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Sensitivity of Listed European Hotels with the Sustainable Tourism

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ABSTRACT: This study examines the responsible energy consumption of listed European hotels. Hotel efficiency is estimated using a Stochastic Frontier Analysis (SFA) production function, with supplies costs as the input and total revenue as the output. Cluster analysis is used to group the hotels into homogeneous groups according to their efficiency level, size, or profitability. The results show that the average efficiency of listed European hotels is 25.34%. Between 2004 and 2007, the larger hotels were very inefficient, but this improved significantly in the last year, 2007. No positive relationship is observed between the returns of these hotels nor is it seen that shareholders clearly reward companies with better efficiency levels.

Key words: Efficiency, Supplies costs, Sustainable tourism, Listed European hotels, Stochastic Frontier Analysis (SFA)

INTRODUCTION

Climate change poses a threat because the changes it is causing to different ecosystems increase the risks of disease, famine, floods and droughts. The main factor causing global warming is CO2 emissions from the use of fossil fuels for energy (Greenpeace & EREC, 2008; EEA, 2008).

For this reason, the issue of energy efficiency has acquired the utmost interest nowadays. The working agendas of international institutions like the UN, European Union, Greenpeace or the World Tourism Organization include clear references to the ever increasing importance of efficient consumption of all kinds of energy (EEA, 2008, Greenpeace & EREC, 2008). This would reduce CO2 emissions and actively act against the warming of our planet.

Due to this international sensitivity and concern about climate change, sustainable tourism based on responsible consumption of all types of energy is a reality with very high estimated growth for the next years (UNWTO, 2009a). Large international hotels are a centre of attention because the services they provide and the quality standards they offer require high consumption of electricity, water or different types of fuel.

Europe's hotel supply is approximately 5.45 million hotel rooms, nearly half the total in the world (UNWTO, 2009b). In recent years, the growth of tourism in Europe has increased this figure significantly. This means that initiatives in this sector are focused on improving energy consumption to achieve a positive impact on planetary pollution from CO2 emissions. Large hotels have great potential for improvement in energy consumption management because when most of their buildings were built, the new techniques and high technology to optimize the consumption of different energies were not available. For that reason, energy efficiency is important for the tourism sector, in general, and for the hotel industry, in particular, hence this paper.

In this study we focus on stock-market listed hotels for two reasons. Firstly, if these hotels achieve a high level of energy efficiency, it will mean savings in resources used which will have a direct effect on the balance sheet and yearly profits. Secondly, as well as the positive effect of these higher profits on investors' predisposition to finance the company, other stakeholders would be motivated to be involved with an organization showing its environmentally friendliness and, commitment sustainable tourism, by providing services while optimizing energy consumption, so showing a concern for the environmental impact caused by its activity.

These features of our study should be stressed. Firstly, this is a study of the energy efficiency of European, stock-market listed hotels. Although there is extensive literature about efficiency in hotels located in different regions or specific countries, we have not

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found any for European, stock-market listed hotel companies. The most recent works similar to ours are those of Önüt & Soner, 2005; Santamoaris *et al.*, 1996, Deng & Burnet, 2000; Deng, 2003; Khemiri & Hassairi, 2005. However, these previous studies do not cover a supranational area like Europe or stock-market listed companies. Secondly, we have concentrated on analysis of the efficiency of energy consumption instead of using a combined set of inputs such as employees, material costs, food and beverage, financial costs and other expenses. Thirdly, we have not found in any work in earlier literature connecting the capital market with responsible energy consumption.

In view of the importance of the hotels included in the study and the large amounts of energy they consume, this measurement of the efficiency achieved is intended to give them orientation. In this way, they will be able to redesign their energy policies, investing in new technologies and buildings, work methods or staff training. Also, our study should also be a point of reference for European institutions. Firstly, to allow them to verify whether the large European industry-leading hotels are complying with the set agenda. Secondly, government agencies will be able to see the effects of the proposals made so far and, if necessary, redesign or modify the strategic plan for energy efficiency in Europe for this sector.

Focusing on studies related with hotel companies, one of the authors most cited is Professor Barros. Several publications with different authors and hotel samples have followed (Barros, 2004) his work on Pousadas (the publicly-owned Portuguese hotel chain). The initial study, based on the estimated cost frontier, found that the efficiency of 42 Pousadas between 1999 and 2001 was very low, 21.6%. Subsequent studies (Barros & Alves, 2004) examined the relationship between efficiency and public or private ownership of establishments and concluded that the change in technical efficiency experienced occurs based on total efficiency and efficiency of scale. Barros and Dieke (2008) applied a new methodology based on Data Envelopment Analysis (DEA) bootstrapping developed by Simar and Wilson (2007). The case study examines a small panel of 12 hotels in Luanda, during 2000-2006. The results show that most hotels are not efficient and that belonging to an international strategy or group increases hotel's efficiency.

Pulina et al. (2010) evaluated the relationship between size and efficiency using a DEA. They used a data panel of 150 hotels of different sizes and regions of Italy during 2002-2005, concluding that the different regions were stability in their technical efficiency. The region of Sardinia was not efficient during the study period and within that region medium-category level hotels were technically more efficient than the rest.

In our review of the literature, only the study of Morey & Dittman (1995) used energy costs as one of the inputs to analyse the efficiency of hotels. Their data were related with 54 American hotels in 1993. They defined the expenses arising from the room department, staff, energy, advertising, other operating expenses, management fees, among others, as resource consumption (input), and used room department revenue and an index of customer satisfaction as the production figure. They applied DEA technique to make a table comparing different hotel groups according to efficiency levels and features with the estimated optimum efficiency frontier.

Perrigot et al. (2009) studied 15 large European hotel chains. Their study was aimed at analysis of efficiency in the major French hotel holdings according to the type of property, privately owned or franchise. Their results showed that hotel chains made up of franchises and privately owned hotels (plural form chain) are the most technically efficient.

In the international literature, especially in the Asia-Pacific, there are the studies of Wang et al. (2006a, 2006b, 2006c), Keh et al. (2006), Yu & Lee (2009), Shang et al. (2009) or Neves & Lourenço (2009), Hu et al. (2010). Here is a brief summary of the objectives, variables used and results of some of these works.

Wang et al. (2006a) used DEA on a sample of 59 tourist hotels in 2001, taking four inputs: number of rooms, the equivalent number of full-time employees in room and food-beverage departments and the area occupied by the restaurant department; their outputs were room department revenue, catering revenue and other income. The authors obtained the optimal production frontier and concluded that management style does not affect efficiency, regardless of hotel type, resort or city hotel. In a study with practically the same variables as inputs and outputs, Wang et al. (2006c), using the same methodology aided by a Tobit regression, with a balanced panel data for the 1992-2002 period and a sample of 29 Taiwanese international hotels, concluded that the factors contributing towards the decrease in and quality of service observed were the local culture, together with the large number of employees with part-time contracts, lack of training and experience.

Shang et al. (2009) analyzed a sample of 57 Taiwanese international hotels in 2005. They applied a stochastic DEA and a regression methodology based on the Tobit model to find the factors conditioning efficiency. The inputs used were the equivalent number of full-time employees, number of rooms, total res-

taurant area and other operating costs. Their outputs were other income, room division revenues and restaurant revenues. The research conclusions were that Taiwanese hotels were not on average efficient, regression results showed that resort hotels were more efficient than metropolitan hotels, and that belonging to a hotel chain was not the most influential factor on the efficiency of these hotels.

Yu & Lee (2009) applied an innovative hyperbolic network DEA technique to Taiwan hotels in 2004. The authors took as inputs the number of employees in the rooms and restaurant departments, number of rooms, restaurant area, total expenses and the number of managers; as outputs they took the total other revenues as well as the rooms and restaurant department revenues. Their main conclusion was that some hotels are efficient in production but not in management of their advertising and vice versa. A tool like RHAED would help a company benchmark and improve hotel management.

Keh et al. (2006), using a DEA method on a sample of 49 hotel chains in the Asian Pacific for the year 1999-2000 to find the efficiency of advertising expenditure management, taking as inputs cost per room and advertising expenditure and as output room and restaurant revenue, concluded that companies which are more effective and efficient in their advertising expenditure get increased productivity back. They recommend that these companies pay more attention to their advertising expenditure management in their strategic plans.

Neves & Lourenço (2009) propose that hotel managements could use DEA as a management and management improvement tool. For this purpose, they determined the efficiency frontier using a sample of hotels worldwide for the period 2000-2002. Their input or resources used were current assets, fixed net assets, net worth, and costs of goods and services, and their outputs, total revenue and EBITDA. Their main conclusions were firstly, that efficiency of scale has a greater effect than technical efficiency, management should pay more attention to improving the productivity of businesses, most companies experienced scale decreases in the period studied, perhaps due to underuse of their capacity because of low occupancy ratios.

Hu et al. (2010) studied a data panel from 66 international hotel companies in Taiwan between 1997 and 2006. Their results include the conclusion that Taiwanese hotels can improve their consumption by 8.85%. Cost efficiency is seen to be influenced by the environmental factors analyzed, the most efficient hotels being those which belong to a chain compared to the independent ones; the number of tourist guides and proximity to international airports.

MATERIALS & METHODS

Our study was intended to obtain an indication of the energy efficiency being achieved by stock-market listed European hotels, and to find out whether there are relationships between efficiency and certain factors such as size, return, or shareholders' assessment. These were our working hypotheses:

H1: *"Larger European hotels achieve greater energy efficiency"*

In principle, we would expect to find a positive relationship between hotel size and the degree of energy efficiency reached, because hotels with more resources are in a better position to make investment to optimize their consumption.

H2: *"The greater the return associated with European hotels, the greater the degree of energy efficiency"*

We would also expect to find a positive relationship between these two variables because energy saving would lead to higher operating margins with a direct effect on economic return and an indirect one on financial return.

H3: *"Shareholders reward top hotels in terms of energy efficiency"*

The expected relationship is explained by the incentive to an investor of being involved with a company with an awareness of climate change.In much of the literature about efficiency in hotels, the most frequently used model is DEA. This may be due to the two great advantages it offers. The first is its ease of application, and the second is that it does not need any production or costs estimate function, taking the premise that there are no stochastic fluctuations on the cost frontier. DEA is a non-parametric methodology which applies a linear mathematical program which can distinguish efficient production units from those which are not efficient. The method optimizes each observation and builds an optimum frontier using the most efficient observations, placing inefficient being left below it.

The other important model used for this kind of analysis is SFA. In this case, a function is needed and the quality of its fit will condition the estimates made. The big advantage of this method is that it decomposes error into noise and deviations associated with efficiency. SFA is a stochastic, parametric method allowing the influence of noise and the inefficiency of a production unit to be distinguished. We chose this production efficiency frontier model for this study because it has these advantages over DEA (Hu *et al.*, 2010; Barros & Dieke, 2008; Barros, 2004):

1.A lot of stochastic developments back up the specifications of the model most frequently used by re-

searchers. The distribution functions used to represent the technical inefficiency term are semi-normal, exponential and truncated normal (Coelli *et al.,* 1998). Two-tailed distribution of errors is assumed with zero variance and mean.

2.If it is decided to include a variable which turns out to be irrelevant for the model, it does not have a negative effect on formation of the optimum efficiency frontier.

3.As has been said, the decomposition of the error term into noise and inefficiency.

There have been many investigations since the pioneering work of Farrel (1957) that have used the optimum efficiency frontier in order to distinguish between production units having regard to their improved use of technique, technology, administration, geographical location, size, and type of ownership amongst other factors we have to be able to observe in the most recent review of the literature carried out (see Table 1).

The first pieces of work are those from Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). We apply SFA in our study, with these pieces of work being based on a data panel where all of the variables are quantities. The starting model is represented in the following expression:

$$Y_{it} = f(X_{it}\mathrm{B}) + e_{it} \quad (1)$$

; i = 1, 2,… N; t = 1, 2,…T

$$Ln\ y_{it} = \beta_{0t} + \beta\ Ln\ x_{it} + e_{it} \quad (2)$$

$$Ln\ y_{it} = \beta_{it} + \beta\ Ln\ x_{it} + v_{it} \quad (3)$$

The subscript i refers to the ith production unit. The variables used in the model relate to what described below:

y_i: output obtained;
x_i: inputs vector consumed;
β: parameters vector to be estimate;
β_0: optimal efficiency frontier parameter to be estimate;
β_i: parameter to i hotel, being $\beta_i = \beta_0 - u_i$;
e_i: term error, $e_i = v_i - u_i$. This is a random disturbance with a twofold component. The first of these, v_i, sets out the effect of random factors that cannot be controlled by the production units. It is assumed that this is independent with respect to the explanatory variables (x_i) and technical inefficiency (u_i), as well as being symmetrically distributed with zero average and a σ_v^2 constant variance, that is to say N (0, σ_v^2).

Table 1. Studies that have used SFA

Study	Methods	Sample	Inputs	Outputs
Barros (2006)	SFA. T. Cost. Technological chage	15 Portuguese Hotels 98-02	Labor, capital, nights slept, trend, historic dimension	Sales
Chen (2007)	SFA cost	55 Int. Tourist Hotels in Taiwan, 2002	Labor, food and beverage and materials	Total revenue
Pérez-Rodríguez & Acosta-González (2007)	SFA, Translog Function	44 Hotels and Apartments, 91-02	Prices: labor, capital and financial cost	Annual revenue
Wang et al. (2007)	SFA- malmquist	66 Int. Tourist Hotels in Taiwan, 92-02	Salaries, area food and beverage, number of rooms, other operating expenses	Number of rooms occupied, f&b revenue, other o. revenue
Assaf, Barros & Josiassen (2010)	SFA Metafrontier	78 Hotels – Taiwan, 2004-2008	Number of rooms; full time employees rooms, beverage, other departments;	Revenue rooms, f&b, other r.; market share; number guest per employee
Hu et al. (2010)	SFA	66 International Hotels in Taiwan, 97-06	Price of labor; price of food and beverage; price of other operation	Rooms revenue; f&b revenue; other o. revenue

With respect to the second component, u_i, represents the inefficiency for each production unit in particular. In this case, this likewise involves a random disturbance that takes non-negative values ($u_i \geq 0$) which is symmetrically distributed with zero average and a σ_v^2 constant variance, that is to say N (0, σ_u^2). In this case we are also going to assume that u_i is distributed independently and in an identical way with respect to the term v_i.

Battesse & Coelli (1992) propose a SFA production function which has firm effects which are assumed to be distributed as truncated normal random variables, which are also permitted to vary systematically with the time. Thereby, uit = {exp[-η(t-T)]}u_i, where u_{it} is a exponential function of η that is a parameter to be estimated.

Under the above assumptions the error term distribution, as did Chen (2007) and Hu et al. (2010), the equation of the function of the efficiency frontier (3) can be estimated by the method of maximum likelihood. To do this, following Battese & Corra (1977), the variance terms are parameterized by replacing σ_u^2 and σ_v^2 with:

$$\sigma^2 = \sigma_u^2 + \sigma_v^2$$
$$\gamma = \sigma_u^2 \Big/ (\sigma_v^2 + \sigma_u^2) \qquad (4)$$

Technical efficiency for each of the productive units analyzed in different years would be given by the following expression:

$$ETit = \exp(-uit), \qquad (5)$$

where 0 d" ET d" 1, the ET subordinate to uit value. Thus, the hotels whose inefficiency is zero will be placed on the efficient frontier estimated reaching maximum efficiency. Otherwise, if uit takes a value greater than zero will cause the production unit is below the efficient frontier reflecting inefficiency.The production efficient frontier identifies the maximum quantity of product that a particular production unit can obtain or the profits that it has been possible to generate (output) on the basis of a set of consumed resources (input). In this first analysis we obtain the relative position of each one of the hotel groups with respect to the efficient frontier according to their energy consumption, for every year and for the whole of the study period.

In order to classify the hotels of our sample into homogenous groups according to their characteristics we use the groups or cluster analysis. In our case, to group the companies together we use the K-measurements non-hierarchical (quick cluster) method. This technique is a useful method for making a division of individuals into k-groups, where this k number must be set on an a priori basis (Ferrán-Arranz, 2001). We aim to check whether the level of information dissemination (nie -variable-) concerning actions of the hotels analyzed on energy management in these periods is associated with those with a higher revaluation of their shares and/or with higher energy efficiency levels, in addition to other factors such as return or size.

As variables used to obtain the optimum production frontier, we take total revenue as output and for inputs, material costs, staff costs and a proxy for energy consumption, which we calculated as follows.In the financial information published by companies, energy consumption (water, electricity, fossil fuels, natural gas, etc.) is recorded together with other expense items of a very different nature as a single item heading, "other operating costs." We cannot, therefore use the exact figure for supply costs. The approximation of the supply costs used was obtained from linear regression relating revenue of the periods examined with the "other operating costs" item by applying ordinary squared minima. This allows the fixed and variable parts of these costs to be separated. Taking the revenues Y (y_i, i=1...4) and other operating costs X (x_i=1…4) for the years in the study, the linear regression line can be obtained using this formula:

$$X = c + a \cdot I$$

$$c = \frac{\sum x_i}{N} - a\frac{\sum i_i}{N} \qquad (6)$$

$$a = \frac{N \cdot \sum x_i \cdot i_i - \sum i_i \cdot \sum x_i}{N \cdot \sum i_i^2 - (\sum i_i)^2}$$

When the constant "*c*" has been isolated, this separates the fixed costs related with cost items which remain constant in relation to the revenues for these periods, such as rentals, insurance, professional fees, fixed supply quotas and all costs which do not vary with regard to the production sold but do so with the capacity offered by the hotels. The slope of line "*a*" indicates how much the other operating costs item increases, including the supply costs, for every euro of income.

In this case, we define the following production function:

$\log TC_{it} = \beta_0 + \beta_1 \log (x_1) + \beta_1 \log (x_2) + \beta_1 \log (x_3) + e_{it}$, where

$\log TC_{it}$: logarithm of revenues (€)

$\log(x_1)$: logarithm of proxy of supplies consumption (€)

$\log(x_2)$: logarithm of materials consumption (€)

$\log(x_3)$: logarithm of employees cost (€)

e_i: term error, $e_i = v_i - u_i$. This is a random disturbance whose component as explained above.

The data used in the study are those that are provided by the AMADEUS database. The work sample was that composed of all of those hotel companies with the same sector code ([1] The code used in AMADEUS to limit the search is Primary Nace Rev 2 Code = 5510, Hotels and similar accommodation).

The years of study are those that run from 2004 to 2007. The resulting balanced data panel comprises with a total of 220 observations.

Frontier Tool v.4.1c and the statistical package Spss v.15.0 software was used for data processing and application of different statistical techniques are needed.

RESULTS & DISCUSSIONS

Table 2 and Table 3 summarize the data panel statics during 2004-2007.

Correlation analysis (see Table 4) shows that returns are highly related, companies with high economic returns also obtaining high financial return. Other significant positive relationships are those between overvaluation on the capital market (M/B ratio) ([2] The Market to Book ratio is the ratio between the value a company reaches on the market and the one it declares in its financial report. This ratio has been interpreted in earlier literature as an indicator of the reward awarded by shareholders for the company's intangible investments,

Table 2. Statistics of variables used in the year 2007

	Mean	S. Dev.	N
Atm	-.1449035	.08823265	50
Roi	-.016037	.2559883	50
Roe	-.004602	.2419223	47
Ef. 04/07	.26169851	.230804248	50
Ef. 07	.53229795	.149112782	50
M/B	2.00714	1.471923	7

Table 3. Main descriptive data panel statics of supplies consumption during 2004/07

	Efficiency		Revenues		Supplies Cost	
Year	Mean	S. Dev.	Mean	S. Dev.	Mean	S. Dev.
2004	.5331329	.1525136	22086.36	129127.57	4660.474	29623.547
2005	.5102263	.1602676	26511.16	157354.35	5566.544	35948.873
2006	.4896811	.1805663	29453.80	169595.37	6133.740	38780.71
2007	.5358292	.1452745	32315.70	181844.78	6650.371	41752.893
Total	.5172174	.1602046	27591.76	159614.67	5752.782	36555.112

Table 4. Pearson correlations between variables in 2007

	Atm	Roi	Roe	Ef. 04/07	Ef. 07	M/B
Atm	1	.219	-.158	.119	.243	.551
Roi	.219	1	.496(**)	-.071	.253	.820(*)
Roe	-.158	.496(**)	1	.048	.169	.904(**)
Ef. 04/07	.119	-.071	.048	1	.757(**)	-.710
Ef. 07	.243	.253	.169	.757(**)	1	.156
M/B	.551	.820(*)	.904(**)	-.710	.156	1

(** Shows significance at 0.01 level; * Shows significance at 0.05 level (bilateral)

behaviours or potential benefits which cannot be recorded in the accounting because current regulations do not allow).

with the hotels obtaining the highest returns (Roe and Roi). Finally, the high significant positive relationship for the efficiency levels obtained in the period between 2004 and 2007 and that reached in 2007 shows that the companies which were efficient in 2007 were the same ones which had been for the previous four years, so demonstrating that this behaviour is linked to companies' strategy and culture, rather than actions which can be undertaken in isolated years.

From the efficiency analysis, it can be seen that during the years 2004 to 2007 (see Table 5), a very low average energy efficiency is obtained, 25.34% (x_1 analysis), i.e., on average, stock-market listed European hotels could consume up to 74.66% fewer resources to obtain the same revenue level. Only one company sits on the optimum production frontier, with another very close, but with the hotels ordered by estimated efficiency lever from the third one down, the level of optimum use of their energy resources could be by more than 25% to obtain the same income level. It can also been seen that the mean energy efficiency of hotels stagnated during 2004-2006 returning to 2004 levels in the last year 2007.

To test our first hypothesis, we related hotel size with the efficiency levels obtained both in the period 2004/2007 and in the last year, 2007. To do this, we carried out k-means clustering, prefixing the desired number of groups (after observation of the dendogram). It can be seen that two groups of hotels can clearly be distinguished in the last four years, of twenty-five and twenty-three components. The smaller-sized group achieved a higher level of efficiency and the larger-sized group lower efficiency, in both cases on average. In this case, we should point out that only the efficiency variable is significant and so is the only one conditioning formation of the groups (see Table 6).

In the last period, it is seen that the trend changes, three well differentiated groups being obtained with regard to the number of hotels, the smaller-sized ones being those which achieve the least efficiency. In this case, both the efficiency and size variables for hotels were significant, supporting the homogeneousness of the groups formed (see Table 6). If we limit the num-

Table 5. Average efficiencies for all hotels

Consumptions	2004/2007	2004	2005	2006	2007
Supplies, Materials and Employees (x_1, x_2 y x_3)	0.470413	0.866633	0.874524	0.871316	0.537155
Supplies (x_1)	0.253435	0.533132	0.510226	0.489681	0.535829

Table 6. Efficiency levels and size during 2004/07, Centers groups and ANOVA

2004/07	ATM	Efic.	2007	ATM	Efic.
1 (25)	-.15787	.356155	1 (27)	-.15519	.627657
2 (23)	-.13063	.096933	2 (12)	-.19473	.338885
3 (2)	-.14697	.975798	3 (11)	-.06530	.509231
Sig. (F)	.574	.000	Sig. (F)	.001	.000

Table 7. Efficiency levels and returns during 2004/07, Centers groups and ANOVA

2004/07	Efic.	ROE	ROI	2007	Efic.	ROE	ROI
1 (2)	,266669	-,9298	-,0495	1 (2)	,419723	-,1885	-,4483
2 (1)	,951597	,4988	,4683	2 (39)	,532623	,0136	,0280
3 (2)	,306780	-,1885	-,4483	3 (4)	,621660	,3723	,2985
4 (42)	,232463	,0362	,0433	4 (2)	,477587	-,9298	-,0495
Sig. (F)	,005	,000	,000	Sig. (F)	,366	,000	,000

Table 8. Efficiency levels and M/B ratio in 2007, Centers groups and ANOVA

2007	Efic.	ROE	ROI	M/B
1 (5)	,588810	,0065	-,0200	1,210
2 (2)	,595595	,2712	,2758	4,000
Sig. (F)	,944	,010	,091	,003

ber of groups to two, the larger-sized hotels obtain better efficiency levels, while the smaller-sized ones are, on average, less efficient. So, from an examination of these results we can argue that larger hotels have, on average, not been very efficient over the last four years, but that in the last year of the study (2007). They significantly improved their efficiency levels by investment in technical actions and improvements and responsible behaviour, with the environment as one of their greatest bastions in energy saving.

Examination of the relationships between efficiency levels and economic and financial returns shows similar behaviour both for the 2004-2007 and for the last year included, 2007. A group including most of the hotels, forty companies, is formed when those with clearly different behaviours are isolated (see Table 7). In this group, both the profitabilities obtained and the efficiency levels are low. A slight drop in profitabilities in 2007 is also observed, compensated for by a significant increase in efficiency levels for all the hotels making up the group on average. It is not possible to relate high profitabilities with greater energy efficiency. In the analysis of both 2004-2007 and of 2007 only, profitabilities are significant in the formation of groups, while efficiency is only significant for 2004-2007. These results bear out the homogeneousness of the groups formed (see Table 7).

Therefore, the initial hypothesis that a positive relationship would be established between financial and economic return and energy efficiency in the study period and for the sample of hotels used must be rejected. On the contrary, on average, improving the level of efficiency reduced the level of financial and economic return of hotels.Finally, analysis of the seven companies which provide the M/B ratio shows that, as expected, higher ratios correspond to hotels with greater economic and financial return (see Table 8). In contrast, the M/B ratio for the first group is much lower than that of the second, on average, whereas the efficiency levels obtained for the two groups are very similar.The analysis of variance shows that economic return and the M/B ratio are significant showing their importance in the formation of the groups obtained.

CONCLUSION

From the foregoing results, a relationship between the variables size, return or M/B ratio and a greater level of efficiency cannot be established. But it has been observed that the trend for the last year 2007, changed in comparison with that for the period 2004-2007.

The smaller hotels which had been more efficient in their energy consumption lost some of that advantage in 2007. In recent years, larger hotels have become aware of the importance of energy saving, incorporating it into their business cultures and strategies. In our opinion, the improvement has been greater among larger hotels than small ones because of their greater resources and the greater importance given to these matters in their strategic planning.

The measures adopted and investments made have caused the efficiency level achieved in 2007 to improve but have had a negative effect on both economic return, because of the increase in expense items such as training and payments for new investments, and on financial return, because of the increased financial costs and reduction in the operating results.Finally, we cannot state that shareholders are clearly rewarding hotels achieving greater levels of efficiency, as very similar efficiency levels are obtained on average for very different values of the M/B ratio.

So, the awareness of the stock-market listed European hotels studied for the period between 2004 and 2007 is very low, because a very low level of energy efficiency is obtained and only three out of a total of sixty-six companies are near optimum efficiency values. In our opinion, this lack of awareness is due to the following reasons:

- It is something which needs to be instilled in the culture of a hotel, included in its strategic plan, and this takes time.
- Only larger hotels are becoming aware of the importance energy efficiency is acquiring, partly because they have sufficient resources to meet the investments required and bear the related costs such as training or communication, among others.

• European institutions and administrations have not clearly developed enough support measure to encourage greater investment by hotels in improving their building and installations to optimize energy consumption.

The trend is slowly changing and in coming years European hotels should become more aware of the importance of energy efficiency as a bastion of environmentally responsible behaviour. In addition, it provides the extra advantage of improving the hotel's economic return after the initial adaptation stage, which is where the greatest costs are incurred.

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