Extended Abstract

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Does industry change affect strategic, governance, and financial configurations of private hospital providers? A survey of Italian private healthcare organizations.

Objectives. The National Health Service, for years, has been affected by a profound evolution of institutional structures, due to the search for greater economic sustainability. In the last decade, ten Regions are or have been affected by the Health Deficit Return Plans, while the remaining ten Regions have initiated processes of greater centralization of health choices and policies, with the aim of rebalancing the system's hospital-centered vision. In this sense, even accredited private hospitals have been affected by a variety of pressures, both financially and from a regulatory standpoint, which feed a progressive sectoral concentration (Cuccurullo et al., 2017). The accredited private nursing homes now have 30.2% of the beds of the overall hospital offer (Lega et al., 2018). They are particular companies, being private but operating in a regulated sector, and are therefore subject to the dynamics and rules of public systems (Carbone 2013). Moreover, they tend to be small (only 12% exceed 200 beds) with concentrated ownership (typically family business), so with greater difficulties they face the sectoral transition. Only recently are they the subject of attention by the academic world, in particular in terms of company size and activities with the use of qualitative methods, such as case studies. The economic-financial configuration is little explored, together with the governance structures and the strategic ones. The purpose of this work is to bridge this gap with the help of a quantitative-statistical method, analyzing the evolution of the strategic, governance and financial configurations of Italian nursing homes over the last decade.

Indeed, our research questions are:

- RQ 1. Which financial aspects best explain the variability among private hospitals?
- RQ 2. What are the main configurations of private hospitals?
- RQ 3. How have these configurations changed over time? (2008; 2012; 2016)

Methodology. The objective of this study is to analyze the distinct configurations of companies operating in the private hospital sector. By using the PTA, combined with clustering techniques, we map: (i) the different corporate governance characteristics of the Private hospital; (ii) the most relevant economic-financial indicators.

Data collection. To conduct the empirical analysis, the Aida database of Bureau van Dijk was used, which contains information from about 980,000 companies. The information that can be consulted concerns all the financial data of Italian companies, in addition to other information of a legal nature such as the corporate structure, group structure, extraordinary finance operations, commercial information and more. All data are indexed and can be used as search keys, processed, evaluated and exported in multiple formats. The survey began in 2018. Through the AIDA database it was possible to find the data of all the private hospital present in the country that duly filed the financial statements in the years 2008-2012-2016. The query was made using Ateco code 86.10.10. To conduct the empirical analysis, the following variables were included:

- location as a Region in which the operational headquarters are located;
- ownership structure, such as (i) legal form, (ii) number of shareholders, (iii) BVD independence indicator;
- company size measured on the basis of (i) related and (ii) total assets;
- operational growth (revenues) and structural growth (employees and total assets);
- economic performance, through (i) ROA, (ii) ebitda margin, (iii) net income/sales;
- financial profile, understood as (i) debt/equity ratio, (ii) financial leverage and (iii) primary liquidity ratio.

The companies in the sector that had regularly presented their financial statements were 1165.

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After which we proceeded excluding (Figure 1):

- companies that presented the following legal forms: Consortium (1), Social Cooperative (27), Entity (1), Foundation (3), S.A.S. (1), S.C.A.R.L. (5), S.C.A.R.L.P.A. (29), S.R.L. simplified (14), limited liability consortium company (6), joint stock consortium company (1), simple company (2);
- companies that carry out rehabilitation activities and rest homes, that is to say those realities that do not provide ordinary or day hospitalization services, as they have financing mechanisms, other than those at a rate per service (459);
- the companies for which complete information was not available for the three financial years considered (418).

Our final dataset is composed of 198 companies observed in 3 different periods (2008 - 2012 - 2016) in which the same variables are measured (EBITDA / Sales, ROA, ROE, Debt-to-equity ratio, financial independence index, rate interest coverage, liquidity index). The data is arranged in a list of three tables, corresponding to the three periods. Each table has 198 rows (companies) and 7 columns (variables). Our data frame is therefore a time series, with each table corresponding to a date.

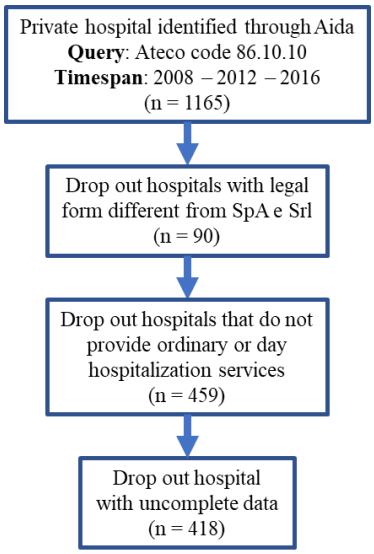


Figure 1 Data collection workflow

Data analysis. To answer the first research question and therefore bring out the most characterizing (and differentiating) characteristics of the Italian private hospital, was used Partial triadic analysis (Jaffrenou PA, 1978). Partial triadic analysis (PTA), also called X-STATIS, is an extension of principal components analysis (PCA). PTA is a tailor-made technique for managing multiple data tables that measure sets of variables collected on the same observations but at different times or places (Thioulouse J. & Chessel D., 1987; Simier M. et al., 1999; Thioulouse J. et al., 2004; Thioulouse J.& Dray S., 2007; Rolland A. et al., 2009; Bertrand F. & Maumy M., 2010; Mendes S. et al., 2010; Thioulouse J, 2011).

Although the same has been little used in economic-financial analyzes, compared to Self-Organizing Maps (Dameri et al., 2017; Lassini et al., 2016), it was considered here that it was better appropriate to represent the most relevant to the private hospital. PTA is a technique based on a simplified approach of three modalities of factor analysis (Tucker LR., 1966; Kiers & Henk, 1991) which allows to:

1. compare relationships between different data sets,
2. integrate these datasets into an optimal weighted average called compromise,
3. and finally, project each original dataset on compromise to analyze commonalities and discrepancies.

Let X_1, ..., X_k, ..., X_K be K-tables of quantitative variables with the same n rows (samples) and the same p columns (variables). Let (X_1, Q, D), ..., (X_k,Q, D), ..., (X_K, Q, D) be the K associated statistical triplets. The PTA can be broken down into three steps (Thioulouse & Chessel, 1987; Lavit, 1988; Lavit et al., 1994):

- The Interstructure uses the vectorial correlation coefficient or RV coefficients to compute a matrix of scalar products between the tables that measures their relationships. Since all the tables have both the same rows and columns, STATIS, and the associated computation of the RV coefficient, is performed directly on tables. The eigenvalues Λ_B and the normed eigenvectors U_B of the Rv matrix are used to compute a score of the tables $S = U_B \Lambda_B^{\frac{1}{2}}$, where the letter B (Between) refers to the interstructure. These scores can be plotted in a correlation circle.

- Let $u_B^T = = (\alpha_1 \ldots \alpha_k \ldots \alpha_K)$ be the first eigenvector of the Interstructure analysis with $\sum_{k=1}^{K} a_k^2 = 1$. The α_k are used to define the K-table weighting. The Compromise table is therefore built as a combination of the K tables: $X = \sum_{k=1}^{K} a_k X_k$

The analysis of the Compromise is the analysis of the triplet (X, Q, D) in the sense of a duality diagram.

The row scores (L) projection of the rows of X onto the principal axes (A) and the column scores (C) projection of the columns of X onto the principal

components (B) are given by L = XQA and C = X^TDB.

An RV coefficient can be calculated between the Compromise table X and each table X_k: Rv(X, X_k). It represents the squared cosine and defines the link between the Compromise and each table.

- The Infrastructure projects the elements (rows and columns) of each table onto the analysis of the Compromise.

Comparing the PTA with other data dimensional reduction techniques such as the SOM we note how the PTA is better able to manage a large amount of data unlike the SOM. Despite this, the SOMs have a great advantage, that is, they favor a direct interpretation of the data by also explaining the non-linear relationships (Peeters et al. 2006). Taking this into account, given the high number of observations and given the structure of our data, it was decided to use the PTA. For the analysis, was used ade4, a multivariate data analysis package for the R statistical environment (Thioulouse & Dray, 2007). We calculate the PTA of the economic-financial variables measured on 198 private ospital but in three different periods. The three tables, which form our historical series, are standardized for each year and then transformed into a single data frame. The PTA is calculated with the pta function.

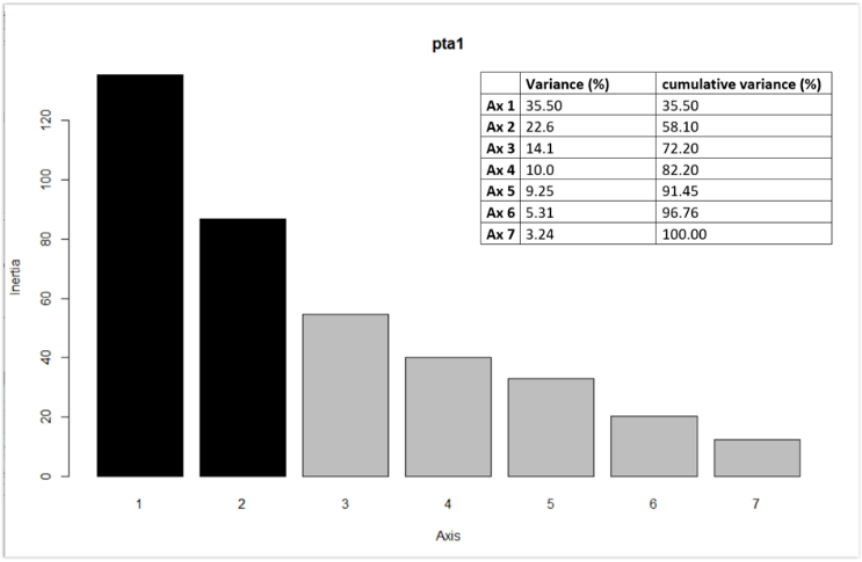
To answer the second research question, that is identify the configuration of Italian private hospitals, was used hierarchical clustering techniques. Cluster analysis has been used several times both in the hospital sector and in the corporate economic sector. Clustering or group analysis is a set of multivariate data analysis techniques aimed at selecting and grouping homogeneous elements in a data set. Clustering techniques are based on measures related to the similarity between elements (Romesburg, 2004). In the hierarchical analysis of clusters, the segmentation technique is based on a logic of minimizing the distances between the statistical units within the groups and maximizing the distances between the groups (Saâdaoui et al., 2015). Initially, each element is assigned to its own cluster and the hierarchical clustering algorithm proceeds iteratively, at each stage joining the two most similar clusters, continuing until there is only one cluster (Bridges & Cecil, 1966). The results can be viewed through a dendrogram which will help to understand exactly how many groups to form. For the hierarchical analysis of the clusters was used the hclust function of the stats package. This package contains functions for statistical calculations in R.

Finally, to answer the third research question, that is to identify how the configuration of Italian private hospitals change over time, we combined the results of PTA with the results of hierarchical analysis of the clusters. We identified the barycenters of each cluster and analyzed their trajectory over time (2008-2012-2016). We choose to use the barycenters because studying the trajectory of all 198 private hospitals would lead to poorly understood results. The centers of gravity represent the "average position" of all the companies that are in a particular cluster, or the arithmetic mean of the coordinates of each company on the axes identified through the PTA. Therefore, they are the best representation of our clusters.

Descriptive findings. We analyze the ownership structure of the 198 private hospitals of all 21 Italian regional health systems considering the legal form, the number of shareholders and the BVD independence indicator. Regarding the legal form, the private hospitals that make up our dataset are distributed in a homogeneous way. In total, there are 85 companies that are joint stock companies (n = 79 s.p.a. and n = 6 s.p.a. with sole shareholder) and 113 companies that are limited liability companies (n = 100 s.r.l. and n = 13 s.r.l. with single shareholder). Regarding the number of shareholders, they have on average 11 shareholders. as proof of the fact that Italian private hospitals are small companies and above all family-run companies, 50% of them have between 1 and 3 shareholders. Finally, to characterize the degree of independence of a company with regard to its shareholders, we use the BvD Independence Indicator. More than 50% of the private hospitals in our dataset have an Indicator D. It is allocated to any company with a recorded shareholder with a direct ownership of over 50%.

Results of the partial triadic analysis. In the ade4 package, the results of a PTA are stored in an object of the Dudi class. A Dudi class object is a list that contains both input and output data. The input data are the data tables (transformed into data.frame) and the weights for the rows and columns (stored as vectors). The output data are the results of the analysis of the input data. Among the output data we have the screeplot of the eigenvalues ($eig). The screeplot shows the importance of each major component. In the screeplot in Figure 2, we see the first two components (colored black) which are the ones selected to form the biplot. These summarize 58% of the variance of the original variables. Since we are in a compromise situation, we believe that these two axes (Ax 1 and Ax 2) represent satisfactorily the information contained in the original variables.

The results of the partial triadic analysis are presented in Figure 3. This figure uses the coordinates of the Intrastructure step of the PTA and shows the factorial map of the economic-financial variables. Compared to the results obtainable with a PCA, the graphs of the three periods are now at the same scale and can be overlaid and compared. The advantage of using the PTA lies in the fact that all points are in the same space, so the two axes have the same meaning in all three graphs. We can interpret the first axis as the solvency axis (financial profile) and the second axis as the profitability axis (economic performance). Through PTA, these two aspects have been identified as the best aspects to explain the variability among private hospitals.



	Variance (%)	cumulative variance (%)
Ax 1	35.50	35.50
Ax 2	22.6	58.10
Ax 3	14.1	72.20
Ax 4	10.0	82.20
Ax 5	9.25	91.45
Ax 6	5.31	96.76
Ax 7	3.24	100.00

Figure 2 Eigenvalues screeplot

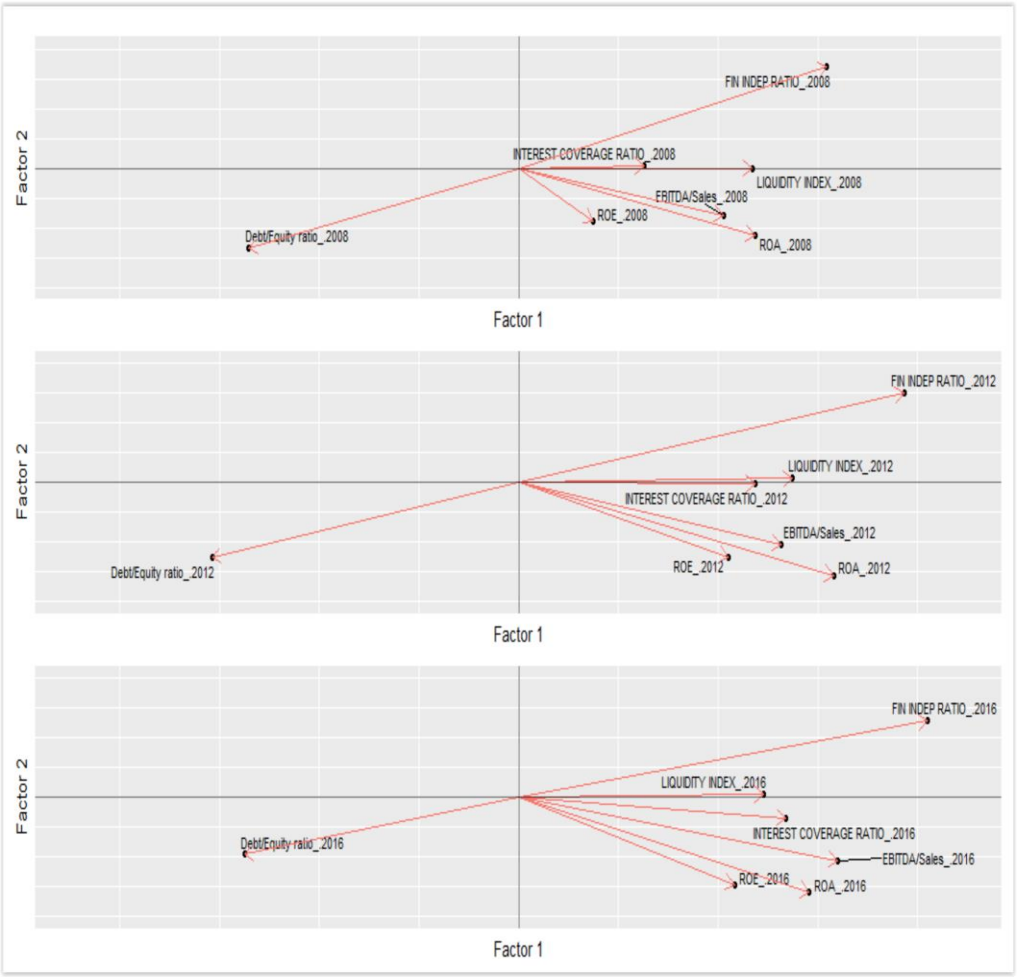


Figure 3 Factorial map of the economic-financial variables

Results of hierarchical clustering techniques. Starting from the common structure of the axes over the years, it was possible to identify the main configurations of private hospitals, through a hierarchical cluster analysis. The results of the hierarchical analysis cluster, in the three periods, are presented in Figures 4 - 6. As we can see, there are 4 different clusters identified by the scree-plot criterium (criterion of the maximum difference in Height). Looking at the average values of the variables in each cluster, we can understand what are the configurations of the private hospitals that compose them.

Cluster n°1 is located in the upper left quadrant. This cluster is characterized by private hospitals in a situation of severe financial stress. This cluster is defined by a liquidity index and an interest coverage rate of less than 1. The liquidity index is an instrument that expresses the company's ability to meet the financial commitments undertaken. It is given by the ratio between available assets and short-term debt. The numerator represents the amount of cash in hand and in the bank, the readiness for realization and short-term credits. The denominator instead is given by the debts to be paid immediately on sight or in the short term. Having a liquidity index lower than one means that the companies that are part of this cluster have a shortage of liquidity with respect to short-term debts. The interest coverage rate, on the other hand, indicates the degree of coverage that the operating result is able to provide at the cost of financial charges. It is given by the ratio between EBITDA and financial charges. The numerator represents the operational management of the company. The denominator, on the other hand, is given by financial charges. Similarly, having an interest coverage rate of less than one means that the income generated by the operations is not sufficient to remunerate the capital acquired to produce it. In this case, the final solvency is negative.

Cluster n°2 is located in the upper right quadrant. This cluster is characterized by private hospitals in an excellent situation both financially and economically. In fact, in this cluster we find positive values both of the debt ratios (eg liquidity index = 2) and of the profitability ratios (eg EBITDA/Sales = 16.5%). In this case, the solvency and the final profitability are positive.

Cluster n°3 is located in the lower right quadrant. This cluster is characterized by private hospitals in a situation of severe economic tension. This cluster is defined by an EBITDA/sales ratio of less than 10%. The EBITDA/Sales indicator expresses the company's true ability to stay on the market as it measures how much operating income it is able to generate per unit of turnover. EBITDA is the most important measure of income because it is not influenced by investment policies (through depreciation), financing policies (through interest expense), extraordinary and fiscal policies. Having a low EBITDA/sales ratio means that you are not very profitable companies. Looking also at the ROE values of private hospitals in cluster 3, we see that the percentage of profitability of invested capital is low. A value tending to zero means that wealth is neither being created nor destroyed. In this case, the final profitability is negative.

Finally, cluster n°4 is located in the lower left quadrant. This cluster is made up of private hospitals in the worst situation. Indeed, in this cluster we find lower average values, both for debt ratios (eg liquidity index = 0.69) and profitability ratios (ROE = -3.95%). In this case, the solvency and the final profitability are negative.

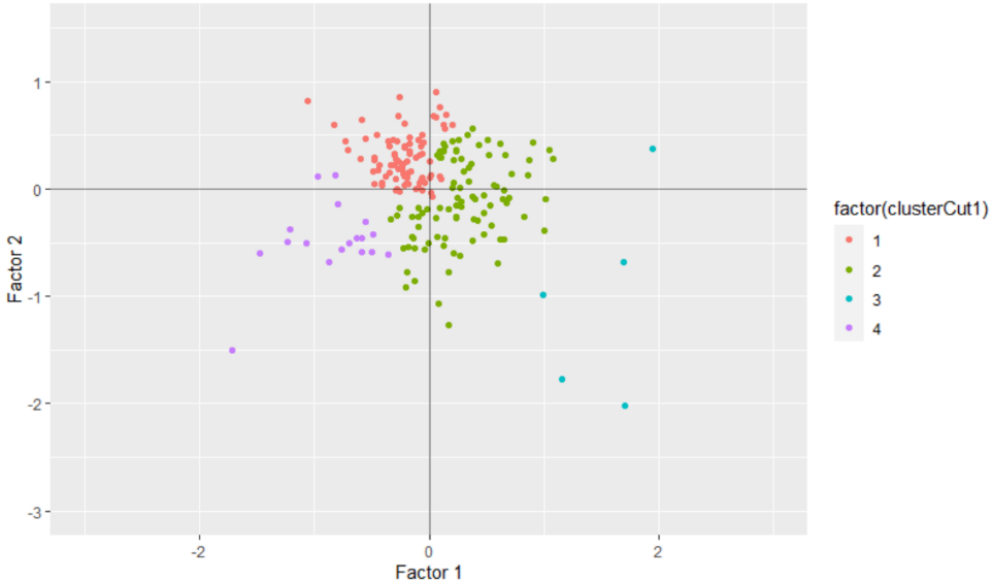


Figure 4 Factorial map of private hospital in 2008

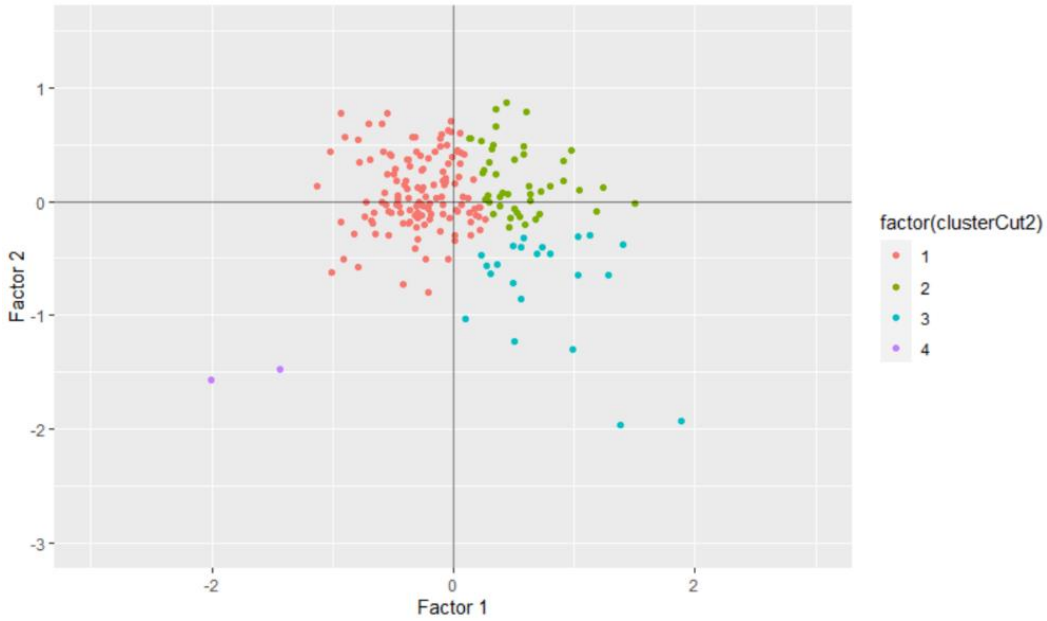


Figure 5 Factorial map of private hospital in 2012

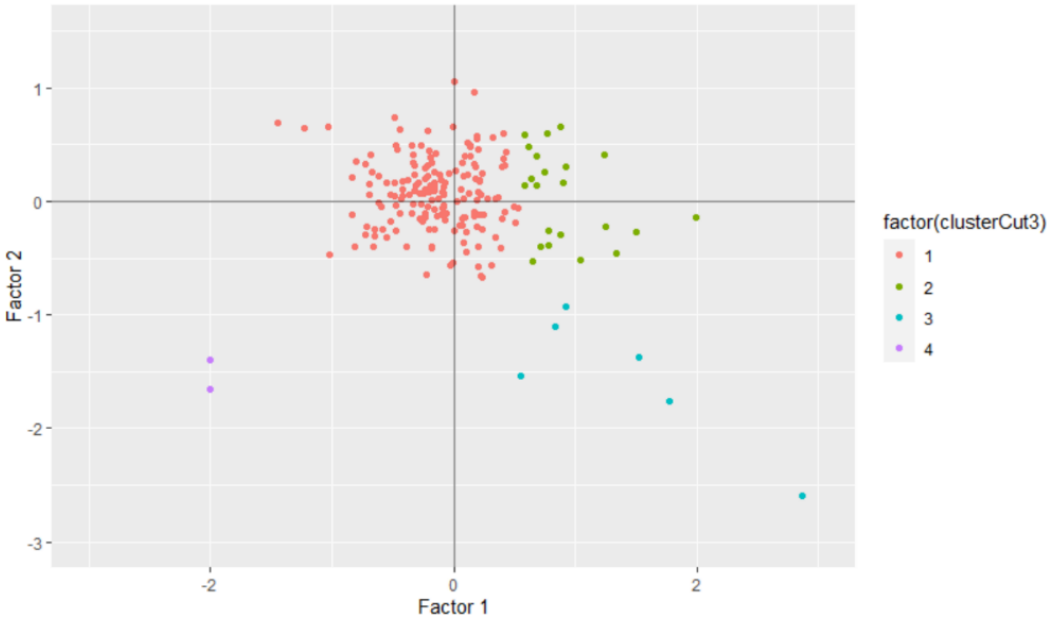


Figure 6 Factorial map of private hospital in 2016

Results of the centroids analysis. Finally, identifying the centroids of each cluster, we analyzed their trajectory over time (2008-2012-2016). Table 1 shows the coordinates of the centroids and the number of each cluster identified in each period. In Figure 7 the coordinates of the centroids are represented on the factorial axes of the PTA and with an arrow we are highlighted the trajectories of the clusters over time. The size of the spheres tells us whether that cluster has grown in number or not, while the arrow shows us how it has moved over time. As we can see, there is a variation in the number of clusters. Cluster n°1, which we remember to be composed of companies with negative solvency, is populated, passing from 84 to 130 to 168 companies. Therefore, between 2008 and 2016, increased the number of private hospitals that became indebted and unable to meet their debts. Cluster n°2, on the contrary, empties, passing from 91 to 44 to 22 companies. Cluster n°2, on the other hand, represented the best companies from both a financial and economic point of view. This reduction highlights what has been the difficulty faced by these hospitals over the years due to the difficulties of the public sector in financing the healthcare services provided. Cluster n ° 3 which is made up of those companies in serious economic tension, first undergoes a strong population in 2012 and then returns to the initial number. This situation shows that the tension to which these private hospitals are subjected leads to constant imbalances especially for the economic

performance. Cluster n°4, which represents the worst companies from both a financial and economic point of view, suddenly decreases (n = 18 in 2008 n = 2 in 2012-2016).

Instead, as regards the trajectories, we see that the four clusters move in different directions over the years. Cluster n° 1 shifts down from factor 2 in 2012 and then shifts slightly to the right in 2016. This change is due to changes in the values that make up Factor 2, ie due to changes in the levels of profitability of firms. Therefore, the enterprises of cluster n ° 1 already characterized by financial stress are also starting to have economic tensions. Cluster n ° 2 rises along Factor 2, in 2012 and then moves decisively to the right, along Factor 1, in 2016. This change, on both axes, is due to a change in both profitability and solvency values. Therefore, the enterprises of cluster n ° 2, which we have said to be the best, continue to improve both financial and economic profile. Cluster n° 3 moves upwards in 2012 falling lower than before in 2016. The final result of the displacements of this cluster on the plane is a worsening of the economic performance. Therefore, the enterprises of cluster n ° 3 that already had a reduced profitability see their economic tension increase. Finally, cluster n°4 moves decisively down, over time. This collapse is due to the worsening of both the economic and financial profile of the companies that formed this cluster. Therefore, the firms in cluster 4, which we said are the worst, continue to deteriorate.

Table 1 Centroids

	Cluster	Average Ax 1	Average Ax 2	Sd Ax 1	Sd Ax 2	n
2008	1	-0,2225487	0,29269345	0,22777408	0,23468525	84
	2	0,29145042	-0,1200571	0,33007207	0,39445972	91
	3	1,50185552	-1,018268	0,40560733	0,95051971	5
	4	-0,8520651	-0,4760954	0,3685302	0,34649442	18
	Cluster	**Average Ax 1**	**Average Ax 2**	**Sd Ax 1**	**Sd Ax 2**	**n**
2012	1	-0,2888035	0,07956118	0,30785852	0,32511005	130
	2	0,54935493	0,1970945	0,30184332	0,2920297	44
	3	0,76398626	-0,7262667	0,45352828	0,4844289	22
	4	-1,7174326	-1,5186223	0,40373301	0,0648922	2
	Cluster	**Average Ax 1**	**Average Ax 2**	**Sd Ax 1**	**Sd Ax 2**	**n**
2016	1	-0,1464898	0,06828224	0,36114775	0,3226437	168
	2	0,91574572	0,03962928	0,35293551	0,39454492	22
	3	1,41206753	-1,5479069	0,84242126	0,59277681	6
	4	-2,0042592	-1,5279097	0,00066634	0,18373098	2

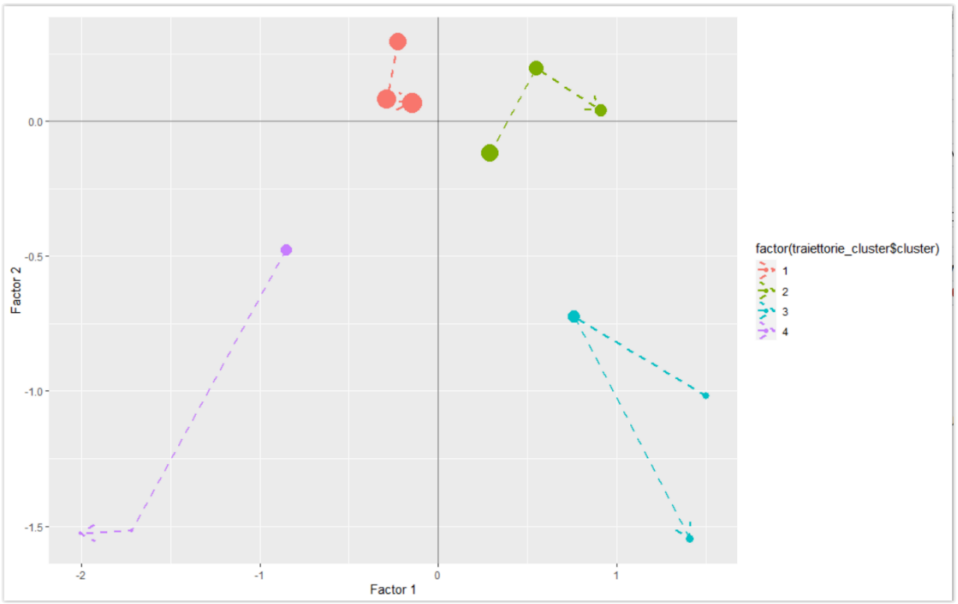


Figure 7 Graphic representation and trajectory of the baryvcenters

Research limits. The limits of our research are related to the fact that having used a factor analysis (PTA) it is not possible to visualize which variable constitutes the change in the number and trajectory of the clusters. In other words, we can analyze the shifts on the 2 new factors that synthesize the 7 original variables, but we cannot specifically say which is the variable that generates the change. Future research may use an ANOVA test to address this issue.

Practical implications. Beyond the conceptual relevance, there is also a practical relevance. In Italy there are approximately 522 accredited private providers and they hold 30.2% of the hospital offer of total beds (PL) (Lega et al., 2018) divided according to the type of hospitalization: (i) in PL for acute 22.8%, (ii) PL for long-term care 53.0%, (iii) PL for rehabilitation activities 74.0%. These companies operate in support of the NHS and are subjected to a multiplicity of pressures both from a financial and regulatory profile, with significant management repercussions (Cuccurullo et al., 2017). The results of our study allow us to understand the profiles of intra-sectoral dissimilarities, with useful implications for policy makers and management. Furthermore, the results can also be useful for providing indications to analysts and evaluators, called upon to play a professional role in company concentration processes.

Originality of the study. The originality of this contribution is both in the setting (ie private hospitals) and methodological. In fact, an academic interest in private hospitalization has only recently emerged (Lega et al., 2018; Carbone, 2013; Cuccurullo, et al., 2017) regarding the characteristics and peculiarities of these companies in terms of expenditure, size and levels sectoral concentration (Cuccurullo, et al., 2017); no study, however, to date, has dealt with analyzing the economic trend, the financial and structural growth profiles that distinguish the sector, nor the presence of well-defined corporate configurations, nor their evolution over time. The present study aims to map these private hospital configurations, through PTA combined with clustering techniques. In addition of being of very practical importance, PTA is a robust technique that can be used to integrate multiple data tables collected on the same set of observations and when there are numerous observations as in our case.

Key words: Private hospital, PTA, financial profile, economic performance

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