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Efficiency Measurement of a Malaysian Hotel Chain Using DEA

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ABSTRACT

Efficiency evaluation has become an important improvement tool for hotels to sustain in today's highly competitive environment. This study used DEA approach to evaluate the relative efficiency of a Malaysian hotel chain during the period of 2004 to 2008 in terms of Total Factor Productivity (TFP) change. TFP change is measured using DEA-Malmquist productivity index. DEA is a pragmatic tool which combines multiple inputs and outputs objectively onto an overall measure of organizational efficiency. The Malmquist TFP index measures are decomposed into technical efficiency change and technological change. The decomposition of technical efficiency change into two sub-components, pure technical efficiency change, and scale efficiency change is also discussed in this paper. The actual operating data of five inputs and five outputs were collected from 10 hotels under the chain. Empirical results revealed that the TFP of the hotel chain slightly increased by 0.7% over the time period. Six of the hotels in the chain experienced positive TFP change while the others experienced TFP decline. The quadrant of efficiency was proposed to give a two-dimensional view of the hotel efficiency. Meanwhile, technological change was found to be more important factor of TFP growth as compared to technical efficiency change. Therefore, hotels which faced negative growths of technological change are recommended to improve their efficiency through investment in new technology or by upgrading the necessary skills. Additionally, the paper has also identified the best performing hotel within the chain which can be benchmarked by others who are seeking for performance improvement.

Keywords: Data envelopment analysis, hotel efficiency, Malmquist index, total factor productivity

INTRODUCTION

Tourism is defined as a unique product as it is composite in nature, a combination of the tangible and intangible that includes everything that tourists experience (Kandampully, 2000). Tourism has become a major element of the economic prosperity for almost all countries of the world and Malaysia is of no exceptions. Being one of Asia's most popular tourist destinations, Malaysia attracted 22.0 million tourists with tourist receipts of RM 49.5 billion in 2008 (Ministry of Tourism Malaysia, 2009). The statistics has shown that the tourism industry has emerged as an important sector of the Malaysian economy by virtue of the amount of receipts collected from its activities.

The tourism industry in Malaysia comprises of hotels, resorts, lodging, tour services, travel

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agencies, restaurants as well as catering services, and transport companies. The scope of the tourism service has progressed from supplying services or mass products and markets to more innovative tourism packages. These include eco-tourism, edu-tourism, health tourism, sports tourism and event organization (MICE). In the Ninth Malaysia Plan, the tourism industry has been identified as having potential to increase its contribution to the service sector in particular and the economy in general. Indeed, under the Third Industrial Master Plan (IMP3, 2006-2020), the tourism services have been identified as one of the eight service sub-sectors to be focused for further development during the IMP3 period. With the implementation of the Ninth Malaysia Plan and IMP3, tourist arrivals to Malaysia were expected to reach 24.6 million by 2010 and correspondingly, tourist receipts were also estimated to reach RM59.4 billion in 2010 (Ninth Malaysia Plan, 2006-2010).

The expansion of the tourism industry, through its linkages, has contributed to growth in other related activities, such as accommodation. With the aim of enhancing Malaysia as one of the global tourism destinations, the hotel sector, being one of the sectors in the tourism industry, plays an important role in maintaining and improving its performance in order to contribute to the growth of the tourism industry. Meanwhile, the hotel sector has also been identified as the potential area having competitive advantage for the development of the Small and Medium Enterprises (SMEs) in IMP3.

In order to sustain and further boost the tourism industry, the hotel sector needs to operate efficiently and provide comfortable accommodations for tourists. It is important for hotels to formulate marketing competitive strategy, strengthen corporate operations and upgrade its quality of service. In formulating these strategies, hotels must first measure their performance. Performance evaluation serves as an important reference for strategic planning and construction policies. Thus, the top management of hotels needs to find ways to evaluate and improve the efficiency and performance of their establishments.

Existing studies on efficiency in Malaysia have primarily focused on the whole economy or the manufacturing industry, yet little has been done in the services industry at firm level. Similarly, there has been extensive literature examining the efficiency of US, UK, Taiwan and Portugal hotels over the recent years, but similar empirical work on Malaysian hotels is still lacking. Much research on the hotel industry in Malaysia has been devoted to the aspects of service quality and customer satisfaction, but very little is known about the efficiency of hotels. Therefore, this paper aims to evaluate the efficiency of a Malaysian hotel chain using the Data Envelopment Analysis (DEA) approach. Consequently, this paper embarks on the following objectives:

- To analyze the relative efficiency of a Malaysian hotel chain in terms of the Total Factor Productivity (TFP) change.
- To identify the best practices hotel with regards to efficiency.
- To determine the factors contributing to efficiency of the hotels.

LITERATURE REVIEW

Data Envelopment Analysis (DEA)

Data envelopment analysis (DEA) has become an increasingly popular efficiency analysis tool. DEA is a non-parametric multiple linear programming technique that utilizes multiple input and output measurements in evaluating relative efficiency of individual units within a given population. DEA constructs a production frontier and measures the efficiency of the developed frontiers in the mathematical programming approach. Charnes *et al*. (1978) were the first to invent data envelopment analysis and proposed the DEA-CCR model (which was named after the authors, namely, Charnes, Cooper and Rhodes). The DEA-CCR model had an input orientation and assumed constant returns-to-scale (CRS). However, the model was later extended by Banker *et al*. (1984) who considered alternative set of assumption. The model is known as the DEA-BCC model with the assumption of variable returns-to-scale (VRS).

In addition to the DEA-CCR and DEA-BCC models, other developments of DEA include the Malmquist Total Factor Productivity (TFP) index. The Malmquist TFP index measures changes in the total output relative to the changes in the usage of the total inputs by obtaining an output-to-input ratio value that takes into account all significant inputs and outputs. The idea was developed by the Swedish statistician Malmquist (1953). The TFP approach is useful both theoretically and empirically. TFP indices can be derived from the theory of production functions and bring a strong theoretical basis in economic to its analysis. Practically, TFP indices are easier to understand as compared to other non-parametric indices (Nyshadham and Rao, 2000). Thus, the Malmquist TFP index gains importance and is frequently used mainly because it can be calculated using quantity information without price data, so problems regarding unavailable or distorted price information are avoided.

Generally, there are two ways to quantitatively analyze efficiency, i.e. the parametric (stochastic frontier analysis, SFA) and non-parametric (DEA) methods. The method adopted by most efficiency studies in the context of hotel industry belongs to the latter. However, both methods have their own advantages and drawbacks. The SFA approach (Anderson *et al*., 1999) is an econometric estimation of a specific model and it is based on the statistical properties of the error terms. For SFA, the choice of the functional form is crucial to model the data as different model specifications can give rise to very different results. Unlike the SFA approach, the DEA does not impose any functional form on the data, or makes distributional assumptions for the inefficiency term. Instead, DEA is easy to apply and it allows the use of multiple inputs and outputs (Bell and Morey, 1995; Morey and Dittman, 1995).

Both SFA and DEA methods assume that the production function of the fully efficient decision unit is known. In practice, however, the efficient isoquant must be estimated from the sample data. Therefore, the production frontier is relative to the sample considered in the analysis. DEA is applied to unit assessment of homogenous units which are normally referred to as decision making unit (DMU). The aim of DEA is to estimate relative efficiency among DMUs which perform the same task using similar technology (processing procedure) to pursue similar objectives (outputs) using similar resources (inputs), such as banks, hospitals, hotels and restaurants. Thus, the identification of DMUs, inputs and outputs in an assessment is as difficult as it is crucial (Barros, 2005a).

The DEA method is able to handle non-commensurate, conflicting multiple output measures and multiple inputs factors of the organizations being evaluated. It provides a comprehensive efficiency evaluation by combining multiple inputs and outputs objectively onto an overall measure of organizational efficiency. DEA is also a benchmarking technique that assesses the relative efficiency of decision making units and analytically identifies the best practices and benchmarks for poor performing DMUs. Applications using DEA for efficiency and performance benchmarking have been numerous. DEA studies have been extensively applied to various industries, such as banking (Debasish, 2006; Lin *et al*., 2007), education (Avkiran, 2001), hospitals (Sarkis and Talluri, 2002; Wei and Liao, 2008; Radam *et al*., 2009) manufacturing (Mahadevan, 2002) and restaurants (Sigala, 2004; Reynolds and Thompson, 2007).

DEA-Based Studies in the Hotel Industry

An extensive literature review on 35 DEA applications in the tourism and hospitality sectors between 1986 and 2006 was conducted by Wober (2007). The study concluded that DEA has just raised a lot of attention among tourism researchers recently. Majority of the DEA applications are in the hotel industry. Among the earliest, Morey and Dittman (1995) applied data envelopment analysis to evaluate the general-manager performance of 54 owner-managed hotels of a national chain in the United States for the year 1993. This study provided the owners of single properties with the ability to benchmark a manager's performance. Bell and Morey (1995) also employed DEA to evaluate the relative efficiency and to discover the best practice solutions of 31 travel departments. The study suggested an extension to the basic DEA which is allocative data envelopment analysis as the benchmarking tool. The authors were the first who highlighted the strengths of DEA for the selection of comparison partners.

In the late 90s, there were several DEA studies in the hotel industry. For example, Johns *et al*. (1997) and Tsaur *et al*. (1999) used DEA to measure efficiency of hotels in the United Kingdom and Taiwan, respectively. Johns *et al*. (1997) implemented DEA to monitor and benchmark productivity in a chain of 15 hotels using data for a 12 month's period. The authors found that DEA is very useful for diagnosing and identifying outstanding behaviour in terms of their measured productivity and gross profit. By using a new efficiency measure (EAM) in their data envelopment analysis, Tsaur *et al*. (1999) estimated efficiency the levels of international tourist hotels of Taiwan. The study showed that the EAM could provide a strong discriminating power as compared to traditional DEA, whereby 10% of the 47 hotels studied were relatively efficient in the EAM model while 17% were relatively efficient in the DEA-CCR model.

More studies to gauge the efficiency of the hotels using DEA were carried out in the recent years. For instance, Anderson *et al*. (2000) estimated managerial efficiency in the US hotel industry using linear programming procedure, DEA. Their findings revealed efficiency levels in various forms (namely, overall, allocative, technical, pure technical, and scale efficiency) and showed that the US hotel industry is highly inefficient with a mean overall efficiency measure of approximately 42%. In Taiwan, Chiang *et al*. (2004) with the interest to compare the performance of hotels under different operational styles, using the DEA-CCR and BCC models, to measure the efficiency of 25 Taipei hotels under three types of management (namely, independently owned and operated, franchise licensed, and managed by international hotel operators). The authors found that not all hotels franchised or managed by international hotel operators performed more efficiently than the independent ones. Instead of using the basic DEA model, Barros (2005b) evaluated the determinants of efficiency of Portugal's public-owned hotel chain, Enatur, using the Malmquist productivity index and the Tobit econometric model for the period between 1999 and 2001. The study contemplated four combinations of technical efficiency and technological change and also explained the determinants of the TFP change.

Inputs and Outputs Identification

There are three main categories of measurement units of inputs and outputs, namely financial, physical and a combination of both (Ball *et al*., 1986). Both the financial and physical units have been used in previous studies. Simple inputs and outputs which have no ratio or composite data were used by Johns *et al*. (1997). The authors preferred non-financial data to be used in developing their DEA model and analysis. Thus, the following four inputs and three outputs were employed: (1) the number of room nights available, (2) total labour hours, (3) total food and beverage costs, (4) total utilities cost; and (1) number room nights sold, (2) total covers served and (3) total beverage revenue. Meanwhile, the use of the financial data, such as beverage revenue, food and beverage material costs and utility costs, was inescapable but their uses were justified on the basis that they were constant across the country and constant with respect to time.

By applying the DEA-CCR model and the Malmquist productivity index, Hwang and Chang (2003) considered indicators used by the Taiwan Tourism Bureau for input-output factors. In measuring the performance and the efficiency change of 45 hotels in Taiwan, four inputs and three outputs were used: (1) number of full time employees, (2) number of guest rooms, (3) total area of meal department, (4) operating expenses; and (1) room revenue, (2) food and beverage revenue and (3) other revenue. Similarly, Barros and Alves (2004) looked at hotel efficiency, evaluated a Portuguese public-owned hotel chain and estimated their total factor productivity (TFP) change using the DEA-Malmquist TFP index. The authors used five inputs: (1) number of full-time workers, (2) cost of labour, (3) book value of property, (4) operating costs, and (5) external costs. The sales, number of guests and number of nights spent in the hotel were used as outputs.

On the other hand, Sun and Lu (2005) chose slack-based measure (SBM) Malmquist approach as the appropriate version of DEA to measure the hotel performance of 55 international tourist hotels in Taiwan. The four inputs and four outputs used include (1) total operating expenses, (2) number of employees, (3) number of guest rooms, (4) total area of catering department; and (1) total operating revenues, (2) average occupancy rate, (3) average daily rate, and (4) average production value per employee in the catering department. Despite the inputs and outputs discussed, relevant inputs and outputs should be used depending on the focus of the analysis.

METHODOLOGY

This study applied the Malmquist TFP productivity index, i.e. a non-parametric approach to measure the productive efficiency of a Malaysian hotel chain. This index represents the TFP growth of a DMU, in which it reflects (1) progress or regress in efficiency along with the (2) progress or regress of the frontier technology between two periods of time under the multiple inputs and multiple outputs framework (Cooper *et al*., 2007). This study employed the output-based approach where the question "by how much can the output quantities be proportionally expanded without altering the input quantities used?" could be asked. In this paper, the productivity change is decomposes into two components namely, technological change (TECHch) and technical efficiency change (EFFch). The decomposition of TFP into technical efficiency change and technological changes shall provide useful information in the productivity analysis. Technical efficiency change shows that the hotel can be more productive by utilizing the existing technology and economic inputs more efficiently. Meanwhile, technological change refers to the growth in the total factor productivity (TFP) as a result of the technological advancements and innovations in the hotel system.

The Malmquist TFP index measures the TFP change between two data points (e.g. those of a particular firm in two adjacent time periods) by calculating the ratio of the distances of each data point relative to a common technology. Fare *et al*. (1994) specified an output-based Malmquist productivity change index between period t (the base period) and the period $t+1$ is given by:

$$M_0(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_0^t(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} \times \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^{t+1}(x_t, y_t)}\right]_{1/2} \quad [1]$$

where $d_o^t\,(x_{t+1}, y_{t+1})$ represents the distance from the period $t+1$ observation to the period t technology. A value greater than one indicates a positive TFP growth from period t to period $t+1$, while a value less than one indicates a TFP decline. The decomposition is as follows:

$$\text{Technical efficiency change} = \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} \quad [2]$$

$$\text{Technological change} = \left[\frac{d_0^t(x_{t+1}, y_{t+1}) \times d_0^t x_t, y_t}{d_0^{t+1}(x_{t+1}, y_{t+1}) \times d_0^{t+1}(x_t, y_t)}\right]_{1/2} \quad [3]$$

Thus, the Malmquist TFP index can be written as:

$$TFP = EFFch \times TECHch \quad [4]$$

However, improvement in TFP growth does not mean enhancement in both technical efficiency and technological change. Technical efficiency change measures the change in efficiency between current (t) and next ($t+1$) periods, while the technological change (innovation) captures the shift in the frontier technology. By differentiating technical efficiency and technological change, policy actions can be expected to bring about improvement in TFP growth directly.

Furthermore, technical efficiency change can be further decomposed into sub-components, namely, pure technical efficiency change (PEch) and scale efficiency change (SEch), as follows:

$$EFFch = PEch \times SEch \quad [5]$$

Pure technical efficiency change which is calculated relative to the variable returns-to-scale (VRS) technology measures the relative ability of DMUs to convert inputs into outputs. It shows the investments in the organizational factors related to hotel operation. Meanwhile, scale efficiency change captures changes in the deviation between the VRS and CRS (constant returns-to-scale) technology and measures to what extent DMUs can take advantage of returns to scale by altering its size towards optimal scale (Fare *et al*., 1994).

Input and Output Measures

Careful identification of the inputs and outputs is very important for a successful application of the DEA. The assessment of comparative efficiency using DEA should begin with the selection of appropriate input and output measures which can be aggregated into a composite index of overall performance standards. Although any resources used by DMU can be included as inputs, five inputs were selected for this study. The identified inputs were the number of room nights available, the number of employees, employment costs, food and beverage costs, and total operating costs, whereas the five selected outputs included the number of room nights occupied, the number of guests, average occupancy rate, food and beverage revenues, and total operating revenues.

The variables were selected based on the reviewed literature and the availability of the data. For example, total operating expenses including room costs, utilities and maintenance fees whcih affected the profitability of hotels were viewed as inputs. As for the outputs, the total operating revenues which significantly influenced the financial efficiency of hotels were included. As the profit measure alone might not be a good indicator of how efficiently resources were used to provide customer services, the average occupancy rate was also included as an output, because it reflected how efficiently room capacity was utilized as a result of the invested expenses.

Panel data covering the observations on the input and output variables for all decision making units in for year 2004 to year 2008 were collected through mail survey. The questionnaires, which were accompanied with an explanatory letter, were mailed to the managers of the 10 hotels under the chain. The questionnaire contained five input and five output variables with definition and unit. The managers were asked to complete the questionnaire with the operational data of their hotels. After the collection of data, the cost and economic data (e.g. employment costs, food and beverage costs, etc.) were deflated into a constant value (base year 2000) using deflators such as consumer price index (CPI) and added value deflator which were obtained from the Department of Statistics, Malaysia. After deflation, the panel data were analyzed using the Data Envelopment Analysis Programme 2.1 (DEAP 2.1) Software (Coelli, 1996) to compute the Malmquist productivity index of the hotel chain.

Table 1 shows the descriptive statistics of the inputs and outputs of 10 hotels under the chain incorporated in this study.

RESULTS AND DISCUSSION

Based on the output-oriented DEA-Malmquist productivity index, the efficiency of the Malaysian hotel chain was measured for the period 2004 to 2008. The performance of the Malmquist productivity index of the 10 hotels under the chain is displayed in Table 2. On the

TABLE 1
Descriptive statistics of the inputs and outputs of the hotel chain, 2004-2008

Variables	Minimum	Maximum	Mean	Std. dev.
Input				
Number of room nights available	17155	54900	33120.46	12310.80
Number of full-time equivalent employees	28	69	48.64	14.22
Employment costs (RM)	56883.72	1185121.11	569247.91	275032.74
Food and beverage costs (RM)	93166.67	879471.65	360587.01	173619.80
Total operating costs (RM)	66624.55	4251303.25	1103950.41	1048039.13
Output				
Number of room nights occupied	7704	36424	22418.06	8848.21
Number of guests	16911	79774	45747.88	17944.14
Average occupancy rate (%)	44.79	82.92	66.77	9.79
Food and beverage revenues (RM)	17394.64	1830227.74	885923.86	454694.82
Total operating revenues (RM)	52515.96	4074534.16	2350302.10	1163878.27

average, Hotel J recorded the highest growth in term of the TFP with 5.1%, followed by Hotel A (4.2%), and Hotel F (1.8%). Meanwhile, Hotel B recorded the lowest growth in the TFP with negative 2.5%. Overall, the results revealed that the mean score of the TFP change was 1.007, indicating that the TFP of the hotel chain had slightly increased by 0.7% over the time period. Within the chain, 6 of the hotels experienced positive TFP change while the others faced TFP decline.

Table 2 also presents the decomposition of the TFP changes into two components, namely, technical efficiency change and technological change. There was lower technical efficiency change and higher technological change for all hotels. This might be due to the short-run cost-minimizing behaviour in the face of quasi-fixed vintage of capital. All hotels recorded the same level of technical efficiency change (1.000) suggesting no change in technical efficiency during the time period. Meanwhile, all the hotels experienced different levels of technological changes. Six hotels registered increased technological changes of more than 1.000, while the other four registered decreased in the technological change of less than 1.000.

Technical changes can be associated with the diffusion of best-practice technology in the management of hotel activity, such as investment planning, technical experience, and the management and organization in the hotel. On the other hand, technological change is related to the consequence of innovation, such as the adoption of new technologies in the hotel system. On the average, the improvement in the TFP of the Malaysian hotel chain was attributed by technological change (0.7%). Thus, technological change was found to be more important factor of TFP growth as compared to technical efficiency change.

Based on the four combinations of technical efficiency change and technological change introduced by Barros (2005b), this study also contemplated the combinations of technical efficiency change and technological change of the Malaysian hotel chain into a quadrant of efficiency. *Fig. 1* depicts the quadrant of efficiency of the 10 hotels under the chain examined in this study.

There were six hotels included in the first quadrant (Q1), namely, Hotel J, Hotel A, Hotel F, Hotel H, Hotel D, and Hotel E. This quadrant illustrated the hotels with improvements in the

TABLE 2
Malmquist productivity index of Malaysian hotel chain means, 2004-2008

DMU	TFP change (TFPch)	Technical efficiency change (EFFch)	Technological change (TECHch)
Hotel A	1.042	1.000	1.042
Hotel B	0.975	1.000	0.975
Hotel C	0.982	1.000	0.982
Hotel D	1.007	1.000	1.007
Hotel E	1.003	1.000	1.003
Hotel F	1.018	1.000	1.018
Hotel G	0.998	1.000	0.998
Hotel H	1.014	1.000	1.014
Hotel I	0.979	1.000	0.979
Hotel J	1.051	1.000	1.051
Mean	1.007	1.000	1.007

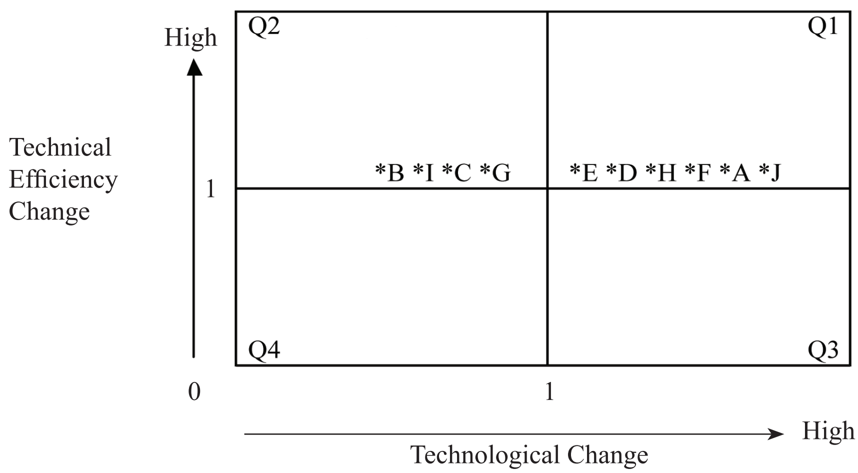

Fig. 1: Quadrant of efficiency for a Malaysian hotel chain, 2004-2008

technical efficiency change co-existed with the improvements in technological change. These hotels were found to be the best-performing hotels during the period because they had upgraded the organizational factors related to the uses of inputs and outputs and showed innovations related to new technology. As for Hotel J, which was the hotel with the best practices within the chain, it showed improvement in resource allocation by using less inputs (the number of employees maintained and a decrease in the total operating costs during the period), increasing its outputs (the number of room night occupied, number of guests, and total operating revenues). This hotel was able to fully utilize resources available and obtained better revenues. In addition, Hotel J also had a better implementation on the multi-skilling concept and more effective staffing and scheduling which helped to reduce the dependency on additional employees and consequently contributed to the efficiency of the hotel. The second quadrant (Q2) illustrates hotels with improvements in the technical efficiency change that co-existed with a decline in the technological change. Four hotels, namely, Hotel G, Hotel C, Hotel I, and Hotel B fell into this particular quadrant. These hotels faced a decline in technological change because they upgraded their organizational factors without introducing any new technology that could help them in improving their organizational factors. These hotels are recommended for an induction in technological innovation. In other words, they may need to acquire new technology or innovations and upgrade necessary skills in order to improve the performance.

Hotels which experienced a decline in the technical efficiency change co-existed with improvements in technological change were categorized in the third quadrant (Q3). However, the results in this study showed that none of the hotels fell into this quadrant. Falling into this quadrant would mean that the hotels might have invested in new technologies but were not able to balance the use of inputs versus outputs. They might need to upgrade their organizational factors, such as marketing initiatives, improvement in quality and achievement of a better balance between the inputs and outputs. Finally, the fourth quadrant (Q4) displays hotels which experienced a decline in both the technical efficiency change and technological change simultaneously. Nevertheless, none of the hotels in the chain fell into this quadrant. If they were classified into this quadrant, the hotels would be categorized as inefficient. Hence, the policy has to accelerate the efficiency through the application of the latest technology, learning-by-doing processes and managerial practices. Corrective actions such as improving the organizational factors related to the balanced use of inputs versus outputs and adopting new technologies or innovations associated with the upgrading of organizational skills are therefore necessary.

The decomposition of the technical efficiency change was further divided into two sub-components, namely pure technical efficiency change and scale efficiency change, as presented in Table 3. All the hotels experienced no changes in both pure technical efficiency change and scale efficiency change (1.000)

TABLE 3
Technical efficiency components of a Malaysian hotel chain, 2004-2008

DMU	Technical efficiency change (EFFch)	Pure technical efficiency change (PEch)	Scale efficiency change (SEch)
Hotel A	1.000	1.000	1.000
Hotel B	1.000	1.000	1.000
Hotel C	1.000	1.000	1.000
Hotel D	1.000	1.000	1.000
Hotel E	1.000	1.000	1.000
Hotel F	1.000	1.000	1.000
Hotel G	1.000	1.000	1.000
Hotel H	1.000	1.000	1.000
Hotel I	1.000	1.000	1.000
Hotel J	1.000	1.000	1.000
Mean	1.000	1.000	1.000

during the time period. The results showed that both the subcomponents appeared to be equally important to the technical efficiency change. However, there was no improvement in both the sub-components. The improvement in pure technical efficiency change would also mean that the hotels might have invested in organizational factors related to hotel operation and achieved better balance between inputs and outputs. On the other hand, the growth in the scale efficiency change would mean that the size of hotels did matter in affecting their efficiency changes and obtaining economies of scale.

This study also analyzed the productivity changes of 10 hotels under the chain for the period from 2004-2008 using the output-oriented Malmquist approach. The results are presented in Table 4.

As shown in Table 4, none of the hotels had a clear-cut positive or negative productivity change from 2004-2008. Two hotels, namely Hotel A and Hotel G, revealed a better achievement, whereby they achieved positive productivity changes for 3 out of the 4 period intervals. This might be due to the reason that these two hotels are located at famous tourist destinations and they had also performed better and allocated resources effectively. Conversely, Hotel C and Hotel I recorded negative productivity changes for 3 out of the 4 period intervals. These hotels may need to improve in their performances and resource allocation in order to achieve positive productivity change.

Table 4 also suggests that 7 out of 10 hotels had positive productivity changes between 2005 and 2006. This might be due to the contribution of the promotional efforts by the Malaysian Tourism Promotion Board (MTPB) and Malaysia's increasingly strong reputation as a centre for international events. Besides, this might be the results of the implementation of strategic measures by the Malaysian Government during the Eight Malaysia Plan (2001-2005) to attain rapid tourism growth on a sustainable basis. These strategic measures have benefited the tourism and hotel industry in particular. In contrast, 7 out of 10 hotels had negative productivity changes between 2007 and 2008.

TABLE 4
Productivity changes of a Malaysian hotel chain, 2004-2008

DMU	2004-2005	2005-2006	2006-2007	2007-2008	Firm means	Positive changes	Negative changes
Hotel A	1.119	1.023	0.828	1.246	1.042	3/4	1/4
Hotel B	0.958	0.909	1.034	1.005	0.975	2/4	2/4
Hotel C	0.958	1.040	0.949	0.981	0.982	1/4	3/4
Hotel D	0.983	1.058	1.012	0.977	1.007	2/4	2/4
Hotel E	0.908	1.117	1.012	0.985	1.003	2/4	2/4
Hotel F	1.155	0.890	0.959	1.090	1.018	2/4	2/4
Hotel G	1.008	1.035	1.003	0.948	0.998	3/4	1/4
Hotel H	0.985	1.081	1.009	0.985	1.014	2/4	2/4
Hotel I	1.028	0.993	0.934	0.961	0.979	1/4	3/4
Hotel J	0.999	1.105	1.168	0.947	1.051	2/4	2/4
Annual means	1.008	1.023	0.987	1.009	1.007	3/4	1/4
Positive changes	4/10	7/10	6/10	3/10	6/10	20/40	20/40
Negative changes	6/10	3/10	4/10	7/10	4/10	20/40	20/40

The increase in the negative productivity changes in the hotel chain during this period was possibly caused by the global financial crisis (2007–2008). In more specific, this crisis had adversely affected many businesses related to the tourism sector, such as the hotels, tour agents, airlines, retail trade, restaurants, as well as other businesses in other sectors.

CONCLUSIONS

This paper has examined the efficiency of a Malaysian hotel chain in terms of their TFP growth. A DEA model with five inputs and five outputs was specified and used to estimate hotel efficiency. The analysis was based on the DEA-Malmquist productivity index, which could be decomposed into technical efficiency change and technological change. Additionally, the technical efficiency changes were further divided into subcomponents, namely pure technical efficiency change and scale efficiency change. The Malmquist TFP index is important in performance measurement as it helps in the determination of the factors contributing to the efficiency of hotels.

The findings of this study can briefly be concluded as follows. Hotels J, A, F, H, D, and E were relatively efficient as compared to other hotels within the chain, with Hotel J being the top performer in the hotel chain. TFP was found to have increased by 0.7% throughout the period between 2004 and 2008 for the whole chain. The years from 2005 to 2006 recorded the highest TFP growth (2.3%) whereas the lowest growth (-1.3%) was recorded for the period from 2006 to 2007. The TFP growth in the hotel chain was mainly due to the technological change (0.7%). The results of the analysis have important implications to the Malaysian hotels chain. In more specific, the results indicate that the hotel chain has the potential to further increase its TFP growth through improvement in technological advancement and innovations, along with a constant upgrade of organizational factors. The technological advancement can also be associated with the investment in new methods, procedures and techniques in the hotel operation. The findings can benefit hotel managers who are seeking for performance improvement in which they can benchmark practices being adopted by the best performing hotels. Finally, the findings also serve as an index for hotel management to further improve their establishment's efficiency.

REFERENCES

Anderson, R. I., Fish, M., Xia, Y. and Michello, F. (1999). Measuring efficiency in the hotel industry: a stochastic frontier approach. *International Journal of Hospitality Management*, *18*(1), 45-57.

Anderson, R. I., Fok, R. and Scott, J. (2000). Hotel industry efficiency: An advanced linear programming examination. *American Business Review*, *18*(1), 40-48.

Avkiran, N. K. (2001). Investigating technical and scale efficiencies of Australian universities through data envelopment analysis. *Socio-Economic Planning Sciences*, *35*(1), 57-80.

Ball, S. D., Johnson, K. and Slattery, P. (1986). Labour productivity in hotels: An empirical analysis. *International Journal of Hospitality Management*, *5*(3), 141-147.

Banker, R. D., Charnes, A. and Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, *30*(9), 1078-1092.

Barros, C. P. (2005a). Measuring efficiency in the hotel sector. *Annals of Tourism Research*, *32*(2), 456-477.

Barros, C. P. (2005b). Evaluating the efficiency of a small hotel chain with a Malmquist productivity index. *International Journal of Tourism Research*, *7*(3), 173-184.

Barros, C. P. and Alves, F. (2004). Productivity in the tourism industry. *International Advances in Economic Research*, *10*(3), 215-225.

Bell, R. A. and Morey, R. C. (1995). Increasing the efficiency of corporate travel management through macro benchmarking. *Journal of Travel Research*, *33*(3), 11-20.

Charnes, A., Cooper, W. W. and Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, *2*, 429-444.

Chiang, W. E., Tsai, M. H. and Wang, L. S. M. (2004). A DEA evaluation of Taipei hotels. *Annals of Tourism Research*, *31*(3), 712-715.

Coelli, T. J. (1996). A guide to DEAP version 2.1: A data envelopment analysis (computer) program. Centre for Efficiency and Productivity Analysis (CEPA) Working Papers. Centre for Efficiency and Productivity Analysis, University of New England, Armidale, Australia.

Cooper, W. W., Seiford, L. M. and Tone, K. (2007). *Data Envelopment Analysis- A Comprehensive Text with Models, Applications, References and DEA-solver Software.* Springer Science Business Media, LLC.

Debasish, S. S. (2006). Efficiency performance in Indian banking-use of data envelopment analysis. *Global Business Review*, *7*(2), 325-333.

Facts & Figures, Ministry of Tourism Malaysia, Retrieved on August 7, 2009 from Ministry of Tourism, Malaysia http://www.tourismmalaysia.gov.my/corporate/research.asp?page=facts_figures.

Fare, R., Grosskopf, S., Norris, M. and Zhang, Z. (1994). Productivity growth, technical progress, and efficiency change in industrialized countries. *The American Economic Review*, *84*(1), 66-83.

Hwang, S. N. and Chang, T. Y. (2003). Using data envelopment analysis to measure hotel managerial efficiency change in Taiwan. *Tourism Management*, *24*(4), 357-369.

Johns, N., Howcroft, B. and Drake, L. (1997). The use of data envelopment analysis to monitor hotel productivity. *Progress in Tourism and Hospitality Research*, *3*, 119-127.

Kandampully, J. (2000). The impact of demand fluctuation on the quality of service: A tourism industry example. *Managing Service Quality*, *10*(1), 10-18.

Lin, Y.H., Hsu, G. J. Y. and Hsiao, C. K. (2007). Measuring efficiency of domestic banks in Taiwan: application of data envelopment analysis and Malmquist index. *Applied Economics Letters*, *14*(11), 821 - 827.

Mahadevan, R. (2002). A DEA approach to understanding the productivity growth of Malaysia's manufacturing industries. *Asia Pacific Journal of Management*, *19*, 587-600.

Malmquist, S. (1953). Index numbers and indifference surfaces. *Trabajos de Estadı´stica*, *4*, 209–242.

Ministry of International Trade and Industry Malaysia. (2006). *Third Industrial Master Plan 2006-2020*.

Morey, R. C. and Dittman, D. A. (1995). Evaluating a hotel GM's performance. *Cornell Hotel and Restaurant Administration Quarterly*, *36*(5), 5-30.

Nyshadham, E. A. and Rao, V. K. (2000). Assessing efficiency of European airports: A total factor productivity approach. *Public Works Management & Policy*, *5*(2), 106-114.

Radam, A., Baharom, A. H., Affizah, A. M. D. and Ismail, F. (2009). Effect of mergers on efficiency and productivity: Some evidence for banks in Malaysia. *The ICFAI University Journal of Bank Management*, *8*(1), 31-46.

Reynolds, D. and Thompson, G. M. (2007). Multiunit restaurant productivity assessment using three-phase data envelopment analysis. *International Journal of Hospitality Management*, *26*(1), 20-32.

Sarkis, J. and Talluri, S. (2002). Efficiency measurement of hospitals: Issues and extensions. *International Journal of Operations & Production Management*, *22*(3), 306-313.

Sigala, M. (2004). Integrating and exploiting information and communication technologies (ICT) in restaurant operations - implications for restaurant productivity. *Journal of Foodservice Business Research*, *6*(3), 55 - 76.

Sun, S. and Lu, W. M. (2005). Evaluating the performance of the Taiwanese hotel industry using a weight slacks-based measure. *Asia-Pacific Journal of Operational Research*, *22*(4), 487-512.

The Economic Planning Unit, Prime Minister's Department. (2006). *Ninth Malaysia Plan 2006-2010*.

Tsaur, S. H., Chiang, C. I. and Chang, T. Y. (1999). Evaluating the operating efficiency of international tourist hotels using the modified DEA model. *Asia Pacific Journal of Tourism Research*, *4*(2), 73 – 78.

Wei, C. K. and Liao, M. L. (2008). Analysis of regional competition efficiency of the hospitals in Taiwan: A case study. *The Business Review, Cambridge*, *9*(2), 92-96.

Wober, K. W. (2007). Data envelopment analysis. *Journal of Travel & Tourism Marketing*, *21*(4), 91 - 108.