns of correlations among technical efficiency scores and other factors which may affect the performance. The variables considered as external factors are: overall (average) performance measured using all the indicators of the Performance Evaluation System with the exclusion of the population health status dimension; management variables represented by (weighted) per capita cost; organizational factors given by Total employee and Internal services evaluation by head of department.

While technical efficiency scores compare the result of each DMU with the most efficient in the group, as given by the estimated efficient frontier; the overall performance, instead, is an average performance indicator that takes into account the good and the poor performances of each LHA as follows:

\[
OverallPerf. = \frac{(N.Green + N.DarkGreen) - (N.Orange + N.Red)}{N.Indicators}
\]

For instance, LHA 8 (illustrated in Figure 1, left side) has an overall performance of 56% whilst LHA 1 has a value of 29% (illustrated in Figure 1, right side).

Figure 2, reports the mapping quadrants we propose to address the second research question.
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Figure 2 a)

Figure 2 b)

Figure 2 c)
Figure 2 d)

Figure 2 e)

Figure 2 Mapping quadrants of: % of overall performances vs Per capita cost (a); technical efficiency (bias corrected) vs. % of overall performances (b); technical efficiency (bias corrected) vs. (weighted) per capita cost (c); technical efficiency (bias corrected) vs. total employees (d); technical efficiency (bias corrected) vs. evaluation of internal services by head of department (e).

The first mapping quadrant taken into account (Figure 2 a), shows the relation between technical efficiency and overall performance (or % of overall performances); the other two quadrants (Figure 2 b and c) show the relation between (weighted) per capita cost and overall
performance and between technical efficiency and (weighted) per capita cost. Finally, Figure 2 d) and e) illustrate the relation among technical efficiency and organizational factors.

While there is a significant linear correlation between per capita cost and the overall (average) performance (Figure 2 a), no correlation has been found in 2007 (and also for 2005 and 2006) between technical efficiency and the overall (average) performance (Figure 2 b) neither between technical efficiency and the per capita cost (Figure 2 c).

Although further investigation are needed, it seems that quality, equity, effectiveness and appropriateness indicators are the determinants of costs while technical efficiency seems to have little impact both on weighted per capita costs and on the overall (average) performance.

In the literature there is not a common position on the relationship between quality and costs. For instance Jarman (2006) highlighted that there is no correlation between adjusted mortality rates and reimbursement while there are other studies such as Berg et al. (2005) that asserted that a reduction of medical errors and quality (measured by the hospital readmission rate) led to a reduction of costs. The results of this research seem to sustain the last position and seem to highlight that, since no correlation has been found between technical efficiency and (weighted) per capita costs, it is important to consider not only the technical efficiency (the ability to provide the volume of services to its own community by LHA) but also the financial sustainability and the appropriateness of these services has to be taken into account.

Crossing the technical efficiency with other variables we found an interesting correlation between technical efficiency and organizational factors. It seems that a larger number of employees is associated to lower level of technical efficiency (Figure 2 d), whilst an higher satisfaction of employees towards managers is associated to higher level of technical efficiency (Figure 2 e). This final result support the
importance of the managerial use of the integrated benchmarking system we propose in this paper to support the implementation of changes and continuous improvement, as well as to monitor the “organizational readiness for change” (Weiner, Amick, Lee, 2008) of LHAs.

**Conclusions and further developments**

The growth of health care costs in a recession period has driven the public health authorities to encourage health institutions to increase their technical efficiency and costs control, considering the effectiveness, appropriateness, quality and equity at the same time. As we have illustrated in the paper, a Multidimensional Performance Evaluation System developed in close collaboration with health care professionals and managers combined with a bias corrected indicator of technical efficiency, implemented at the level of LHAs.

This study provides interesting policy implications in healthcare: Cost management can be achieved not only working on technical efficiency but especially improving quality of care.

Technical efficiency is an important synthetic measure that has to be included in a wide multi-dimensional analysis that considers appropriateness and quality performance measures that are crucial in health systems. Keeping technical efficiency under control on one side and quality care, appropriateness and patient satisfaction, on the other, may help health managers to consider as a dynamic relationship complex linkages existing between costs and outcomes in healthcare. Policy makers and managers are in fact responsible both for achieving the best results in terms of resource productivity and to continuously verify the impact of their actions on population health and quality of care.
The combined evaluation system, proposed in the paper, may be used continuously and systematically both at regional and local level, as a public policy tool to help, on one side, the Regional government to evaluate its strategic actions and, on the other side, to promote a “managed” competition among the health authorities, helpful to enhance innovation and improve their financial results, but also their technical efficiency while keeping cost under control.

In order to enhance the results found future developments are requested. In particular we plan to extend the number of units analyzed to the 34 Tuscany local areas levels and include in the analysis other Italian regions (extending the analysis to the 43 LHAs of 4 Italian regions: Tuscany, Umbria, Piedmont, Liguria). Other developments include also the application of nonparametric efficiency techniques that are more robust to the influence of outliers (Daraio and Simar, 2007).
References


OECD (2002), Measuring Up - Improving health system performance in OECD countries, OECD.
