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EXPLORING THE DYNAMICS OF THE EFFICIENCY IN THE ITALIAN HOSPITALITY SECTOR. A REGIONAL CASE STUDY

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Exploring the dynamics of the efficiency in the Italian hospitality sector. A regional case study

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Abstract

This paper introduces a methodology to describe and compare the economic relative performance of the hospitality sector of the Italian regions during the period 2000-2004. Dynamics of the hospitality sector of each region is represented by the evolution of its economic efficiency. The investigation involves the following steps: a static Data Envelopment Analysis (DEA) to estimate the pure economic efficiency; two different notions of distances between time series and hierarchical clustering techniques are used to classify the economies in the sample. By using a correlation-based distance, three main clusters are detected, while two clusters are identified when the average distance is used. The trend patterns, identified by employing the correlation distance, can be interpreted in terms of exogenous factors that influence the economic efficiency of the group of regions, causing shocks picked up by the high volatility as well as structural breaks. By employing the average distance, one infers information on the cluster that have had similar efficiency values over the period under analysis. This efficiency can be also interpreted in terms of a particular type of hospitality management as well as the firm structure. Following the analysis, some policy and management implications are presented.

Keywords: Regional hospitality sector; window DEA; hierarchical clustering
Jel classification: C14; C24; L83

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1. Introduction

The hospitality sector plays an important role in the Italian economy as a revenue generator. Federalberghi and Mercury (2010) emphases that the Italian hospitality sector, expressed in terms of number of hotel rooms, ranks fourth after the United States, Japan and China. Besides, amongst the European countries, Italy is a leader in terms of hotel dimension and quality (number of stars). This motivates the interests of the this paper to examine the economic efficiency of the Italian hospitality sector. This question is particularly important in the light of an increasing awareness of sustainability issues that challenge the need for a further expansion of tourism infrastructure that may exploit finite and no-renewable natural resources (e.g. Bruni et al., 2011). As a matter of fact, within the time span between 2000 and 2004, supply capacity has grown by 7.9%, reaching two million beds-place in 2004 (ISTAT, 2011). Since the seminal work on Data Envelopment Analysis (DEA) by Charnes et al. (1978), empirical research papers have focused on efficiency in the manufacturing sector, health services, educational institutions, the services sector and private organizations such as banks. The analysis of efficiency in the tourism and hospitality sector has been growing during the last two decades (see Barros, 2005; Pulina, Detotto and Paba, 2010, or Fuentes 2011 for a literature account).

In this paper the dynamic evolution of the efficiency of the hospitality sector in the Italian regions is explored. The dynamic of the efficiency is explored in two steps. In the first step, following the work by Baker et al. (1984) a Data Envelopment Analysis (DEA) is applied to all the regions in the temporal window 2000-2004. Assuming a variable return to scale frontier of efficiency, the pure technical efficiency (PTE) is obtained for each region and period. This information allows one to quantify the efficiency level of the regions with respect to its own performance over time, as well as the performance of the relatively most efficient regions and periods. In the second step, the regions are clustered according to the temporal evolution of their efficiency. Two measures of distance between the time series of the hospitality sector in each Italian region are employed: the correlation and the supremum distance. These two measures are complementary to understand the dynamic evolution of the relative efficiency of the regions. Dynamics of two regions are close with respect to the correlation distance (Gower, 1966) if they have similar trend behavior across the time period. The supremum distance, on the other hand, groups regions in corridors along the whole period of study. If the supremum distance among the efficiency of a group of regions is equal to 10, it means that across the different periods, no one of the regions were separated more than 10 points of efficiency. Whereas the correlation distance gives information about the trends of the efficiency, the supremum distance informs on how different the dynamics of regional efficiency was during the period of study. Then, both distances give complementary information about the dynamics of the regions. On the one hand, if a group of regions have small correlation distance among them, this can be interpreted as economies having similar responses to external shocks affecting their efficiency. On the other hand, if a group of regions are "close" with respect to the supremum distance, this means that they have followed almost the same trajectory during the period under study, although they could have had different trends.

Even though there is an increasing concern with efficiency in the literature of tourism and hospitality (See Barros, 2005; Pulina, Detotto and Paba, 2010, and Fuentes 2011 for a literature account), so far a few studies have expored the dynamic evolution of efficiency. Tsaur and Shen-Hshiung (2001) study the efficiency of the 53 international tourist hotels in Taiwan from 1996 to 1998 and the time effect is introduced computing the average of the inputs and outputs during the three years. Hwang and Chang (2002) compute the efficiency change in year 1994 to 1998 for 45 Taiwan hotels using the Malmquist productivity decomposition. The authors use this temporal information to organize the 45 hotels into 6 clusters according to the efficiency change during the period 1994-1998 and the final relative efficiency in 1998. Thus, they identify in the two extremes; hotels with high competitiveness and a fast pace of progress as hotels in the "right track" and hotels with low competitiveness and worse pace of progress as firms with managerial deficiencies. Barros (2005b) explores the evolution of the efficiency of a hotel chain through two alternatives: on the one hand he uses a Malmquist productivity index to decompose the total productivity change in technical efficiency change and technological change and, on the other hand, the author analyzes the changes of the total productivity measures across the time with a Tobit model. Assaf and Agbola (2011) study the efficiency of a sample of 31 Australian hotels during the period 2004-2007. They employed the 31x4=124 observations in one DEA analysis, comparing the efficiency of the same hotels across the temporal window of 4 years. The authors use a truncated regression for showing that large hotels located in Australian cities are the conditions for being more efficient. This finding is consistent with the study by Barros (2006) and suggests that big hotels located in cities tend to be more efficient than those small in remote areas. Barros used information from Portuguese hotels between 1998 and 2002 to estimate a translog frontier model. Stochastic frontier analysis has provided an instrument for exploration of the dynamic, through the data panel study of different specification of cost and production functions. Perez-Rodriguez y Acosta-Gonzalez (2007) explored the cost efficiency and economic scales of the lodging industry on the island of Gran Canaria during the period 1991-2002 using a stochastic cost frontier model. The authors show statistically that efficiencies vary in time and that the mean cost inefficiency decreased over time.

The paper is organized as follows. Section 2 introduces the DEA methodology and applies it to the hospitality sector of the 21 Italian regions. Starting from these results, section 3 analyses the dynamics of the economic efficiency for these economies by introducing two different metric distances and hierarchical clustering techniques. The final section includes concluding remarks, policy and management implications of the results and future research.

2. Static methodology: DEA

DEA is a flexible technique that, in a multiple input-output framework, is reduced to a virtual uni-input-output structure, (for a more detailed discussion, see Charnes et al. 1978; Banker et al., 1984; Cooper et al., 2000). Within a given sample of decision making units (DMUs), a subgroup will achieve a relative efficiency equal to 1 (or 100%) and the residual DMU will be considered as inefficient if it has reached a score of less than 1 (or less than 100%). The efficiency (Y) of the DMU i is given by the following expression:

$$Y_i = \frac{\sum_{n=1}^{N} u_{ni} p_{ni}}{\sum_{k=1}^{K} v_{ni} x_{ki}}$$

where p_{ni} is the quantity of output n produced by the DMU i; uni is the weight of output n for the DMU i; x_{ki} is the quantity of input k employed by the DMU i; v_{ki} is the weight of input k for the DMU i. A high value of the input weight (v_{ki}) relates to an underperformance of that specific DMU with respect to all the other inputs employed by the DMU. Equivalently, a high value of the output weight (u_{ni}) denotes a strength in the production process.

The vectors of weights $v_{.i}$ and $u_{.i}$ for each DMU i are obtained through the solution of the following linear program: The vectors of weights $v_{.i}$ and $u_{.i}$ for each DMU i are obtained through the solution of the following linear program:

$$\max_{u,v} \sum_{n=1}^{N} u_n p_{ni}$$

subject to

$$\sum_{k=1}^{K} v_k x_{ki} = 1 \tag{1}$$

$$\sum_{n=1}^{N} u_n p_{nj} - \sum_{k=1}^{K} v_k x_{kj} \leq 0 \quad \text{para } j = 1..D$$

$$u \geq 0, v \geq 0$$

where D is the number of DMUs in the sample under study. In the presence of a multivariate input-output framework, the problem can be solved with either an output-oriented method, by maximizing the numerator while keeping the denominator constant, or an input-oriented method, by minimizing the denominator while keeping the numerator constant.

In this study, an input-orientated firm level model is used as a more appropriate setting when operational and management objectives are involved; for example, when DMUs are more interested in how to reduce their production costs (Cullinane et al., 2004). By adopting a Constant Return to Scale (CRS) framework, it is possible to obtain a DMU technical efficiency (*TE*), while by employing Variable Return to Scale (*VRS*) pure technical efficiency (*PTE*) is obtained. A ratio of these two economic measures gives scale efficiency scores (*SE*). In this study, the Baker, Charnes and Cooper (BCC) model is adopted, since most of the regions show *VRS*. Specifically, under *VRS*, the productive frontier is characterized by a piece-wise linear and concave shape. Hence, the calculated efficiency scores are defined as pure technical efficiency (*PTE*). The pure scale inefficiency is given by deviation from the efficiency frontier since resources are not used in an efficient manner. The *TE* is also calculated, under *CRS*, that measures the maximum level of output produced from a given set of inputs with the prevailing technology. The *TE* is composed by the *PTE* (under *VRS*) and the efficiency scores *SE*. Algebraically, *TE* is given by:

$$TE = PTE * SE \tag{2}$$

Hence, the DEA analysis has been further implemented by calculating the ratio between *CRS* and *VRS* technical efficiency scores, that gives *SE*. The scale inefficiency indicates that a DMU is not operating at optimal scale (i.e. at *CRS*). Specifically, *SE* can be either *CRS*, Decreasing Returns to Scale (*DRS*) or Increasing Returns to Scale (*IRS*) (see Charnes et al., 1978; Banker et al., 1984; Cullinane et al., 2004). In this study, the efficiency of 21 DMUs at regional level is compared. Given the availability of official statistic data (ISTAT, 2011) on hotels and restaurants, a time span of five years (2000-2004) is considered. In this case, the choice of inputs and outputs is important in the application of DEA. In the present study, sales revenue and value added are employed as outputs. Sales revenue is defined as the product between the price at which goods and services are sold and the number of units, or amount sold. Value added is defined as the market value of firms' product, or service, minus the cost of inputs purchased from other firms. These measures are recognized to be good indicators of financial efficiency (e.g. Wang et al., 2006; Min et al., 2008). Given the highly labour-intensive nature of the hospitality sector, labour costs are used as an input together with gross fix investment as physical capital production factor (Barros, 2005). Specifically, labour costs are defined as the total expenditure borne by employers in order to employ workers; this indicator includes direct remuneration, bonuses, payments for days not worked, severance pay, benefits in kind. They also include indirect costs linked to employees, such as contractual and voluntary social security contributions, direct social benefits, vocational training costs, other social expenditure (e.g medical services), and taxes relating to employment regarded as labour costs, less any subsidies received. Gross fix investment are defined as the acquisition of fix capital that also comprises the value of capital goods produced by the firm. Table 1 provides a description on the statistical characteristics of the economic indicators employed in this study (for a full detail by region, see Table A.1, in Appendix). To run the analysis, the software package Frontier Analyst 3.1.5 is used.

Table 1: Descriptive statistics, all sample (2000-2004)

	SR	VA	LC	K
Average	2,401,337	915,966	486,391	186,578
Stand.Dev.	2,369,254	845,287	483,187	199,323
Min.	100,890	25,982	14,581	5,796
Max.	10,770,620	3,710,862	2,157,532	1,277,027

Note. SR = sales revenue; VA = value added; LC = labour costs; K = gross fixed investment

3. Results of the DEA for each year

Table 2.A in the Appendix provides a detailed picture of the Italian regions economic efficiency, by year of investigation (t= 2000,…,2004). As stated, TE can be examined by decomposing it into PTE and SE. Overall, the TE index decreases from 92.20% in 2000 to 88.36% in 2004. Similar picture for the PTE that shows a decrease from 95.41% to 89.98%. An increase by 1.57% is only found for the SE, though the percentage of DMUs characterized by CRS diminishes from a quota of 47.62% to 38.10%, meaning that most of the Italian regions are relatively inefficient across the decade. Table 2 provides results on the PTE of all the Italian regions. As one can notice, only two regions, namely Lombardy and Molise, have 100% of efficiency for the whole period. Piedmont shows the second best performance. However, the majority of the regions are well below of the production frontier for most of the years.

Table 2: Efficiency of the Italian region

Region	Code	2000	2001	2002	2003	2004
Abruzzo	Abr.	100	100	100	97.49	82.45
Aosta Valley	Avl.	97.69	100	71.27	61.01	84.42
Apulia	Apl.	89.25	59.38	100	71.82	86.85
Basilicata	Bas.	100	90.785	81.57	95.23	79.66
Bolzano	Boz.	89.43	85.7	100	78.68	88.56
Calabria	Cal.	85.19	80.71	100	78.64	77.71
Campania	Cam.	100	100	100	76.7	75.09
Emilia Romagna	Ero.	90.57	100	94.43	87.2	100
Friuli Venezia Giulia	Fri.	91.71	83.07	100	100	83.73
Lazio	Laz.	100	100	96.8	95.08	100
Liguria	Lig.	100	96.71	71.84	100	98.92
Lombardy	Lom.	100	100	100	100	100
Marche	Mar.	100	89.19	75.52	91.94	100
Molise	Mol.	100	100	100	100	100
Piedmont	Pie.	100	100	100	100	91.78
Sardinia	Sar.	87.32	74.46	78.7	70.73	100
Sicily	Sic.	90.15	99.87	71.97	65.21	63.81
Toscany	Tos.	100	88.03	84.29	90.18	98.13
Trento	Tre.	93.15	69.47	91.01	74.4	78.53
Umbria	Umb.	89.05	100	89.83	98.87	100
Veneto	Ven.	100	96.57	100	100	100

4. Dynamic analysis: distances and clustering techniques

In the previous section an indicator of efficiency for the hospitality sector of each of the Italian regions and for each year of the period under analysis was obtained. The time series vector $Y_i = (y_{i1}, y_{i2}, y_{i3}, y_{i4}, y_{i5})$, where each entry is the value of the efficiency of DMU labeled by i ($i = 1,\ldots,20$) represents the dynamic trajectory of region i. In this section we compare the evolution of the efficiency of the DMUs by using hierarchical clustering methodologies to obtain groups of regions with similar dynamics. In order to decide where a cluster should be split, a measure of dissimilarity between sets of observations is required. This is achieved by use of an appropriate metric that measures distances between pairs of observations and a linkage criterion which specifies the dissimilarity of sets as a function of the pair wise distances of observations in the sets. In this paper we introduce two different metric distances to compare dynamics of the regions: the correlation distance and the average distance. Table 2 shows that Molise and Lombardia are the unique regions with 100% of efficiency in all periods of our study. For this reason, we will consider only the rest of the regions.

5. Correlation distance

The correlation coefficient is defined as

$$\rho_{ij}(\Delta t) = \frac{\langle Y_i, Y_j\rangle - \langle Y_i\rangle\langle Y_j\rangle}{\sqrt{\left(\langle Y_i^2\rangle - \langle Y_i\rangle^2\right)\left(\langle Y_j^2\rangle - \langle Y_j\rangle^2\right)}} \quad (3)$$

where $Y_i$and $Y_j$are two time seriesand Δt is the time horizon. The empirical statistical average, indicated in this paper with the symbol $\langle .,. \rangle$, is here a temporal average always performed over the investigated time period.

By definition, $\rho_{ij}(\Delta t)$can vary from −1 (completely anticorrelated pair of series) to 1 (completely correlated pair of series). When $\rho_{ij}(\Delta t)$= 0 the two stocks are uncorrelated. Then, following (Gower, 1966) a metric distance between a pair of time series can be rigorously determined by defining

$$d^\rho(Y_i, Y_j) = \sqrt{2\left(1 - \rho_{ij}(\Delta t)\right)} \quad (4)$$

Let call these metric the *correlation distance*. Note that the correlation distance d^ρbetween two DMUs *i* and *j* measures how close is the trend behavior of both variables. The distance varies in the range [0,2] with 0 meaning that the two DMUs had the same behavior and 2 means that the two DMUs had completely different behavior, therefore they are far between them. Note that d_{ij}^ρ fulfils the three axioms of a metric: (i) $d_{ij}^\rho = 0$ if and only if$i = j$; (ii) $d_{i,j}^\rho = d_{j,i}^\rho$ and (iii) $d_{i,j}^\rho \leq d_{i,k}^\rho + d_{k,j}^\rho$. We call d_{ij}^ρ the correlation distance between two time series. The correlation distance among all the DMUs is captured in the distance matrix D^ρ.

6. Average Distance

Given two time series $X = (x_t)_{1\leq t\leq T}$ and $Y = (y_t)_{1\leq t\leq T}$, the average distance between them is computed according to:

$$d^m(X,Y) = \frac{1}{T}\sum_{1\leq t\leq T}|x_t - y_t| \qquad (5)$$

where | | represent the absolute value of a real number.

The average distance between time series in our contextcaptures how far two DMUs were during their trajectories. This distance might vary between 0 and 100 points. A distance of size 0, means that both variables are the same whereas a distance of size 100 means that during their trajectory one of the DMUs had 0 efficiency whereas the other was on the frontier of efficiency. The average distance among all the DMUs is captured in the distance matrix D^m.

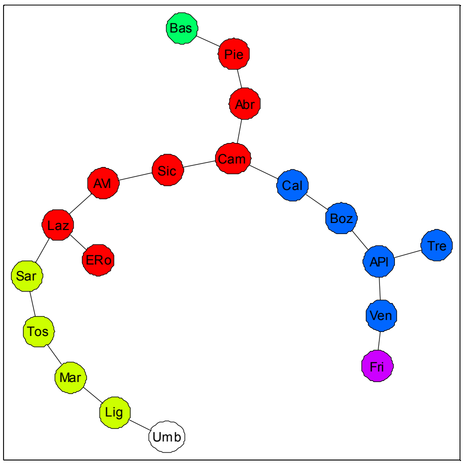
7. Minimal spanning and hierarchical trees

The metric distances introduced in the previous section allow us to obtain the minimum spanning tree (MST) and a hierarchical tree (HT) by using the nearest neighbor single linkage cluster analysis (Ramal et al. (1986); Brida et al. (2009)). In other words, geometrical (throughout the MST) and taxonomic (throughout the HT) aspects of the performances present between the reggion pairs of our sample can be sorted out using the information contained in the table of distances between countries. The MST is a graph which selects the most relevant connections of each element (region in our case) of the set. The MST allows us to obtain the ultrametric distance matrix and the hierarchical organization of the elements of the investigated data set. The MST is progressively constructed by linking all the countries together in a graph characterized by a minimal distance between time series, starting with the shortest distance. The method relies upon Kruskal's algorithm of single linkage (Kruskal, 1956) and in our case the tree is a graph with 19 vertices corresponding to each region and 18 links which selects the most relevant connections of each element of the set. In the first step we choose a pair of time series with the shortest distance and we connect them. In the second step we connect a pair with the 2nd shortest distance with a line proportional to the previous link. In the third step we connect the nearest pair that is not connected by the same tree. We repeat this until all the given countries are connected in a unique tree. A pedagogical exposition of the determination of the MST in the contest of financial time series is provided in Mantegna (1999). The MST allows us to obtain, in a direct and essentially unique way, the ultrametric distance and the hierarchical organization of the elements (countries in our case) of the investigated data set. (see Brida and Risso, 2008 and 2010).

8. Empirical Results

In Figure 1 we show the Minimum Spanning Tree obtained by using the correlation distance d^{ρ}. In this MST, some regions like Campania are linked with regions geographically neighbors (like Sicily and Calabria) whereas others are linked to not neighbor regions (the most notable case is Apulia, a region of the South of Italy that is linked with three regions of the North of the country). As a matter of fact, Apulia has a similar rate of tourism propensity (number of tourism municipalities over the total municipalities in the region, 87.2%), as the Northern regions of Veneto (89.3%), Friuli Venezia Giulia (93.6%) and Trentino (94.4%) (see Federalberghi & Mercury, 2010).

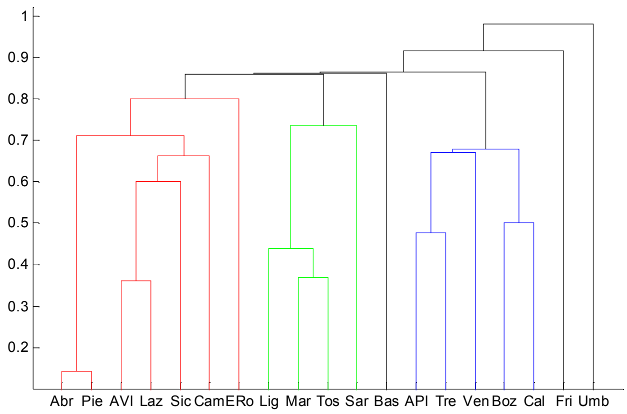
Figure 1: Minimum Spanning Tree using the Correlation Matrix D^{ρ}



The HT obtained starting from the MST described in Figure 1 is shown in Figure 2. In the figure, each vertical line indicates a region. Each of the investigated economies is indicated with its tick symbol in the figure caption. The stopping rule from the test introduced in Tibshirani et al. (2001), indicate that the optimal number of clusters is three. This optimal number is also confirmed by the Pseudo-F test (Calinski 1974) and Pseudo-t test (Duda and Hart 1973). Cluster A is composed by Abruzzo, Piedmont,Aosta Valley, Lazio, Sicily , Campania and Emilia Romagna; cluster B by Liguria, Marche, Sardinia and Toscany; cluster C by Apulia, Trento, Veneto, Bolzano and Calabria. Campania forms a link between the other regions belonging to cluster A and cluster C.

The regions Basilicata, Friuli Venezia Giulia and Umbria are not grouped and can be considered as outliers. Note that all the clusters are integrated by regions of the north, center and south of Italy. Thus, no geographical groping exists with respect to the correlation metric. Moreover, if we look inside each cluster at the hierarchical tree, we cannot find subclusters corresponding to neighbor regions. For instance, cluster C can be decomposed into two subclusters whose members are one region of the north and one of the south (Apulia and Trento; Bolzano and Calabria) plus the region of Veneto.

Figure 2: Hierarchical Tree using the Correlation Distance *D*[ρ]



Note: The three clusters are painted in different colors. The cut-off is to distance of 1.7 according to the gap test.

Each cluster represents an homogeneous behavior with respect to correlations. The three distinguished behaviors are captured by the average trends of each group in Figure 3. The figure represents the trajectory of an average region of each of the three clusters. Note that cluster C is characterized by an irregular W trajectory, where efficiency first decrease, then increase, decrease again to increase at the end of the period. The trend in this case is almost constant. Cluster A is characterized by increasing efficiency in 2000-2001 and 2003-2004 and decreasing efficiency in 2001-2003, but the trend of efficiency in this cluster is decreasing. Finally, cluster B first decreases and then increases efficiency, arriving at the end of the period to an efficiency level of almost 100. The outliers present irregular patterns.

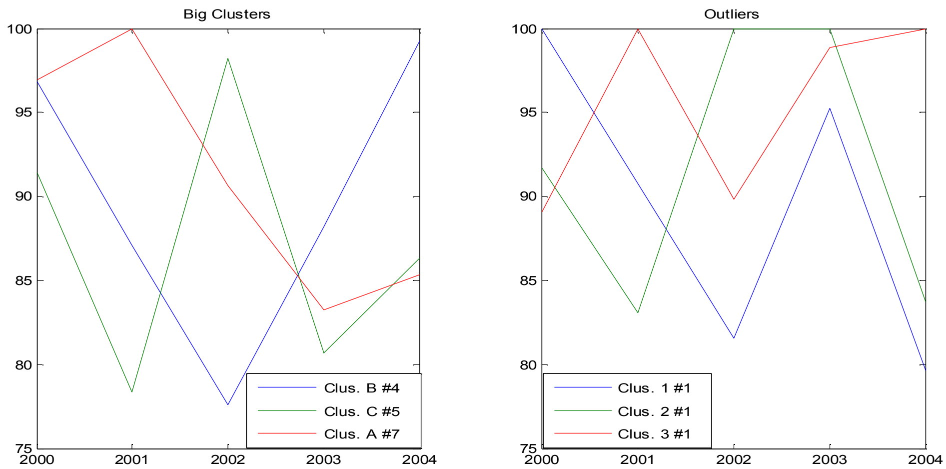
These trend patterns can be interpreted in terms of exogenous factors that influence the economic efficiency of the group of regions, causing shocks picked up by the high volatility as well as structural breaks. Of particular importance, the introduction of low cost carriers in several Italian airports. This event has been considered as an opportunity and yet a competition challenge for many European destinations (e.g. O'Connell and Williams, 2005; Pulina and Cortés Jiménez, 2010). Interestingly, if in Italy the average growth of nights of stay in hotels during the period 1997-2000 was 4.0% (with a minimum of 2.4% in between 1998/1999 and a maximum of 6.9% for 1999/2000), during the period 2000-2004 was 0.05% (with a minimum of -2.3% in between 2000/2001 and a maximum of 2.8% for 2003/2004), denoting a high degree of volatility of tourism flows.

As a matter of fact, the average number of overnight stays between 2000 and 2001 show an increase of 2.3% (Federalberghi & Mercury, 2008). However, only regions belonging to cluster A show an increase in their efficiency, whereas both regions belonging to cluster B and C show a decrease in the level of their efficiency. Actually, the evolution of the growth of overnight stays during the period of observation is characterized by a strong decrease (-3.2%) between 2001 and 2002.

The evolution of efficiency for clusters B and C matches the evolution of overnight stays during the period of interest, but to a less extent with respect to cluster A. Particularly, cluster C is characterized by an increase in the efficiency between 2001 and 2003, the time span when, overall, the hotel infrastructures were characterized by a decrease in the overnight of stays.

One may explain this fact by considering that the terroristic attack on September the 11th may have influenced tourists' perception, moving tourism flows towards peripheral regions, thus diminishing the number of arrivals in central regions, especially in large cities such as Florence (Tuscany) and Rome (Lazio). In this respect, tourists' perception of unsafe regarding regions belonging to clusters A and B may have moved tourism flows towards more peripheral regions. This explanation can be complementary to the high tourism vocation – and therefore capacity to attract tourism flows - of the regions belonging to cluster C. According to Federalberghi & Mercury (2004), the province of Trento, Bolzano and Venezia (Veneto) indeed rank among the first five provinces in Italy with the highest number of overnight of stays, thus confirming their high tourism potential. Moreover, Puglia and Calabria rank 1st and 4th respectively as far as the evolution of the number of hotel infrastructure is concerned (Federalberghi & Mercury, 2006). Furthermore, Calabria ranks 2nd for the number of rooms and beds (Puglia ranks 5th and 4th, respectively).

Figure 3: Average efficiency of the clusters using D^o

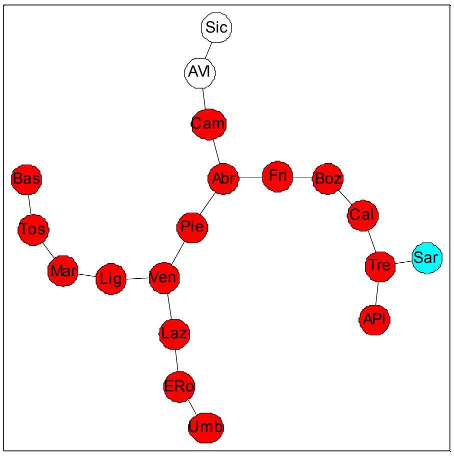


Note: Cluster A is the average efficiency of Abruzzo; Campania; Piedmon;Sicily; Aosta Valley; Emilia Romagna and Lazio. Cluster B : Liguria; Marche;Toscany and Sardinia and Cluster C: Apulia; Bozen; Calabria; Trento and Veneto. Cluster 1: Basilicata. Cluster 2: Friuli Venezia Giulia, Cluster 3: Umbria.

In Figure 4 we show the Minimum Spanning Tree obtained by using the average distance d^m. In this MST, the central positions are occupied by

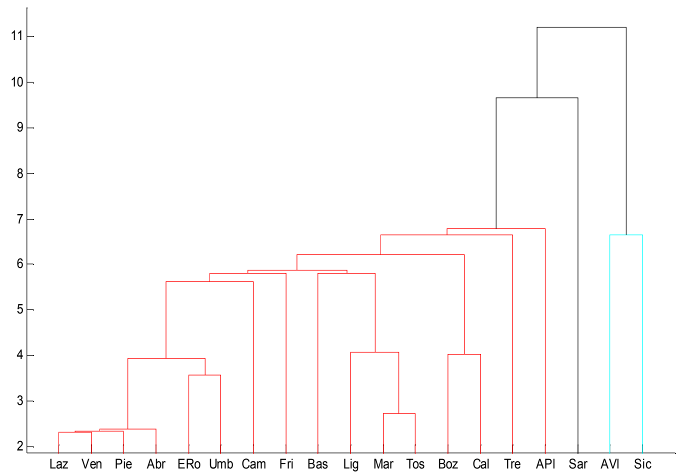
Veneto, Piedmont and Abruzzo. As in the case of the correlation distance, some are linked with regions geographically neighbors and others are linked to not neighborhood regions. Thus, one does not find any geographical criteria shared neither by regions belonging to the same cluster, nor by regions which are close to each other.

Figure 4: Minimum Spanning Tree using the Average Distance Matrix D^m



The hierarchical tree obtained starting from the MST described in Figure 4 is shown in Figure 5. The stopping rule Tibshirani et al. (2001) indicate that the optimal number of clusters is two and there is a region outside the clusters (Sardinia). These clusters are composed by: Sicily and Aosta Valley (Cluster 1) and Lazio, Veneto, Piedmont, Abruzzo, Emilia Romagna, Umbria, Campania, Friuli Venezia Giulia, Basilicata, Liguria, Marche, Toscany, Bozen, Calabria, Trento and Apulia (Cluster 2). In this case we have a cluster containing most of the regions under study, indicating that the dynamic behavior is almost homogeneous. Just three regions (Sardinia, Sicily and Aosta Valley) follow trajectories that are in average far from the cluster.

Figure 5: Hierarchical Tree using the Average Distance Matrix D^m



Note: The two clusters are painted in different colors. The cut-off is to distance of 7.5 according to the gap test.

Note that Cluster 1, the most numerous one, contains sub clusters that can help the interpretation of the results. For example, in the group composed by Veneto, Abruzzo, Piedmont, and Lazio, the ultrametric distance between two members is less than 2.5, indicating that the members of this group are the most compact between Cluster 1. Note that this group has also a central position in the MST and then it is well connected with all other regions.

This subcluster has no geographical connotation, since it is composed by two regions in the Centre (Abruzzo and Lazio) and two regions in the North of Italy (Piedmont and Veneto).

However, these regions share some common features that may explain the similar evolution of the efficiency. Federalberghi & Mercury (2006) point out that these regions, in the period between 1995 and 2005 present a similar variation in terms of number of beds and rooms. Moreover, as far as the variation of the number of infrastructure is concerned, the subcluster can be further divided into two groups, according to a geographical criteria. In particular, regions in the North of Italy show a negative variation in the number of hotels, whereas central regions (i.e. Abruzzo and Lazio) are characterized by a positive variation.

Marche and Tuscany form a subluster of Cluster 1. These regions are geographically neighbors and stay at an average distance of less than 2% during the period under study. This is an indicator of a close evolution of efficiency. Moreover, given that these regions also belong to the same Cluster B with respect to the correlation distance, they have also followed a similar variation of efficiency.

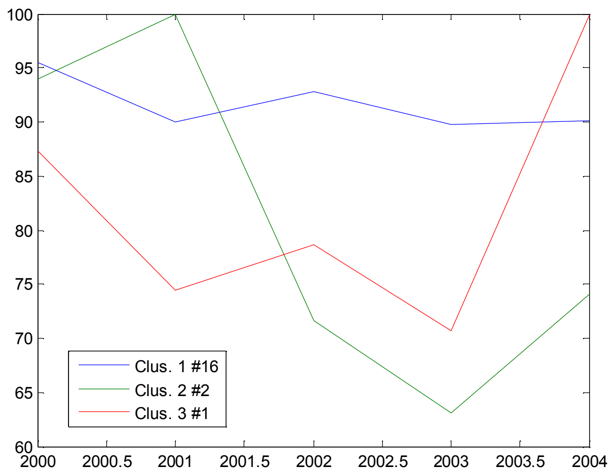
Figure 6 represents the trajectory of an average region of each of the five clusters. Note that Cluster 1 is characterized by high efficiency, all the values of efficiency of the average region in this cluster are almost constant and between 90 and 95. Moreover, the pattern of the regions belonging to Cluster 1 is smoothed during the period under analysis. This may be due to the fact that Cluster 1 comprises almost all Italian regions. The high heterogeneity between them may smooth differences in the efficiency, giving rise to a relatively flat pattern.

The average region of the Cluster 2 present similar dynamics to the average region of Cluster B with respect to the correlation distance. In fact, Sicily and Aosta Valley are regions belonging to Cluster B.

The pattern of regions belonging to Clusters 2 and 3 may be explained taking into consideration that all the regions belonging to these clusters are regions with a high tourism propensity.

In particular, Cluster 2 comprises Sicily and Aosta Valley and denotes the sharpest decline of efficiency during the period under study. This pattern for the regions belonging to Cluster 2 may be due to inefficiencies in the rate of utilization. As far as regions in Cluster 2 are concerned, they denote similar characteristics as far as seasonality is concerned. The percentage of seasonal hotels is medium-high for the regions belonging to such a cluster that is according to in 2004 it was 19.8% for Aosta Valley and 19.0% for Sicily (Federalberghi & Mercury, 2006).

Figure 6: Average efficiency of the three clusters using D^m



Note: Cluster 1 is the average efficiency of Apulia, Trento; Friuli Venezia Giulia, Veneto, Abruzzo, Piedmont, Emilia Romagna, Lazio, Toscany, Umbria; Liguria; Marche Bozen, Calabria, Basilicata and Campania. Cluster 2: Sicily and Aosta Valley, and Cluster 3 Sardinia.

Table 3 summarizes the composition of the clusters obtained by means of the two distances. For example, the group of regions composed by Liguria, Marche and Tuscany is contained in Cluster B with respect to the correlation distance and in Cluster 1 with respect to the average distance. One can note that the graphs of the average region in these cluster have a similar form. This is also the case of Sicily and Aosta Valley, a group contained in Cluster A with respect to the correlation distance and in Cluster 2 with respect to the average distance.

Table 3: Clusters composition. Rows represent clusters obtained by mean of the average distance while columns represent clusters obtained from the correlation distance. Regions belonging to the same row and column of the table (for example, Abruzzo and Piemonte) are "close" with respect to both distances; i.e., they have showed a similar trend and dynamics for the whole period.

<table>
<tr><td></td><td></td><td colspan="4">Cluster using D^m</td><td></td></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td>C</td><td>outliers</td><td>Total</td></tr>
<tr><td rowspan="3">Clusters using D^ρ</td><td>1</td><td>Abr, Pie, Laz, Cam, ERo</td><td>Lig, Mar, Tos</td><td>APl, Tre, Ven, Boz, Cal</td><td>Fri, Umb, Bas</td><td>16</td></tr>
<tr><td>2</td><td>Avi, Sic</td><td></td><td></td><td></td><td>2</td></tr>
<tr><td>outliers</td><td></td><td>Sar</td><td></td><td></td><td>1</td></tr>
<tr><td></td><td>Total</td><td>7</td><td>4</td><td>5</td><td>3</td><td>19</td></tr>
</table>

If one uses both the segmentations of the set of regions obtains twelve different groups. Six of these groups are empty and one has only one element. Reading Table 3 in columns, one infers the regions that have similar pattern responds to exogenous shocks. In this case, one has three distinct types of responses to exogenous shocks, denoting indeed three different clusters. Reading Table 3 in rows, one infers information on the cluster that has had similar efficiency values over the period under analysis. This efficiency can be also interpreted in terms of a particular type of hospitality management as well as the firm structure.

Tuscany, Liguria and Marche belong to Cluster B with respect to the correlation distance and to Cluster 1 with respect to the average distance. These regions present similar variation of consistency (expressed in terms of infrastructure) and capacity (expressed in terms of beds and rooms) and quality of firms (stars) during the period under study (see Federalberghi & Mercury, 2006). This can be an explanation of the very similar dynamical behavior of efficiency of the members of this group.

Sicily and Aosta Valley are the only regions belonging to Cluster A and Cluster 2. These regions present a decline in efficiency from a starting value of 95 in 2000 to 75 in 2006. This is the largest decline of efficiency during the period under study. One may attribute this pattern to similarities in the rate of utilization, that shows a negative variation in the last years of investigation, hence possibly denoting a lack of adequate management.

Specifically, Abruzzo, Piedmont, Lazio, Campania and Emilia Romagna belong to Cluster 1 as far as correlation distance is concerned, and to Cluster A for the average distance. Actually, this means that not only they have showed a similar response to external shocks, but they have also followed a similar path during all the period taken into consideration.

Among those regions, Abruzzo, Campania and Emilia Romagna are characterized by a medium-high seasonality (Federalberghi & Mercury, 2010). Particularly, as Federalberghi & Mercury (2006) highlights, Emilia Romagna has the highest percentage of hotels which open only during the summer months (53%). Affecting hotels' rate of utilization, the seasonality is not neutral for the efficiency of the hotel sector. Decreasing seasonality would indeed lead to a better exploitation of inputs, and therefore to a higher efficiency.

Furthermore, the regions belonging to Cluster 1 and Cluster A share similar characteristics as far as the distribution of rooms for each hotel category. These regions have the highest percentage of hotels belonging to the three-stars category. The highest percentage is the one of Abruzzo (61.2%), whereas the highest is the one of Campania (41.6%) (Federalberghi & Mercury, 2004). In this respect, regions belonging to the cell identified by Cluster 1 and Cluster A share a common entrepreneurial structure.

9. Conclusions

In this paper, a methodology has been introduced to explore the dynamical behavior of the economic efficiency of the hospitality sector in the Italian regions, during the period 2000-2004. This tool allows one to construct clusters according to two measures of distance between the trajectory efficiency of the regions: the correlation and the average distance. The correlation distance clusters together regions where the time series of the measure of efficiency are correlated. The average distance clusters together regions having a similar level of efficiency during the whole period.

All regions, except three outliers have been clustered in three groups according to the correlation distance. Then, the evolution of the average efficiency has been taken into consideration, in order to identify some common features which may have determined regions belonging to the same cluster to respond to shock in a similar way. Considering the evolution of the overnight of stays during the period of interest, as an indicator for external shocks, it has been noticed that regions belonging to Cluster C (i.e. Apulia, Trento, Veneto and Bozen) show an opposite pattern with respect to the evolution of such an economic indicator. It may be possible that the terroristic attack in 2001 have moved tourism flows away from central regions with large cities such as Florence and Rome, thus causing an opposite movement of the efficiency in the peripheral regions.

On the one hand, when considering the average distance, regions are grouped into two clusters, with the majority of regions belonging to the first cluster. When looking at the evolution of the average efficiency over the period under consideration, the path of the efficiency of all the regions, but those belonging to Cluster 2, is rather smooth. On the other hand, Sicily and Aosta Valley, which belong to the second cluster, are characterized by a large decrease of the efficiency in the period taken into consideration. This may be due to the high seasonality of these regions, which may cause inefficiencies in the utilization of resources.

Finally, all regions are segmented according to the fact that their belonging to the clusters identified with the correlation distance rather than the average distance. Regions which show a similar trend and dynamics share common features in terms of entrepreneurial structure (i.e. number of stars, beds, rooms) as well as for the seasonality. Structural factors rather than the mere geographical location of hotels indeed affects the evolution of hotel efficiency over time.

The results obtained in this paper suggests future research into two lines. On the one hand, the exploration of the data in the Italian hospitality sector has indicated the possibility to explore new relationships between investments, labor, revenues and value added among the regions. On the other hand, new distances can be employed to extract different information from this empirical data and another data sources. In particular, if longer time series were available, the evolution of the clusters could be further investigated. (see Brida et al., 2010). Limitation of the present research includes the relatively short time span of the data set and the use of aggregate data that may not be entirely represent tourism demand and supply.

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Appendix

Table A1: Descriptive statistics, by region (2000-2004)

Regions	Code	SR				VA				LC				INV			
		mean	stand.dev	min.	max	mean	stand.dev	min.	max	mean	stand.dev	min.	max	mean	stand.dev	min.	max
Abruzzo	Abr.	847459	109946	109946	1010752	286805	35693	244547	346481	139524	20630	106779	162255	66575	34396	37568	126735
Aosta Valley	Avl.	293614	34424	34424	349392	131915	28185	99047	169447	71276	8527	58530	83641	23807	6452	13412	31214
Apulia	Apl.	1795017	147127	147127	1994744	640496	58892	584101	722057	351011	39710	287756	412350	221271	107128	114012	418683
Basilicata	Bas.	234823	53495	53495	294429	91031	28494	46914	125044	43985	12879	22263	54674	53027	29343	10376	83995
Bozen	Boz.	1433232	121764	121764	1661344	714572	85431	640092	856690	327008	15105	305722	347460	393335	442809	138158	1277027
Calabria	Cal.	844473	116739	116739	1011321	336649	62830	271753	431507	166327	29364	129114	205353	164663	54522	107464	264436
Campania	Cam.	2722508	196878	196878	3049676	1073670	58075	992553	1162099	565633	120577	452826	784498	146408	54181	72089	222301
Emilia Romagna	Ero.	5080050	456675	456675	5985210	1979330	217340	1677241	2248674	1046344	120569	943849	1281708	321840	121824	196314	518639
Friuli Venezia Giulia	Fri.	1318820	155920	155920	1553218	475465	92983	408134	659731	232486	27802	195414	268372	137487	95097	46625	278862
Lazio	Laz.	5633815	667647	667647	6367234	1995175	178716	1786942	2227798	1267897	236832	989690	1614357	323456	209790	160541	725535
Liguria	Lig.	1685520	122612	122612	1847318	666740	47438	598509	741284	312497	45315	262505	391723	85370	31780	40527	120839
Lombardy	Lom.	9840470	989065	989065	10770620	3380587	329867	2789580	3710862	1897960	241388	1482318	2157532	632043	202500	373784	968037
Marche	Mar.	1130035	126715	126715	1381307	414210	75911	357722	560299	214335	36992	153404	260150	61996	16854	37926	81180
Molise	Mol.	143880	22468	22468	175606	54440	15500	25982	72269	22846	5304	14581	29536	11325	4259	5796	18592
Piedmont	Pie.	3023242	355843	355843	3717479	1089232	122267	991718	1326779	481899	74557	381140	589796	165229	38642	101636	214837
Sardinia	Sar.	1198570	123439	123439	1382740	534296	128539	452069	790045	246866	18738	223414	277272	117537	36025	52459	157231
Sicily	Sic.	1804193	224695	224695	2275664	702677	96894	590469	858395	450829	86125	313968	547376	103707	39152	59909	167395
Toscany	Tos.	3789810	319297	319297	4302412	1557084	162319	1261991	1715011	802720	126180	637651	947634	257220	74903	170527	367566
Trento	Tre.	973727	92537	92537	1101604	445778	56212	373376	519640	223996	24003	204329	270345	205918	163142	55804	498809
Umbria	Umb.	739811	65973	65973	873423	294977	14988	267436	309478	129993	12054	108620	145578	55839	38867	19721	119905
Veneto	Ven.	5461703	353281	353281	5957460	2205163	112866	2086004	2418614	1130304	62787	1046586	1209115	343370	89559	192319	466104

Table A2. Italian hotel and restaurants efficiency: technical efficiency (*TE*), Pure Technical Efficiency (*PTE*), Scale Efficiency (*SE*), Returns to Scale (*RS*) – (2000-2004)

Regions	Code	TE00	PTE00	SE 00	RS 00	TE01	PTE01	SE 01	RS 01	TE02	PTE02	SE 02	RS 02	TE03	PTE03	SE 03	RS 03	TE04	PTE04	SE04	RS 04
Abruzzo	Abr.	100	100	100	CRS	100	100	100	CRS	90.87	100	90.87	CRS	96.74	97.49	99.23	DRS	81.95	82.45	99.39	IRS
Aosta Valley	Avl.	97.49	97.69	99.80	IRS	74.17	100	74.17	CRS	69.35	71.27	97.31	IRS	57.68	61.01	94.54	DRS	83.48	84.42	98.89	DRS
Apulia	Apl.	87.78	89.25	98.35	IRS	59.35	59.38	99.95	DRS	86.3	100	86.30	CRS	71.53	71.82	99.60	DRS	85.84	86.85	98.84	IRS
Basilicata	Bas.	98.8	100	98.80	CRS	-	-	-	-	75.5	81.57	92.56	IRS	91.38	95.23	95.96	DRS	79.32	79.66	99.57	IRS
Bozen	Boz.	84.94	89.43	94.98	IRS	81.99	85.7	95.67	IRS	81.4	100	81.40	CRS	78.3	78.68	99.52	DRS	86.75	88.56	97.96	IRS
Calabria	Cal.	85.15	85.19	99.95	DRS	79.9	80.71	98.99	DRS	89.04	100	89.04	CRS	77.76	78.64	98.88	DRS	77.21	77.71	99.36	IRS
Campania	Cam.	97.66	100	97.66	CRS	96.23	100	96.23	CRS	100	100	100	CRS	76.62	76.7	99.90	DRS	73.65	75.09	98.08	IRS
Emilia Romagna	Ero.	80.27	90.57	88.63	IRS	77.24	100	77.24	CRS	79.77	94.43	84.48	IRS	71.82	87.2	82.36	IRS	93.71	100	93.71	CRS
Friuli Venezia Giulia	Fri.	91.68	91.71	99.97	DRS	82.79	83.07	99.66	IRS	84.76	100	84.76	CRS	100	100	100	CRS	83.57	83.73	99.81	DRS
Lazio	Laz.	92.6	100	92.60	CRS	100	100	100	CRS	83.86	96.8	86.63	IRS	64.9	95.08	68.26	IRS	91.39	100	91.39	CRS
Liguria	Lig.	100	100	100.00	CRS	93.48	96.71	96.66	IRS	69.83	71.84	97.20	IRS	100	100	100.00	CRS	96.77	98.92	97.83	IRS
Lombardy	Lom.	89.34	100	89.34	CRS	79.98	100	79.98	CRS	88.4	100	88.40	CRS	71.65	100	71.65	CRS	100	100	100	CRS
Marche	Mar.	100	100	100	CRS	87.67	89.19	98.30	IRS	70.91	75.52	93.90	IRS	91.02	91.94	99.00	DRS	100	100	100	CRS
Molise	Mol.	100	100	100	CRS	83.14	100	83.14	CRS	100	100	100	CRS	96.52	100	96.52	CRS	100	100	100	CRS
Piedmont	Pie.	92.93	100	92.93	CRS	100	100	100	CRS	100	100	100	CRS	100	100	100	CRS	90.75	91.78	98.88	IRS
Sardinia	Sar.	85.43	87.32	97.84	IRS	73.73	74.46	99.02	IRS	67.76	78.7	86.10	IRS	70.14	70.73	99.17	DRS	100	100	100.00	CRS
Sicily	Sic.	89.8	90.15	99.61	IRS	98.56	99.87	98.69	DRS	70.7	71.97	98.24	IRS	65.12	65.21	99.86	DRS	63.47	63.81	99.47	IRS
Toscany	Tos.	96.15	100	96.15	CRS	69.72	88.03	79.2	IRS	72.28	84.29	85.75	IRS	76.6	90.18	84.94	IRS	96.26	98.13	98.09	IRS
Trento	Tre.	92.68	93.15	99.50	IRS	68.85	69.47	99.11	IRS	77.21	91.01	84.84	IRS	73.51	74.4	98.80	DRS	76.01	78.53	96.79	IRS
Umbria	Umb.	89	89.05	99.94	DRS	100	100	100	CRS	78.69	89.83	87.60	IRS	98.51	98.87	99.64	DRS	100	100	100.0	CRS
Veneto	Ven.	84.54	100	84.54	CRS	73.09	96.57	75.686	IRS	74.7	100	74.70	CRS	99.14	100	99.14	CRS	95.37	100	95.37	CRS
Average		92.20	95.41	96.69	47.62%	83.99	91.16	92.58	42.86%	81.49	90.82	90.00	47.62%	82.33	87.29	94.62	28.57%	88.36	89.98	98.26	38.10%

Notes: % quota of regions that denote CRS

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