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Management in Healthcare System: A Case Study

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Abstract
The aim of this work is to investigate the efficiency level of healthcare system in Apulia.
This is a study design; in fact, peculiar and objective efficiency index is built with ISTAT data from most of territorial healthcare structures (public, non-profit and private). This coefficient is calculated to compare with more generic and traditional indexes. Moreover, a forward analysis is conducted for the selected period and for the investigated structures, using directly perceived Data (2013-2015). One of the principal findings is that it could be possible to identify the gap of the single structure (public, non-profit and private) and of the healthcare system. Moreover, this study puts in evidence some gaps of the public management system.
Keywords: Business and Management; Health Behaviour; profit and non-profit Case Study

Introduction

The Italian National healthcare system has, over the years, presented serious problems in terms of quality. In Italy there are enormous differences between the North, Centre and South of the country as regards the service sectors, a fact that becomes even more evident in the healthcare quality-system.

In the South of Italy, the Apulia region has a rooted tradition in tourism, especially when associated with food and wine. The regional capital is the city of Bari, which has a high local population and a high proportion of immigrants. It continues to present serious problems due to the low quality of healthcare services, an issue that needs to be addressed and rebalanced. The local population, however, does not contribute to maintaining the integrity of the available structures and vandalism is commonplace, especially in public facilities. Moreover, a large number of healthcare professionals belong to well-known disreputable families in the area and, until some years ago, employment selection procedures for public jobs were also corrupt.

In the South of Italy resources have been wasted, generating a loss of quality, especially in public facilities. Consequently, this has encouraged people with health issues to move from the South to the North of Italy to be treated.

In reality, many doctors in the South of Italy are highly qualified and extremely capable of providing quality care. What is really necessary are financial resources. These have been wasted over time or used for other purposes. Wrong political choices were made, but for a long period a corruptive system that negatively influenced results also existed.

Nowadays, the situation has slightly changed. In accordance with national policy, the political system has tried to reorganize the public health system and, through competition among public, private and non profit hospitals, better performances have been registered.

The aim of this study is to investigate the levels of efficiency in healthcare systems in Apulia, a region in Southern Italy. Efficiency is estimated using only quantitative information as data on the costs of health provision is not available.

Using the data provided by Istat (2016), it is possible to provide general information about the health care situation in the Apulia Region and its capital city. At present, the National Health System, recognizes 6 types of health care structures: hospital companies, classified hospitals, accredited home care, University-Polyclinic hospitals, hospitals under direct management, and IRCCS research institutes. Among these, Polyclinics and accredited homecare present the best performances, both in quantitative and qualitative terms. Tab. 1 shows only numeric information for the period 2009-2012. As can be seen, after the beginning of the economic crisis (2008), there is a decrease in all figures. This result could be connected to a health scandal in the Region (involving the University and funding), and for political reasons.

Tab. 1: Hospitals in Apulia and Bari (2009-2012)

	2009	**2010**	**2011**	**2012**
APULIA-ALL STRUCTURES				
Doctors+Odontologists	7745	7995	7696	7276
Technical health personnel	2086	2104	2196	2080
Health assistants	16575	16935	16888	16098
Rehabilitation Therapists	762	808	816	721
Other	10164	10638	10210	9615
All	37332	38480	37806	35790
APULIA-POLYCLINIC				
Doctors+Odontologists	1483	1521	1417	1348

Technical health personnel	403	403	400	389
Health assistants	2734	2802	2604	2530
Rehabilitation Therapists	86	85	84	79
Other	2010	2195	2117	2038
All	6716	7006	6622	6384
APULIA-CLASSIFIED HOSPITALS				
Doctors+Odontologists	401	385	379	397
Technical health personnel	108	109	107	104
Health assistants	1058	1018	992	1017
Rehabilitation Therapists	16	17	17	19
Other	588	602	604	540
All	2171	2131	2099	2077
APULIA-ACCREDITED HOME CARE				
Doctors+Odontologists	971	1016	1077	1097
Technical health personnel	155	187	169	164
Health assistants	1908	1919	1874	1658
Rehabilitation Therapists	321	330	343	321
Other	2546	2611	2560	2397
All	5901	6063	6023	5637
BARI-POLYCLINIC				
Doctors+Odontologists	1013	1037	949	895

Technical health personnel	287	280	281	252
Health assistants	1839	1886	1681	1566
Rehabilitation Therapists	65	64	63	59
Other	1519	1492	1435	1360
All	4723	4759	4409	4132
BARI-ACCREDITED HOME CARE				
Doctors+Odontologists	374	340	357	368
Technical health personnel	65	75	64	61
Health assistants	998	650	639	646
Rehabilitation Therapists	118	32	31	32
Other	1381	748	688	637
All	2936	1845	1779	1744
BARI-CLASSIFIED HOSPITALS				
Doctors+Odontologists	245	230	226	225
Technical health personnel	64	62	60	54
Health assistants	691	673	644	648
Rehabilitation Therapists	10	10	10	10
Other	346	333	311	267
All	1356	1308	1251	1204

Source: Istat, 2016

Literature

It is very complicated to measure public sector services. In economic literature (Barro and Lee, 2001; Hanuschek and Luque, 2002) the comparison between inputs, outputs and resources utilized is usually applied. Thus, DEA and FDH methods are used (Charnes, Cooper and Rhodes, 1978; Simar and Wilson, 2003). It is possible to measure health efficiency by using non-parametric frontiers (Afonso and Aubyn, 2005; Jandaghi et al. 2010).

Many studies also investigate the inefficiency of healthcare systems, using a principal agent theory, Ludwing, Van Merode and Groot (2010) explain the differences in efficiency among hospitals. There are two issues at the basis of this work: internal organization (links between departments and hospitals), and quality of care (links between patients and hospitals).

Another methodology for evaluating hospital performances is DRG (diagnosis related groups). Studies on this confirm that the potential for efficiency gains may depend on the pre-existing hospital payment system (Rosenberg and Browne, 2001; Moreno-Serra and Wagstaff, 2010).

In financial literature there are studies that investigate the impact of information technologies in the health care sector (Grover, Jeong and Segars, 1996; Burke et al., 2002; Meyer, Degoulet and Omnes, 2007). However, very few studies (Meyer and Degoulet, 2008) try to measure the direct earnings derived from the combination of the health system components (quality, user satisfaction, clinical information systems, etc.). One method for quantifying the performance of a health information system is the return on investment. This could be calculated using the internal rate of return (return on investment derived as a percentage of information technology investment), costs benefit analysis (division of the total benefits given by a project divided by the amount of money used to build it) and the net present value (result of a multiyear invested in today's currency).

This study uses a simple method for calculating and evaluating efficiency, determined by the availability of data.

Analysis of the sample

Finding a source that could provide data for private, public and non profit hospitals was a problem. The statistical office of the Apulia Region did not answer any of the official e-mail requests that were sent. Internet could help resolve this lack of information, but using internet as a source sometimes presents incomplete information. In fact, not all the necessary information (on doctors, healthcare assistants, number of beds etc.) is provided by each Unit (public, private and non profit). Thus, it is reasonable to think that all the variables reproduced are numerically inferior to the real situation.

For this reason we constructed peculiar indices, **ia** and **ib**.

Traditional literature on the measure of efficiency index is output/input. As regards the health service, we used the number of employees (doctors plus healthcare assistants) as the input. There were some problems in measuring output. Usually the proxies introduced are: the number of admissions, the average days of hospitalization and treatment of outpatients. Due to the impossibility of obtaining exhaustive information for all 3 categories, we used only the first two.

We constructed two efficiency-indexes; **ia** = number of admissions/doctors plus healthcare assistants; **ib** = average days of hospitalization/doctors plus healthcare assistants.
Fortunately, the use of the Diagnosis Related Group permits a comparison of all types of hospitals. In fact, DRG classifies all patients discharged from a hospital (hospitalization in ordinary regime or day hospital) into homogeneous groups for the absorption of resources committed. In this way the data are homogeneous.
The period this study referred to is 2013-2015, and the total number of hospitals is 20: 12 public service, 2 non profit and 6 private ones. In this work we also consider another large non profit hospital which is not in the province of Bari, but in that of Foggia, another town in Apulia. This structure was introduced due to its importance and to have a better comparison. Moreover, only 2 private structures can be considered as hospitals based on their size and operation units, but each one has sub-structures. The selected area is the city and province of Bari.
The choice of this area was based on the opportunity of having more information. Moreover, Bari is the main city in the Apulia Region and it is also the largest city in terms of population. It is important to notice that we use information from the University Hospital, which has 2 locations (structures), and is the biggest hospital in the Region. In Bari there are many health institutions, thus there is a high concentration of information. However it is also important to consider that the huge presence of competitors determines more competition and so higher levels of efficiency. The sample is representative because it includes all public structures, the only non profit one in the area (the other is in the province of Foggia), and a high number of large private structures.
It is important to underline the high number of medical specialties available. In fact, the public institutions and the non profit one include numerous medical specialties (the university hospital includes all areas), while, given the high costs, the private sector does not. Even if the private sector does not cover all specialties, in those sectors in which it is present, there is a high level of training and investment.
We tried to find updated information on the Apulia Region and Istat, but no recent data were available, so we contacted the hospitals directly.
It is interesting to note that the non profit hospital located in the province of Bari is a huge reality, as is the one in San Giovanni Rotondo (province of Foggia), with many highly qualified levels of performance and quality. Its results are a redundant at national level. For reasons of professional correctness, we use only macro-data in this paper. In fact, because there is only one big non profit reality in the province of Bari, using disaggregate data could produce problems of credibility and legacy in a public-private and non profit sector, this is why it is necessary to introduce only aggregate and macro data.

Tab. 2 Calculated Indexes

	2013		2014		2015	
Hospitals	**ia**	**ib**	**ia**	**ib**	**ia**	**ib**
1 pub	133.84	0.012	138.03	0.034	136.08	0.035
2 pub	71.27	0.024	76.23	0.051	65.94	0.043
3 pub	83.65	0.072	79.02	0.067	78.21	0.061
4 pr	76.51	0.095	70.74	0.071	82.03	0.063
5 pub	76.21	0.097	78.42	0.106	77.57	0.113
6 np	69.26	0.010	65.96	0.011	64.53	0.011
7 pub	108.74	0.051	110.05	0.054	11.56	0.059
8 pub	63.83	0.058	61.14	0.058	64.72	0.067
9 pub	74.07	0.036	70.14	0.033	70.21	0.033
10 pr	60.64	0.098	60.83	0.103	65.69	0.120
11 pr	83.87	0.017	84.45	0.019	83.83	0.021
12 pub	78.13	0.094	68.45	0.081	69.91	0.089
13 pub	83.40	0.015	54.40	0.016	55.28	0.019
14 pr	87.24	0.017	99.08	0.014	97.24	0.030
15 pr	80.03	0.045	67.03	0.046	68.42	0.052
16 pub	90.43	0.054	91.24	0.016	83.20	0.061
17 pub	74.49	0.053	60.19	0.038	66.0	0.041
18 pub	69.45	0.051	62.02	0.027	73.04	0.022
19 pr	46.69	0.030	56.93	0.032	56.21	0.029
20 np	318.37	0.006	315.78	0.006	317.15	0.006

Source: own elaboration

A comparison between **ia** and **ib**, must be interpreted in this way: a structure is much more efficient because **ia is** higher and **ib** is lower.

A high level of **ia** has a constant denominator (doctors+healthcare assistants) during the selected period. Thus, there is an increasing numerator, so it is possible to assume that the number of admissions increases because of the high level of quality of health care services.
The **ib** index must be interpreted positively if it is low. In fact, that the denominator is fairly constant, as in **ia**, and there is a numerator decrease. Therefore, fewer days of hospitalization produce a Diagnosis Related Group increase for a single unit and also many input -patients, thus confirming the high level of **ia**.
A low **ib** value decreasing over time could represent an efficient hospital because a decrease in the average number of days of hospitalization (numerator) implies fewer (none) medical complications, particularly after surgery. This consideration is more evident if we consider that in the period analyzed, the number of doctors and healthcare assistants (denominator) is mainly constant.
Tab. highlights that one (obser. N. 20) non profit hospital presents **ia** and **ib** values in line for all the years, in line with our efficiency hypothesis. The corresponding value stands out and shows a notable difference from the other observations., Values are quite similar among public hospitals, supposedly with a high **ia** and lower **ib** for the biggest units. Private structures also present a good level of efficiency.

Methodology and Results
Efficiency-indexes were built/used, due to the impossibility of obtaining data on the costs of healthcare (disaggregate). So efficiency frontiers could not be used (Lovell, 1993).
Useful information included: number of beds, doctors and healthcare assistants, operating rooms (daily), number of medical procedures, average days of hospitalization, number of operating rooms, number of meals served, number of bathrooms, square metres of health facilities. These elements give us an idea of the level of quality of the structures. To use **ia** and **ib** among these variables, we chose those that, in our opinion, are linked with the calculated indices. Moreover, the denominator-input (doctors+healthcare assistants) of **ia** and **ib** is now a determinant of efficiency level. Also the “average number of days of hospitalization” now has a different role that was before a proxy of the efficiency.
$Y= f(x1,x2,x3,x4,x5,x6)+ \boldsymbol{\varepsilon}$
where y is the efficiency, x1,…, x6 are: number of doctors, number of operating rooms, average days of hospitalization, number of beds, number of healthcare assistants and number of baths. $\boldsymbol{\varepsilon}$ is the error. These are not dummy variables because they are all essential for the healthcare reality, and they are also linked by collinearity. The selected independent variables are those that present an objective numerical evaluation. Using patient questionnaires could produce discretionary problems.
We used a pluriparametric regression analysis for the period 2013-2015.

Analysis of the variables 2013

Tab. 3 Martrix correletion: 2013-2014-2015-2015a

2013	INDEX	BEDS	DOCTORS	H.ASSISTANTS	OP.ROOMS	BATHS	H.DAYS
INDEX	1						
BEDS	0.55468	1					
DOCTORS	0.51853	0.73278	1				
H.ASSISTANTS	0.48788	0.69199	0.62481	1			
OP.ROOMS	0.30224	0.30459	0.21344	0.18750	1		
BATHS	0.55032	0.33470	0.33726	0.60633	0.56718	1	
H.DAYS	0.21164	0.32652	0.55811	0.23588	-0.38794	-0.32700	1
2014	**INDEX**	**BEDS**	**DOCTORS**	**H.ASSISTANTS**	**OP.ROOMS**	**BATHS**	**H.DAYS**
INDEX	1						
BEDS	0.68543	1					
DOCTORS	0.52891	0.69455	1				
H.ASSISTANTS	0.55492	0.77918	0.58120	1			
OP.ROOMS	0.29997	0.33619	0.19035	0.22243	1		
BATHS	0.57385	0.46129	0.38958	0.67818	0.56718	1	
H.DAYS	0.18659	0.26171	0.50098	0.05313	-0.35149	0.40595	1
2015	**INDEX**	**BEDS**	**DOCTORS**	**H.ASSISTANTS**	**OP.ROOMS**	**BATHS**	**H.DAYS**
INDEX	1						
BEDS	0.70033	1					
DOCTORS	0.56036	0.82250	1				
H.ASSISTANTS	0.56096	0.81589	0.67222	1			
OP.ROOMS	0.29322	0.32373	0.19672	0.10717	1		
BATHS	0.59526	0.57009	0.34770	0.53999	0.56718	1	
H.DAYS	0.16449	0.18408	0.54194	0.14900	-0.31374	-0.42687	1
2015a	**INDEX**	**DOCTORS**	**H.ASSISTANTS**	**OP.ROOMS**	**BATHS**	**H.DAYS**	
INDEX	1						
DOCTORS	0.56036	1					
H.ASSISTANTS	0.56096	0.67222	1				
OP.ROOMS	0.29322	0.19672	0.10717	1			
BATHS	0.59526	0.34770	0.53999	0.56718	1		
H.DAYS	0.16449	0.54194	0.14900	-0.31374	-0.42687	1	

Source: own elaboration

As can be noted Beds - H.Assistants have an e value near 1, thus showing a correlation. To confirm this idea the VIF index is calculated as:

Tab. 4 VIF and Param (years 2013-2014-2015-2015a)

2013		
VARIABLES	**VIF**	**ESTIMATED PARAM.**
BEDS	3.19520037	4.356910
DOCTORS	4.05348348	-3.834347
H.ASSISTANTS	3.70455316	-4.081735
OP.ROOMS	2.09491098	-13.861950
BATHS	3.68255433	15.012746
H.DAYS	3.28849915	15.585544
2014		
BEDS	4.21508251	8.055859
DOCTORS	3.59839995	-7.271178
H.ASSISTANTS	5.00344718	-6.128761
OP.ROOMS	2.05620103	-69.635326
BATHS	4.00259134	18.015929
H.DAYS	3.35057259	16.984179
2015		
BEDS	6.63971600	
DOCTORS	7.12480494	
H.ASSISTANTS	3.77813520	
OP.ROOMS	1.82366254	
BATHS	3.70482941	
H.DAYS	4.01196736	
2015a		
DOCTORS	-	-1.469276
H.ASSISTANTS	-	1.178519
OP.ROOMS	-	8.427944
BATHS	-	13.199266
H.DAYS	-	16.816342

Source: own elaboration

The variable for **Doctors** has a high VIF, considering that the preferred maximum value is 5 (even if Marquandt considers 10 as a maximum value). Because the variable for **Doctors** is lower then 5, it is still useful. The estimation of a linear regression can give information on the significance of the sample, the determinant coefficient and βi parameters of the equation. The regression has an R2 0.5706, F value = 3.987 and error = 0.013.

Estimated parameters show a relevance of **Baths** and **H.Days** variables. The negative sign of variables **Doctors** and **H.Assistants** is probably due to the high correlation (less than 5) between these two variables. Thus, we believe that variable **Beds** absorbs the other two variables. Variable **Op.Rooms** is negative and high. We believe that this is the result of the scarcity of the operating rooms, either for the hospital in general, or for the single Unit. Moreover, the negative sign could be interpreted as a potential complementarity with variables **Doctors** and **H.Assistants**: an increase in the number of operating rooms, without an increase in the number

of doctors and healthcare assistants, could only be/mean?/lead to? an increase in costs. Thus, a loose of efficiency exists.
In order to better evaluate the relevance of the single variable, we use a forward analysis.
Tab.5 Forward analysis (years 2013-2014-2015a)

2013	2014	2015a
First variable: Beds (α)	**First variable: Beds (α)**	**First variable: Baths (α)**
R2(α)=0.30766459	R2(α)=0.46981885	R2(α)=0.35433522
Fvalue=10.22	Fvalue=20.38	Fvalue=12.62
ε(α)=0.0040	ε(α)=0.0002	ε(α)=0.0017
Second Variable: Baths (β)	**Second Variable: Baths (β)**	**Second Variable: H.Days (β)**
R2(α+β)=0.45742828	R2(α+β)=0.55415840	R2(α+β)=0.56859477
Fvalue(α+β)=9.27	Fvalue(α+β)=13.67	Fvalue(α+β)=14.50
ε(α+β)=0.0012	ε(α+β)=0.0001	ε(α+β)=0.0001
Third Variable: H.Days (γ)	**Third Variable: H.Days (γ)**	
R2(α+β+γ)=0.52218999	R2(α+β+γ)=0.60984966	
Fvalue(α+β+γ)=7.65	Fvalue(α+β+γ)=10.94	
ε(α+β+γ)=0.0012	ε(α+β+γ)=0.0002	
	Fourth Variable: H.assistants (δ)	
	R2(α+β+γ+δ)=0.65100750	
	Fvalue(α+β+γ+δ)=9.33	
	ε(α+β+γ+δ)=0.0002	
	Fifth variable: Doctors (η)	
	R2(α+β+γ+δ+η)=0.68287816	
	Fvalue(α+β+γ+δ+η)=8.18	
	ε(α+β+γ+δ+η)=0.0003	
	Six variable: O.Rooms (θ)	
	R2(α+β+γ+δ+η+θ)=0.69908410	
	Fvalue(α+β+γ+δ+η+θ)=6.97	
	ε(α+β+γ+δ+η+θ)=0.0006	

Source: own elaboration

The weight of Beds is about 30%, with a low probability of error. Also the F value is good because it is higher than the critical values, therefore the sample is good. In combination with **Beds**, enter **Baths**. The F value is still under critical values (F value partial=6.0726), confirming sample-goodness. Also R2 is higher and partial error is lower (so the weight of the non-introduced variables is lower). When entering **H.Days** variable, the results are even better (F value partial=2.8463). The interpretation of the elimination from a forward analysis of the other variable could be interpreted in a similar way: Beds captures, because the collinearity, doctors and healthcare assistants. Also, the number of **Operating rooms** alone does not affect efficiency.

Analysis of the variables 2014

In this year (see Tab.3), as in the previous one, there could be a collinearity between Doctors/Beds and healthcare assistants/beds. But in 2014 the relation between

doctors/healthcare assistants does not have a high value.The variable for healthcare assistants has a high VIF (see tab.4), but this variable was still included and considered as a border line, therefore all 6 variables are used.
The sample is significant: R2 is 0.6991, F value = 6.970 and error = 0.0006. These values confirm the importance of the selected variables for measuring efficiency.
We proceeded with the estimation of parameters (see tab.4). Variables **Baths** and **H.Days** are still relevant. The negative sign of variables **Doctors** and **H.Assistants** persists. Variable **Op.Rooms** is negative and higher than for 2013. The same explanations as 2013 could also be offered for 2014.
A forward analysis confirms the significance of both samples and the incidence of variables on efficiency (see tab.4). In this year, as in 2013, the first variable introduced, by forward analysis, is Beds, with a weight of 47% in explaining healthcare efficiency (error is low). The second variable introduced is Baths that, when combined with the first, has an R2 of 50% (also the F value and error are good). When introducin**g** the number of days of hospitalization and healthcare assistants the sample significance increases, while error is quite constant and the F value is still below critical values. The last two variables, **Doctors** and **Op.Rooms**, do not significantly affect the model.
In this year it is possible to confirm and repeat the consideration made for 2013, but with better results. In fact, all the variables enter in the forward analysis (See tab.5), while in 2013, only 3 variables were significant.

Analysis of the variables for 2015

The values present collinearity between doctors/beds and healthcare assistants/beds (See tab. 3-year 2015). VIF index confirms this collinearity (See tab.4). As this is the third year in which collinarity between these variables is present, we eliminated Beds and repeated the evaluation. The choice not to consider Beds is also a political choice. In fact, in 2015 the effects of a hospital reorganization program which merged public structures were significant. This reduced beds in optical management organization and costs saving (Laws n.502 1992 and 517 1993; see tab.3 – year 2015a). There is a correlation between doctors/H.Assistants, which is lower than for previous years and is confirmed by the VIF index. Even without including the variable of Beds, the sample is still significant: R2 is 0.5735, F value is 5.110 and error is 0.0039. The estimated parameters are in Tab. 4.
There is a relevance of **Baths** and **H.Days** variables. The negative sign of variable **Doctors** is probably due to the elimination of the variable Beds from the analysis: what is a doctor without a bed? There could be a loss in efficiency having Doctors without beds-patients. The positive sign of variable **Op.Rooms** is also interesting. The elimination of 'Beds', paradoxically, does not permit the measurement of the shortage of this variable. The forward analysis confirms everything (see Tab.5). Only 2 of 5 variables are significant (**Baths** and **H.Days**). Data show the validity of the sample, and the error is lower.
In the final analysis, we inserted the calculated parameters of the regression in the estimated equation. Thus, we obtained 3 average values, one for each year: 2013 – 825.7376; 2014 – 1034.1524 and 2015- 1013.1213. For these 3 years the analysis of observations was conducted.

However, as can be noted, there is quite a similar efficiency-estimated index for a large part of the investigated units, none of these can be considered an outlier.
For this reason we also measured the efficiency coefficient for each observation for each of the 3 years. The non profit presents an efficiency value greater than the average value. In the first year (2013), about the 25% of public structures are efficient, while more than the 35% of private hospitals are efficient. For both public and private structures the efficiency value is close to the average value. Those units present a higher dimension in terms of beds, doctors, and of all the variables considered in the analysis. The analysis for 2013 continues with the comparison between the estimated efficiency (the **y** of the equation), and observed efficiency (the **ia** and **ib** indices). The values of **y**, **ia** and **ib** are in line for the non profit structure: there is a correspondence between estimated and observed efficiency. For all the other units we can consider:

- Estimated efficiency > observed for more than 40% of the sample. Private structures have healthcare benefits paid for by the patient thus, they are valid in terms of estimated efficiency and not in terms of observed efficiency. In fact, this last indicator is linked to the volume of admissions, and patients must pay for part of these hospitalizations. An explanation for public hospitals is the territorial position of the structure. If a hospital is located in a rural area, due to the Law for the reorganization of the healthcare system, it may cover a lower number of admissions and, probably, it not all the healthcare units would be available.
- Estimated efficiency < observed one for 30% of the sample. For this group, even if the number of health admissions is high, the number of employees in not. Moreover, we must take into consideration the number of day-hospital admissions, which only affect the observed efficiency.

This situation is quite similar for all the years considered. Only one observation is considered an outline, the non profit hospital. This structure presents a high level of efficiency and performance for the whole period investigated. In fact, this is an art facility, in which high private – ecclesiastical and public investments have recently been made. There is a pyramid structure led by a priest and many of the practising doctors are very famous. High quality technology is also available.

Conclusions

The aim of this work is to identify an objective, simple and rough index of healthcare efficiency. This index is constructed using a traditional vision of efficiency, given by the relation output/input.
Thus, 6 numeric variables, specific to health systems, are identified and investigated for the years 2013-2015. The analysis includes three types of structure: public, private and non profit. Twenty units are included in the sample.
At the basis of the analysis there is the desire to highlight the problems related to poor management, that is too politicized and opaque, in order to invite Apulia Governors to realize that citizens are also capable of verifying the quality of a healthcare system.

These specific indices for measuring efficiency have been used in order to identify the real territorial problems. In fact, using DEA or FDH for measuring efficiency can only give us a general vision of the quality system. The south of Italy needs a different system to identify the real problems.
The result is positive: there is a relation between the selected variables and hospital efficiency (indices). The study limitation is that all the selected variables must exist concurrently. In fact, the use of forward analysis permits us to state that the specific-single contribution of each variable could be indeterminate. However, the weak contribution of the weak variables could explain efficiency. In our opinion, this result could be the explanation of a potential complementarity: these variables must be present at the same time and must grow together. Moreover, the estimation-quantification of an average efficiency threshold, for each year, gives the opportunity to construct the evolution of healthcare efficiency. Finally, the resolution of the equation, obtained by entering numerical values, identified by a regression model (estimated efficiency) and the correspondent traditional coefficients (observed efficiency), permits the identification of those structures with a high relative efficiency. There is a threshold and the non profit unit emerges. This threshold could be used for identifying and resolving the problems of both the single unit and the healthcare system. Another study limitation is the paucity of data. It is very difficult to obtain homogeneous data. Moreover, only a few years were investigated, but it is difficult to work on recent and homogeneous data. This study could be the start-analysis for a wider project in which other performance variables, such as costs, could be included.

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