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EVALUATING THE EFFICIENCY PROGRESS WITH TECHNOLOGY IN A SPANISH HOTEL CHAIN

Avaliando o progresso da eficiência com tecnologia em uma cadeia de hotéis espanhola

Evaluando el progreso de la eficiencia con tecnología en una cadena de hoteles española

ABSTRACT

This paper analyzes the changes in the total factor productivity index of a Spanish hotel chain in the period from 2007 to 2010 with the purpose of identifying efficiency patterns for the chain in a period of financial crisis. The data envelopment analysis (DEA) Malmquist productivity index was used to estimate productivity change in 38 hotels of the AC chain. Results reveal AC hotels' efficiency trends and, therefore, their competitiveness in the recession period; they also show the changes experienced in these hotels' total productivity and its components: technological and efficiency changes. Positive efficiency changes were due to positive technical efficiency rather than technological efficiency. The recession period certainly influenced the performance of AC Hotels, which focused on organizational changes rather than investing in technology.

KEYWORDS | Efficiency, productivity, data envelopment analysis, Malmquist index, Spanish hotel chains.

RESUMO

Este artigo analisa as mudanças no fator total de produtividade de uma cadeia de hotéis na Espanha, no período de 2007-2010, com o propósito de identificar os padrões da cadeia em um período de crise financeira. O índice data envelopment analysis (DEA) Malmquist de produtividade foi usado para estimar a mudança da produtividade nos 38 hotéis da AC Cadeia de Hotéis. Os resultados revelaram as tendências de eficiência e competitividade da AC Hotéis em um período de recessão, bem como as mudanças vivenciadas na produtividade total e, consequentemente, em seus componentes de eficiência e tecnológicos. O período de recessão influenciou, sem dúvida, o comportamento da AC Hotéis, que buscou mais mudanças organizacionais do que tecnológicas.

***PALAVRAS-CHAVE** | Eficiência, produtividade, data envelopment analysis, índice Malmquist, cadeia de hotéis espanhola.*

RESUMEN

Este artículo analiza los cambios del índice de productividad del factor total de una cadena de hoteles españoles en el periodo de 2007 hasta 2010, con el propósito de identificar patrones de eficiencia para la cadena en un periodo de crisis financiera. El índice de productividad data envelopment analysis (DEA) Malmquist fue utilizado para estimar el cambio de productividad en 38 hoteles de la cadena AC. Los resultados revelan las tendencias de la eficiencia de los hoteles AC y, por lo tanto, su competitividad en el periodo de recisión; ellos también demuestran los cambios experimentados en la productividad total de eses hoteles y sus componentes: cambios de eficiencia y tecnológicos. Cambios de eficiencia positivos se debieron más bien a eficiencias técnicas positivas que a eficiencias tecnológicas. El periodo de recesión ciertamente ha influenciado los Hoteles AC, que enfocaron más en los cambios organizacionales que en invirtiendo en tecnología.

***PALABRAS CLAVE** | Eficiencia, productividad, data envelopment analysis, índice Malmquist, cadenas de hoteles española.*

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INTRODUCTION

The tourism industry is a pillar of the Spanish economy. According to Exceltur (2008), Spain is the second country in the world in number of international tourists (7 percent of total tourist figures) and holds the same position in tourism revenues.

In the years before the financial crisis, new internal and external factors helped the Spanish tourism sector, particularly receptive tourism, thus producing good overall business results. Promotional efforts made by central, regional, and municipal administrations explain part of this tourism bonanza in terms total arrival figures. On the other hand, the strength of domestic demand (though already showing signs of a slow-down), acute geopolitical instability in Spain's main competitor countries in the "sun and sand" product category, increased European family spending, and a decrease in fuel prices helped to raise the influx of tourists in Spanish resorts.

In the 2007-2010 period, the Spanish tourism situation was a very different one, as it was severely affected by the national and global economic and financial crisis. The period was marked by a decrease in the dynamism of Spain's tourism activity, caused by a plunge in both foreign and domestic demand.

Although 2007 marked the beginning of the crisis, it ended with a positive balance for the sector, as tourism businesses in general showed a moderate demand increase, with a 2.3 percent growth in overnight stays (Instituto Nacional de Estadística, 2007), which meant a moderate increase in sales and profits. This improvement in business profitability was due not only to the increase in sales, but also to the implementation of a less aggressive pricing policy to ensure occupancy and, particularly, a progressive improvement in cost management (Exceltur, 2008).

In the 2008-2009 period, the Spanish tourism sector was affected by the financial crisis much more severely than the Spanish economy as a whole, with a 5.6 percent drop in the tourism GDP. The close of 2009 showed an accumulated two-year decrease in sales and profits in most Spanish tourism businesses (Exceltur, 2009). Spanish hotels could not go unharmed through the overall demand fall that affected all of the links in the tourism value chain. In a scenario with little sign of a recovery towards pre-crisis levels of demand, managers at these hotels urgently implemented cost reduction plans and efficiency measures for managing both structural and operational costs.

In 2010, tourism activities overcame what was a complex situation characterized by economic weakness and problems in accessing credit. In aggregate terms, tourism GDP grew moderately by 1 percent, and was accompanied by a moderate growth in sales, while cost reductions achieved by good cost management (Exceltur, 2010) helped guaranteeing revenues. The hotel sub-sector was involved in the resurgence of foreign demand, helping to begin the recovery in overnight stays compared to the previous two years (Instituto Nacional de Estadística, 2009).

In the context of tourism activities, the survival of the hotel sub-sector has definitely been characterized by efficient resource management. The sub-sector had to improve its competitiveness by looking to best practices in the industry, which led to superior performance (Cano, Drummond, Miller, & Barclay, 2001). Performance assessment is an important way to incorporate competitive marketing strategies, improve service quality, and ensure a better combination of inputs and outputs. Though the efficiency of decision units can be assessed using parametric and/or non-parametric techniques, data envelopment analysis (DEA) is one of the most widely used non-parametric tools to analyze efficiency in the hotel sub-sector (Anderson, Fish, Xia, & Michello, 1999; Barros, 2004; Morey & Dittman, 1995).

The Spanish hotel sector is comprised mainly of city hotels and resorts (sun and sand) aimed at a wide range of tourist segments. This study analyses the impact of the crisis period on the efficiency of a particular model of city hotels by determining whether they responded through organizational and/or technological changes in order to improve efficiency levels. The total-factor productivity (TFP) index was used, as well as its decomposition in technical efficiency and technological change. The AC Hotels chain was chosen because it has a strategy that varies with the location of each hotel in the chain, and because of the chain's continuous innovation, renovation, and infrastructure maintenance practices, using its own design team to ensure customers' needs are met. In 2010, AC Hotels formed a joint venture with leading US company Marriott International. Through this joint venture, the AC Hotels by Marriott brand was created to manage the chain. AC Hotels by Marriott is committed to a clear differentiation in its products and services by reinforcing the chain's characteristics, investing in new technologies such communication, management, and direct sales to customers. The inclusion of AC Hotels in Marriot's new distribution channels and marketing tools will help the chain to increase its visibility to international travelers, as well as learn the tastes and preferences of its customers in order to offer them personalized services.

This paper is organized as follows: the introduction describes the tourism industry context during the financial recession period, i.e., 2007-2010. A literature review of the applicability of efficiency analysis in tourism – particularly in the hotel industry – is subsequently presented. Next, the Malmquist productivity index and its decomposition into technological and technical efficiency changes are described. Details on database, as well as the inputs and output chosen in the efficiency analysis, are presented. Then, results obtained from the panel data are discussed, and relevant conclusions are exposed. Finally, the article's limitations are presented and suggestions for future research are made.

LITERATURE REVIEW

The use of benchmarking techniques plays an increasingly important role for firms in determining the efficient allocation of resources. DEA has been widely used for more than a decade as an efficiency analysis tool for studying the tourism sector, and is also used as a highly useful internal and external benchmarking technique between businesses in the sector (Barros, 2005b; Chiang, Tsai, & Wang, 2004; Morey & Ditman, 1995; Sigala, 2003; Wu, Tsai, & Zhou, 2011).

The travel agent industry faces a change of paradigm due to the role played by technological development, business competition, concentration, and disintermediation. These emerging trends require identifying the factors that help agents increase their performance through the formulation of adequate strategies, allowing them to compete and survive in a higher competitive market (Barros & Dieke, 2007; Barros & Matias, 2006; Bell & Morey, 1994, 1995; González & Martín, 2012; Wöber, 2000). The applicability of efficiency analysis has been also justified in the restaurant sector due to its inherent competition, which is influenced by variety in location, neighbourhood characteristics, and menus offered. In fact, this analysis seems to be even more important for restaurant chains, where establishments share the same goals through identical menus, operating procedures, design, and technology. DEA analysis allows identifying the best performing units benchmarked against less efficient ones, therefore providing valuable information to managers so they can allocate available resources properly (Banker & Monrey, 1986; Donthu, Hershberger, & Osmonbekok, 2005; Hruschaka, 1986; Reynolds, 2004; Reynolds & Thompson, 2007).

Assessing service performance in hotels has become an important issue in the service industry. Hotels frequently face difficulties to counterbalance supply and demand due to their inherent characteristics as inseparability, intangibility, heterogeneity, simultaneity and perishability. This requires making accurate decisions about the maximum amount of inputs to be reduced and the marketing strategies to be implemented in order to attract the maximum number of customers, given the available service capacities. Because both technical and allocation efficiencies provide practitioners with a good knowledge of overall efficiency, they justify the increasing interest in efficiency analysis in the hotel sector. Therefore, most efficiency studies in the hotel sector were conducted in the 2000-2010 period. From 2011 to the present, five studies were reviewed base on which we can assume that applying DEA analysis to the hotel industry will continue to be of interest to researchers.

However, we can see some degree of geographic concentration, particularly in Taiwan's hotel industry (Shang, Wamg, & Hung, 2010; Ting & Huang, 2012; Wang, Hung, & Shang, 2006a, 2006b; Wu, Liang, & Song, 2010; Wu et al., 2011), the USA (Hu & Cai, 2004; Morey & Dittman, 2003; Reynolds, 2004; Wöber & Fesenmaier, 2004;) and in Portugal (Barros, 2005a, 2005b, 2006; Barros & Mascarenhas, 2005; Barros & Santos, 2006).

Most efficiency studies have focused their analysis on a sample of hotels, taking into account the use of inputs and the generation of specific outputs. In general, the inputs that appear in the literature concern factors such as size, labour, capital, and technology/organizational aspects. With regard to size, the inputs most commonly used are the number of rooms, the size or area used for each hotel service, and assets volume, all of which are used as indicators of capital. As to the labour factor, staffing costs are widely used, comprising the number of employees and other operating costs as an indicator of the necessary expenses involved. The most widely used outputs are total revenue and the revenue generated by each activity or service, such as accommodation, food and beverages, and others (Chiang et al., 2004; Hu & Cai, 2004; Morey & Dittman, 2003; Shang et al., 2010, Wu et al., 2010, 2011). Occupancy or the number of beds sold are also widely used as output (Alonso de Magdaleno et al., 2009; Barros, 2004, 2005a, 2005b; Barros & Alves, 2004; Barros & Mascarenhas, 2005; Keh, Chu, & Xu, 2006; Shang et al., 2010; Sigala, 2003; Wu et al., 2010). Authors such as Sigala (2003), Fuchs (2004) and Chen (2007) have taken into account outputs such as customer satisfaction indexes and the Yielding Index (Chiang et al., 2004; Fuchs, 2004).

Although most studies analyze the efficiency of a sample of hotels for a specific year, very few are longitudinal studies. These studies assess the efficiency of companies over a period of time, as well as any changes in technical and technological efficiency experienced by hotels, using the Malmquist productivity index (Barros, 2005b, 2006; Barros & Alves, 2004; Hwang & Chang, 2003; Tsaur, 2001).

METHOD

We used the Malmquist productivity index based on DEA to measure and calculate the efficiency of Spanish hotels during the 2007-2010 period. The DEA model developed by Charnes, Cooper, and Rhodes (1978), based on Farrell's seminal work (1957), is a non-parametric methodology that obtains the "best-practice frontier" from multiple inputs and outputs of similar decision-making units (DMUs); it is known in the literature as the CCR model. Banker, Charnes, and Cooper (1984) advanced this CCR approach by assuming variable returns to scale (the BBC model). These two models were later used as basis for subse-

quent models, such as the super-efficiency model (Andersen & Petersen, 1993) and non-radial measure models (Ali, Lerme, & Seiford, 1995). Other DEA developments include Malmquist's total factor productivity (TFP) index, developed by Swedish statistician Malmquist (1953). The Malmquist index appears to be an ideal efficiency measure when working with panel data, as it is key to consider changes over time in the process of efficiency measurements. The Malmquist productivity index produces an efficiency measure for a particular year in relation to the previous, while allowing the best frontier to shift (usually upwards). TFP growth measures how much productivity grows or declines over time. The TFP index divides productivity changes in technical efficiency change (EFFch) and technological change (TECHch). In this study, technical efficiency change refers to growth in a hotel's productivity by using existing technology and economic inputs more efficiently. Technological change refers to growth in total factor productivity (TFP) as a result of improvements in technology and innovations in the hotel's system.

In order to analyze productivity growth, the Malmquist index compares two periods in time. For periods *t=1, 2,..., T*, the technology set can be expressed by the feasible combinations of inputs and outputs, according to the following expression:

S^t / " $\wedge x, y$ h $y x$ can produce y,

Thus, the Malmquist index based on the output distance function is defined as:

$$d^T \wedge x^t, y^t \text{h} / \inf \text{ g i : ` } x^t, \frac{1}{\text{i}} y^t \text{ j ! } S^t \text{ C}$$

Where x is a vector of inputs; y is a vector of outputs; S^t is the technology set; superscript T is the technology reference period ($T=t$ or $T=t+1$); and $1/\theta$ is the amount by which outputs for year t could have been increased given the inputs used, if technology for year T had been fully utilized.

d^T is the reciprocal of Farell's output-oriented efficiency index. If a decision-making unit sits on the efficiency frontier, d^T will be 1; if it is below the frontier, it will not be efficient, and d^T will be less than 1.

The same decision-making unit for period $t+1$ (x^{t+1}, y^{t+1}) can be compared with the technology for period t:

$$d^T \wedge x^t, y^t \text{h} / \inf \text{ g i : ` } x^{t+1}, \frac{1}{\text{i}} y^{t+1} \text{ j ! } S^t \text{ C}$$

The new distance can be 1 if DMU with data for period $t+1$ is efficient regarding technology at t; otherwise, it will be less than 1. Distance can also have a value greater than 1 if the unit with inputs and outputs at $t+1$ is not feasible with the technology at t.

Thus, Caves, Christensen, and Diewert (1982) defined the Malmquist index at t as the ratio:

$$M^T \wedge x^{t+1}, y^{t+1}, x^t, y^t \text{h} = \frac{D^T \wedge x^{t+1}, y^{t+1} \text{h}}{D^T \wedge x^t, y^t \text{h}}$$

Where $M^t > 1$ indicates an increase in productivity for period $t+1$ in relation to period t, $M^t = 1$ shows the opposite, and $M^t = 1$ indicates that productivity has remained constant.

The Malmquist index for $t+1$ is defined as the ratio:

$$M^{T+1} \wedge x^{t+1}, y^{t+1}, x^t, y^t \text{h} = \frac{D^{T+1} \wedge x^{t+1}, y^{t+1} \text{h}}{D^{T+1} \wedge x^t, y^t \text{h}}$$

To avoid arbitrarily using one of the periods as a reference, Färe, Grosskopf, and Lavel (1994) sought to measure the Malmquist index as a geometric mean of such indices, and calculated the reference technologies for both year t and year $t+1$ as:

$$M \wedge x^{t+1}, y^{t+1}, x^t, y^t \text{h} = \frac{D^T \wedge x^{t+1}, y^{t+1} \text{h}}{D^T \wedge x^t, y^t \text{h}} \left(\frac{D^T \wedge x^{t+1}, y^{t+1} \text{h}}{D^{T+1} \wedge x^{t+1}, y^{t+1} \text{h}} \right) \text{H}^{1/2}$$

The ratio outside the brackets is the index of change in technical efficiency between year t and $t+1$ (i.e. the change in the distance between observed production and current maximum feasible production). The bracketed term is the index of change in technology (innovation) between two periods evaluated at x^t and x^{t+1}.

Thus, the Malmquist TFP index can be written as:

$$M \wedge x^{t+1}, y^{t+1}, x^t, y^t \text{h} = \text{TFP} = \text{EFFch} * \text{TECHch}$$

However, an improvement in TFP does not mean an enhancement in both technical efficiency and technological change.

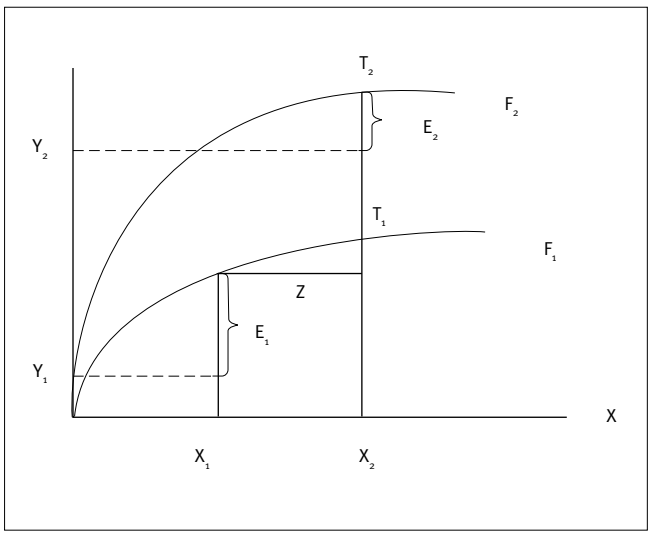
Technical efficiency change can be further divided in two sub-components: pure technical efficiency change (PEch) and scale efficiency change (SEch), as follows:

EFFch=PEch * SEch, and therefore TFP=PEch*SEch*TECHch

Pure technical efficiency change (PEch) measures decision-making units' ability to convert inputs into outputs; it captures changes in efficiency regarding the variable returns-to-scale (VRS) technology. PEch reveals the investments in the organizational factors linked to the hotel's operation. Scale effi-

ciency change captures the DMU position in the VRS technology frontier in relation to the optimum in the constant returns to scale variable (CRS) frontier, and measures to what extent DMUs can take advantage of returns to scale by altering their size towards optimal scale (Färe et al., 1994). The third component, TECHch, shows the (normally upward) shift in the variable returns-to-scale frontier.

Figure 1. **Technological change and technical efficiency**



Growth in production over time (*t* to *t+1*) can be interpreted with regard to technological and technical efficiency changes as shown in Figure 1 (Barros, 2005a). Best-practices hotels experience technological changes in a period of time as a consequence of investments in innovation. In addition to new technologies, the innovations adopted can be also procedures, techniques and methodologies. Technological advances move efficient production frontiers upwards from F_1 to F_2. T_1 and T_2 represent maximum production with technology 1 and 2 respectively, given an input X_2. Technical efficiency corresponds to a better allocation of resources without waste, and, therefore, a consistent movement towards the best-practice frontier for any time. From a dynamic perspective (from year *t* to *t+1*), a technical efficiency change reveals a change between two successive technical efficiency frontiers. While positive pure technical efficiency changes are consequences of investments in organizational factors and better hotel management such as improvement in quality and better balance between inputs and outputs, scale efficiency change occurs when a hotel achieves optimal sales, leading to economies of scale (Färe et al., 1994). Total grow production between *t* and *t+1* (Y_2-Y_1) is the result of three effects: input growth ($Z=X_2$-X_1), technological efficiency change (T_2-T_1) and technical efficiency change (E_2-E_1): $(Y_2-Y_1)=Z+(T_2-T_1)+(E_2-E_1)$.

DATA COLLECTION

To estimate the production frontier, a balanced panel data obtained from Sistema de Análisis de Balances Ibéricos (SABI) was used for the 2007-2010 period. SABI is a database created by Informa, a firm that has been collecting annual accounts from major Spanish and Portuguese companies since 1990. It is an interesting, useful tool for business analysis such as comparisons between companies or company groups, rankings, concentration and segmentation analysis, and sectorial studies.

The study period is of great interest for the tourism sector as, in terms of economy, it covers the end of the upward trend in 2007 and the beginning of recession in 2008 (Instituto de Estudios Turísticos, 2011). This period allows analyzing how businesses have reacted to the change in trends from very favorable to a situation of recession such as the one they faced then. We chose 2007 as the analysis' initial year because it comprises a relevant change in accounting standards that occurred in Spain at the time. This ensures that all data for the period were produced with the same criteria and are therefore homogeneous and comparable for all units in the sample. The horizon considered was the broadest allowed by the database, and the latest data for most of the businesses selected are from 2010.

For this study, we chose the AC Hotels chain as it is considered one the most important Spanish chains, characterized by continual innovation, renovation, and infrastructure maintenance, using its own design team to ensure customer's needs and expectations are met. Knowing AC Hotels' efficiency pattern during the recession period is relevant not only to the firm's managers but also to other practitioners who can learn from AC Hotels' experiences. On the other hand, data available from SABI for AC Hotels in the analyzed period allow adequate statistical analysis and, therefore, reliable conclusions. The number of hotels whose complete data are available at SABI meets the criteria suggested by Cooper, Seiford, and Tone (2001):

$DMU \geq \max\{m \times s, 3(m+s)\}$

Where *m* is the number of inputs and *s* the number of outputs in the analysis.

The non-parametric models for estimating the production frontier required appropriate identification and measuring of inputs (resources) and outputs (transformation of the resources) in order to be used in the analysis. The variables in the article were selected according to the literature reviewed and the information available at the SABI database.

Exhibit 1 describes the inputs and outputs chosen for the analysis. Inputs were measured by (i) assets, (ii) material costs, and (iii) labour costs. Output was measured by total operating income. The inputs represent the main factors required for pro-

duction activity. Variable assets represent capital factor and investments in equipment (Alonso de Magdaleno et al., 2009; Barros, 2005a, 2005b); personnel expenses represent the labour factor (Alonso de Magdaleno et al., 2009; Barros & Alves, 2004; Davutyan, 2007; Morey & Dittman, 1995); and material costs represents the input material (Yu & Lee, 2009; Sigala & Mylonaki, 2005). The output selected is related to the firm's capacity to generate profits from the service provided. The variable Total Operating Income is generally considered a concrete measurement showing that an organization has reached its economic goals (Anderson et al., 1999; Hu & Cai, 2004; Yang & Lu, 2006). We wrote the DEA module in the Stata software in order to compute the Malmquist productivity index for Spanish AC Hotels (Ji & Lee, 2010; Lee, 2011).

Exhibit 1. **Inputs and output in the efficiency analysis**

Variables		Description
Inputs	Assets	Capital factor, equipment investment
	Material cost (matcost)	Investments in a product that are unrelated to its labour cost
	Labour cost (labcost)	Personnel expenses
Output	Operating income (opincome)	Earnings before interest and taxes (EBIT)

Table 1 shows the main descriptive statistics and the selected inputs and output.

Table 1. **Descriptive statistics table: inputs-output 2007-2010**

2007					2008			
Variable	**Mean**	**Std. Dev**	**Min**	**Max**	**Mean**	**Std. Dev**	**Min**	**Max**
o_opincome	2,848,895	2,791.117	1,146	18,266	2,679.368	2,618.906	971	17,328
i_matcost	259.026	218.7151	56	1,421	234	254.319	52	1249
i_labcost	712.578	578.3971	347	3,791	766.105	666.917	367	4,412
i_assets	7417	5,098.65	702	19,173	7,202.737	4,920.66	799	18,309
2009					**2010**			
Variable	**Mean**	**Std. Dev**	**Min**	**Max**	**Mean**	**Std. Dev**	**Min**	**Max**
o_opincome	2,074.921	1,980.023	853	13,110	2,216.158	2,188.061	823	14,228
i_matcost	197.533	185	30	954	191.211	217.969	24	1061
i_labcost	667.079	554.497	307	3,672	656.421	514.111	280	3402
i_assets	6,716.105	4,561.172	733	18,005	6,466.632	4,529.712	702	17,636

RESULTS AND DISCUSSION

Efficiency measures can be either input-oriented or output-oriented. Generally, choosing an orientation depends on which quantity (inputs or outputs) is controlled to a greater extent by decision-making units. Measuring input-oriented technical efficiency depends

on this question: "By how much can input quantities be proportionally reduced without changing output quantities?" Whereas the output-oriented approach addresses the following question: "By how much can output quantities be proportionally expanded without altering input quantities?"

Because the hospitality industry is characterized by maximizing outputs for a particular quantity of inputs, the present study used the output-based approach. Output-oriented efficiency measurements are suitable if we assume hotels to behave in an oligopolistic way (Barros, 2005a).

Based on the output-oriented DEA-Malmquist productivity index, Table 2 shows the estimation for the total factor productivity change (TFPch), as well as its components, i.e., technical efficiency change (EFFch) ('catch-up' component) and technological change (TECHch) (innovation or frontier-shift component) for the 2007-2010 period. The study consisted of analyzing which part of the total productivity factor change can be attributed to efficiency change, and which part to technological change, causing a shift in the productive frontier. Technical efficiency changes require decision-making units to allocate resources without wasting. These requirements imply better investment planning, improved technical expertise, and improved hotel management and organization. Technological change reveals a change in technology as a consequence of innovation and of new technologies being adopted by best practices hotels.

On average, dmu32 recorded the highest TFP growth with 11.62%, and dmu22 the lowest TFP growth, with an 18 percent drop. Overall, the mean TFP change score during the period was 0.9580, which means the hotels' TFP dropped by 4.2 percent. Ten of 38 hotels experienced a positive TFP change (TFP>1), whereas the remainder had no additional productivity over the period (TFP<1). Therefore, most of the hotels experienced total productivity decline. Technical efficiency change for the period was above 1 (EFch>1), while technological efficiency change was below 1 (TECHch), revealing that, for the 2007-2010 period, these hotels improved their management and organization rather than invested in new technologies or innovations, in order to adapt to recession. The variation in inputs used by the hotels shows that, during the period, they improved their organizational factors and reallocated resources by decreasing inputs, particularly labour and material costs. This outcome for the AC chain corroborates the general performance of the hotel sector. Faced with an accumulated decrease in sales and profits, hotel managers had to implement cost-reduction plans and efficiency measures in order to manage structural and operational costs.

Table 2 also shows the division of technical efficiency (TECHch) in pure technical (pech) and scaling efficiency (sech). The hotels' different combinations of technical efficiency and scaling efficiency show that, on average, AC hotels had improvements in both pure (pech>1) and scale efficiency (sech). The improvement in pure technical efficiency meant that hotels invested in organizational factors such as marketing initiatives, improvements in service quality, better investment planning, superior technical experience, and a better balance between inputs and outputs, among others. Improvements in scale efficiency meant that the establishments reached a size according to the number of rooms that allowed them economies of scale.

Based on Table 2, and according to Barros (2005a), this study identifies four combinations of technical efficiency and technological changes, dividing AC Hotels' units among the corresponding efficiency quadrants (Figure 2):

Quadrant 1 contains hotels where technical efficiency improvements occurred in combination with technological change improvements. In the first group, two hotels are included (dmu18, dmu32), representing Spain's best-performing hotels in 2007-2010. These hotels not only upgraded their organizational factor to allocate inputs properly in order to obtain maximum outputs, but also showed particular interest in innovation through new investments.

Quadrant 2 includes 19 hotels where technical efficiency improvements occurred in parallel with a decline in technological change (dmu4, dmu5, dmu6, dmu7, dmu8, dmu9, dmu10, dmu11, dmu17, dmu20, dmu21, dmu23, dmu24, dmu26, dmu28, dmu29, dmu30, dmu31 and dmu33). Once the right input-output balance is reached, this study recommends for these hotels to acquire new technologies or introduce new practices in order to add value to their products or services.

Quadrant 3 contains two hotels and is characterized by a declining technical efficiency and improvements in technological change (dmu27). These hotels invested in technology but failed to reach the right input-output balance. They may need to upgrade organizational factors such as marketing strategies, quality improvement, and a better input-output balance.

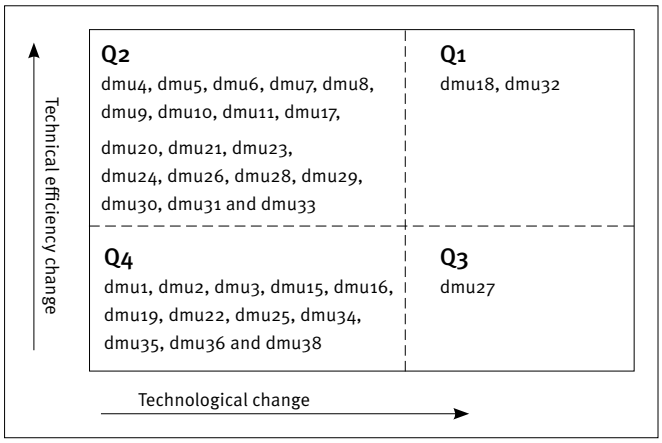
Finally, Quadrant 4 includes 12 hotels where a declining technical efficiency occurred in combination with a decrease in technological change (dmu1, dmu2, dmu3, dmu15, dmu16, dmu19, dmu22, dmu25, dmu34, dmu35, dmu36 and dmu38). These hotels had the lowest TFP score and are, therefore, the most inefficient in the sample. To improve their productivity they would have to upgrade their organizational factors, thus ensuring the right input-output balance, and invest in new technologies or methods to enhance their organizational skills.

Groups 2 and 4, which are characterized by a decline in technological change, contain the highest number of hotels (31 out of 38), revealing the negative effect of the economic crisis on investments in technology or new methods to upgrade the organizational skills in these hotels.

Table 2. **Malmquist productivity index, AC Hotels - 2007-2010**

Dmu	Tfpch	Effch	Techch	Pech	sech
dmu1: AC Hotel Ciudad de Sevilla	0.8834	0.9528	0.9272	0.9355	1.0185
dmu2: AC Hotel Coslada Aeropuerto	0.9004	0.9742	0.9242	0.9708	1.0036
dmu3: AC Hotel La Finca	0.8666	0.9944	0.8715	0.9955	0.9989
dmu4: AC Campo de las Naciones	0.9979	1.0770	0.9265	1.0738	1.0030
dmu5: AC Hotel Aitana	0.9640	1.0350	0.9313	1.0718	0.9657
dmu6: AC Dos Hoteles Toledo Plaza	0.9859	1.0585	0.9314	1.0794	0.9806
dmu7: AC Dos Lérida	0.9596	1.0381	0.9244	1.0287	1.0091
dmu8: AC Dos Santiago	1.0599	1.1427	0.9275	1.0988	1.0400
dmu9: AC Hotel Ciudad Tudela	1.0183	1.0789	0.9438	1.0000	1.0789
dmu10: AC Hotel Ciutat d'Alcoi	0.9526	1.0276	0.9270	1.0000	1.0276
dmu11: AC Hotel Algeciras	0.9407	1.0167	0.9252	1.0035	1.0132
dmu12: AC Hotel Avenida de América	0.9294	1.0000	0.9294	1.0000	1.0000
dmu13: AC Hotel Barcelona	1.0532	1.0000	1.0532	1.0000	1.0000
dmu14: AC Hotel Burgos	1.0377	1.1234	0.9238	1.0663	1.0535
dmu15: AC Hotel Castellón	0.8890	0.9593	0.9267	0.9907	0.9683
dmu16: AC Hotel Cuenca 22	0.9539	0.9635	0.9900	1.0000	0.9635
dmu17: AC Hotel Elche	0.9319	1.0048	0.9274	0.9738	1.0319
dmu18: AC Hotel Elda	1.0669	1.0493	1.0167	1.0000	1.0493
dmu19: AC Hotel Estadio Jerez	0.9111	0.9863	0.9237	1.0043	0.9820
dmu20: AC Hotel Gava	1.0701	1.1095	0.9645	1.0965	1.0118
dmu21: AC Hotel Gerona	0.9518	1.0262	0.9275	0.9940	1.0324
dmu22: AC Hotel Granada	0.8192	0.8558	0.9572	0.9305	0.9197
dmu23: AC Hotel Huelva	0.9460	1.0306	0.9179	0.9995	1.0311
dmu24: AC Hotel La Finca	1.0039	1.0645	0.9431	1.0825	0.9833
dmu25: AC Hotel Línea de la Concepción	0.9143	0.9844	0.9287	0.9615	1.0239
dmu26: AC Hotel Los Ferranes	1.0109	1.0691	0.9456	1.0260	1.0420
dmu27: AC Hotel Los Vascos	0.9678	0.9479	1.0210	1.0000	0.9479
dmu28: AC Hotel Mallorca	0.9401	1.0157	0.9256	0.9990	1.0167
dmu29: AC Hotel Monterreal	1.0180	1.1022	0.9236	1.0836	1.0172
dmu30: AC Hotel Murcia	0.9516	1.0281	0.9256	1.0011	1.0270
dmu31: AC Hotel Palencia	0.9385	1.0176	0.9222	1.0011	1.0165
dmu32: AC Hotel Recoletos	1.1163	1.0657	1.0475	1.0439	1.0208
dmu33: AC Hotel San Sebastián de los Reyes	0.9728	1.0434	0.9323	1.0418	1.0015
dmu34: AC Hotel Sevilla Forum	0.8823	0.9550	0.9239	0.9524	1.0027
dmu35: AC Hotel Tarragona	0.9188	0.9800	0.9375	1.0000	0.9800
dmu36: AC Hotel Valencia	0.9208	0.9979	0.9227	0.9884	1.0096
dmu37: AC Hotel Valladolid	0.9153	1.0000	0.9153	1.0000	1.0000
dmu38: AC Hotel Zaragoza	0.9223	0.9978	0.9243	1.0323	0.9665
Mean	**0.9580**	**1.0189**	**0.9403**	**1.0130**	**1.0058**

Figure 2. **Quadrants of efficiency for Spanish AC hotels - 2007-2010**



Because different trends can be seen for the 2007-2010 period with regard to how hotels adapted to the crisis, the changes in total productivity (TFP) and in technical and technological efficiency have to be analyzed for the three sub-periods, i.e., 2007-2008, 2008-2009, and 2009-2010. Table 3 shows the effect of the crisis first becoming apparent in 2007-2008, whereas the biggest drop in total productivity occurred in 2008-2009. In addition, we can see that TFP dropped mainly because of technological efficiency, decreasing by 11.95% and 13.11% respectively in those two sub-periods. This reveals the negative impact of financial crisis and, therefore, the difficulties to invest in new technologies (procedures, techniques, methodologies, and skills upgrades) in the hotel system. The slight growth in 2009-10 (6.59%) reflects the beginning of Spain's tourism sector recovery, as well as improvements in how the sector adapted to the recession period in the Spanish economy.

Table 3. **Efficiency trend growth for AC hotels, 2007-2010**

Mean	2007/2008	2008/2009	2009/2010
TFP	0.9204	0.8963	1.0659
%	-7.98	-10.37	6.59
EFFCH	1.0453	1.0315	0.9809
%	4.53	3.15	-1.91
TECHCH	0.8805	0.8689	1.087
%	-11.95	-13.11	8.67

The analysis of productivity changes for these 38 hotels in the 2007-2010 period corroborates the growth trend observed in Table 3. Results are shown in Table 4.

Table 4. **Productivity changes 2007-2010**

2007/2008	TFPch	EFFCH	TECH
Positive changes	7/38	22/38	1/38
Negative changes	31/38	11/38	37/38
No change	0/38	4/38	0/38
2008/2009			
Positive changes	8/38	20/38	2/38
Negative changes	30/38	11/38	36/38
No change	0/38	6/38	0/38
2009/2010			
Positive changes	30/38	14/38	38/38
Negative changes	8/38	18/38	0/38
No change	0/38	6/38	0/38

Table 4 suggests that seven hotels in 2007-2008 and eight hotels in 2008-2009 had positive efficiency changes (TFPch>1). Only two hotels (AC GAVE and AC FERRANES) improved their efficiency over both periods. In the 2009-10 period, 30 hotels out of 38 had positive efficiency changes, mostly because of positive technological changes, indicating an improvement in technology and innovation in these hotels. In 2010, AC Hotels merged with Marriott International, creating a joint brand – AC Hotels by Marriot – to manage the former's hotels. As results in Table 3 show, the new brand begins to be typified by a clear commitment to investing in new technologies, particularly regarding communication channels, management, and direct customer sales. This investment via innovation improves the brand's visibility to international travelers while helping to learn the tastes and preferences of its customers in order to offer personalized services.

CONCLUSIONS

Since 2008, the Spanish tourism sector in general and the hotel sub-sector in particular have been affected by the financial crisis much more severely than the Spanish economy as a whole. To halt the decline in tourism and hotel activities, one of the main problems facing the industry has been the need to improve its international competitiveness.

The DEA Malmquist productivity index is a good performance measurement for studying competitiveness, as it indicates changes in efficiency during a particular period, and shows which part of these changes is due to technical efficiency factors and which to technological efficiency factors.

Hotels' efficiency growth rates for the 2007-2010 period were analyzed with regard to changes in accounting rules and the aforementioned economic and financial recession. We chose the Spanish chain AC Hotels (city hotels) for our analysis of hotel efficiency because of city hotels' poor performance in the above period when compared with resorts.

The findings of this study can be briefly concluded as follows. Firstly, the study reveals how the efficiency of the analyzed hotels changed in the 2007-2010 period and what factors determined the changes. The overall mean for total productivity change was negative at 0.9580, as a result of a negative change in technological efficiency and a positive change in technical efficiency. During the studied period, the hotels were able to improve their organizational factors through better resource reallocation, by decreasing their inputs, particularly labour and food and beverages costs. A total 22 hotels out of 38 had a positive technical efficiency change, whereas only four hotels recorded a positive technological change. Only two hotels changed both organizational and technological aspects positively. The recession period certainly affected AC Hotels' performance, which resorted to organizational changes rather than investing in technology. This result for the AC chain corroborates the overall hotel sector performance. Faced with an accumulated decrease in sales and profits, hotel managers had to implement cost-reduction plans, as well as the organizational changes mentioned above.

Efficiency analysis provides some advantages from a management viewpoint. The Malmquist productivity index allows managers to identify strategically important hotels. These hotels where technical efficiency occurred in parallel with technological efficiency change seem to be the ones with highest capabilities and inherent competence to thrive rather than just survive in a highly competitive environment. Technique also identifies hotels with room for improvement in best practices, either by investment in innovation to reverse technology decline or by finding the right input-output balance (against technical efficiency decline). Efficiency analysis can serve as both guidance and encouragement to hotel managers, prompting them to evaluate their performance while improving decision making towards innovation and organizational factors in order to increase products and service value.

Trends in efficiency growth were also analyzed by sub-periods. Results show a negative change in productivity and a positive change in technical efficiency for 2007-2008 and 2008-2009, whereas positive changes in total factor productivity and technological efficiency were found in 2009-2010, as well as a small negative change in 2009-2010. Results are in accordance with the situation that characterized the Spanish hotel sector, which suffered a deep recession in 2008 and 2009, and a slight recovery in 2010 mostly because of a rebound in foreign demand. However, this demand was also driven by innovations in the hotel sub-sector regarding special offers and reduced hotel rates.

The Spanish tourism sector was going through a decline in activities before the period of national and international economic crisis. This situation called for a new approach to the sector and for modernization of its traditional characteristics. The hotel sub-sector was in need of a major innovation effort to allow improvements in the quality of places available and services provided, as well as significant investments in promotional and advertising campaigns. The effort made by the AC Hotels chain in 2010 to improve technological efficiency reflects the subsector's need to adapt and innovate, and it certainly has to continue improving not only in terms of organizational factors – through marketing campaigns, better resource allocation, and staff skills upgrading – but also in terms of technological factors – through innovation and investments in new procedures and techniques, which will help them improve results.

LIMITATIONS AND FUTURE RESEARCH

One of the limitations of this paper is the fact that results are based on a short period, i.e., 2007-2010, although one of great relevance as it was particularly challenging for the Spanish economy and for service sector practitioners. In 2010, Marriott International and AC Hotels merged to form a hotel joint venture and new co-brand, AC by Marriott. AC by Marriott focuses on incorporating AC Hotels' concept and business model of a urban-style, four-star hotel product, characterized by quality, comfort, design, and technology, combined with Marriott International's global systems, distribution, and sales platforms. Based on this new situation, a future study will focus on analyzing the effects of AC by Marriot joint venture on efficiency. Interviews with AC hotel managers are likely to be necessary in order to understand the merger and acquisition process and determine what has changed, considering the situations before and after the process. Using both qualitative and quantitative techniques should add further value to the study. Because efficiency analysis cannot identify the external or internal variables causing inefficiency, econometric models are also necessary, and will be conducted in the future.

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