Performance Assessment of Hong Kong Hotels

Abstract: The study examines the performance, in terms of efficiency, of the Hong Kong hotel industry during the period 2002–2013. Employing both CCR-DEA and BCC-DEA models, the study results show that, among the three Hong Kong hotel tariff categories, in terms of overall managerial efficiency, high tariff A outperformed the other two hotel categories with the strongest stability in performance whereas high tariff B fell behind the other two hotel categories with the most instability in performance; the impact of special events on the performance of different hotel tariff categories is dependent upon whether those events influence the target customers of the hotel tariff categories. Complementary to the hotel industry's prevailing use of performance indicators such as occupancy percentage or average daily rate, this paper offers an alternative perspective to examining hotel industry performance in Hong Kong, and to articulate the relationships between the performance, market positioning, and customer base of the different hotel tariff categories.

Keywords: data envelopment analysis; Hong Kong; performance; efficiency; customer base

Introduction

The Hong Kong tourism industry, including hotels, has witnessed strong recoveries from major disastrous incidents such as the 2003 Severe Acute Respiratory Syndrome (SARS) and the 2008 global financial crisis, mainly owing to the continuous influx of mainland Chinese tourists visiting under the Individual Visit Scheme (IVS) launched in July 2003. In 2014, tourist arrivals to Hong Kong reached 60.8 million, of which 77.7% came from mainland China and 45.6% stayed overnight (with an average stay of 3.3 nights), helping Hong Kong hotels achieve an average occupancy percentage of 90% and hotel room rate of HK$1,473 (Hong Kong Special Administrative Region government, 2015). While Hong Kong hotels should be commended for such satisfactory operating results, it cannot be denied that the industry is rather vulnerable

to fluctuations in the economy and the competition ahead of them will only become fiercer in the years to come. Huge hotel investments in the neighboring regions, such as Macau and Guangdong Province, are also targeting overnight tourists, further intensifying competition in the hotel market in the Pearl River Delta region. In 2014, there were 1,012 star-rated hotels in Guangdong, 4.1 times more than Hong Kong (244 hotels) and 15.3 times more than Macau (66 hotels) (Guangdong Bureau of Statistics, 2015; Hong Kong Special Administrative Region Government, 2015; Statistics and Census Service of Macau, 2015). The large supply of hotel guestrooms in Guangdong and Macau could likely divert some overnight visitors away from Hong Kong, particularly after the Hong Kong-Zhuhai-Macau Bridge opens to traffic at the end of 2017 that is expected to greatly facilitate tourist flow within the region (Hsu & Gu, 2010).

Thus, in sustaining its performance, it is of utmost importance that the Hong Kong hotel industry takes timely precautions to examine the past performance of different hotel categories and enhance their future competitiveness. As Tsai et al. (2011) argued, traditional key performance indicators (KPIs) such as occupancy percentage or average daily rate (ADR) employed in assessing hotel performance are largely confined to the measurement of final operational outcomes; further assessment of efficiency in turning available input resources into hotel products and services does not seem to be of immediate importance to managers, and could therefore receive insufficient attention from them. The quality of the decisions made by hotel management and the resultant operating outcome could therefore be undermined. To the best of our knowledge, there is scant research that assesses the performance of the hotel industry in Hong Kong. As a complement to the industry's prevailing use of KPIs, this study aims to conduct trend and special event analyses on the basis of the data envelopment analysis (DEA)

technique in measuring the performance of hotels belonging to different tariff categories in Hong Kong. Besides, this study further articulates the relation among hotel category, efficiency and customer base to assist Hong Kong hoteliers sustain a similarly positive performance into the future, without relying on essentially a single source market.

Literature review

Studies based on Hong Kong hotel tariff categories

A number of research studies have paid attention to factors related to travelers' needs and consumer perception on the basis of the Hong Kong hotel tariff categories. According to the Hong Kong Hotel Classification System (HKHCS), hotels in Hong Kong are classified into high tariff A, high tariff B, and medium tariff based on a weighted composite score attained from the five key indicators, namely *facilities*, *location*, *staff-to-room ratio*, *average achieved room rate*, and *business mix*, as shown in Table 1 (Hong Kong Tourism Board, HKTB, 2015a).

[Insert Table 1 here]

Chu and Choi (1997) compared consumer perceptions toward the three tariff categories of hotels in Hong Kong, and suggested that travelers chose high tariff A and B hotels because of higher quality rooms and staff service. Subsequently, Chu and Choi (2000) examined business and leisure travelers' preferences regarding the relative importance of six hotel selection factors—service quality, business facilities, value, room and front desk, food and recreation, and security—across the three tariff categories of hotels in Hong Kong. They found that room quality and front desk services, together with security, were the determining factors leading to travelers' hotel selection. Qu et al. (2000) explored travelers' satisfaction levels regarding the quality of the

service and the facilities across the three hotel tariff categories, and found that travelers had the lowest satisfaction level toward the medium tariff hotels.

The hotels in each tariff category differ in their market positioning and they target different customers (De & Scholl, 1998). As Song et al. (2011) pointed out, some markets (such as Australia, the UK and the US) were income elastic in terms of demand for high tariff A and B hotels, and exhibited greater sensitivity to price changes in high tariff A hotels. Other markets, such as mainland China and countries in Southeast Asia, were income elastic in their demand for medium tariff hotels, and exhibited great sensitivity to price changes in the high tariff B and medium tariff categories. It is reasonable to deduce that the market positioning of high tariff A hotels is geared toward the luxury market, and this market is more price inelastic (Griffin et al., 1997); the target customers focus more on service quality and are less concerned about price. In contrast, medium tariff hotels focused more on the budget market, where the target clients are more conscious of room rate than service quality (Chu and Choi, 2000). Lastly, the market positioning of high tariff B hotels lies somewhere in between that of the other two categories (high tariff A and medium-tariff), and the target clients are those who may consider both price and service quality when choosing hotel accommodation.

The above studies investigated the relations between hotel categories and their customer base. On the basis of the above literature, this study assesses the performance of the three hotel tariff categories in Hong Kong by considering their market positioning and customer base, which has not been documented in literature.

DEA Applications in the hotel industry

Many DEA-related studies on hotel efficiency and productivity have been conducted during the period 1995–2015. Morey and Dittman (1995) first applied the DEA

technique to measure the performance of 54 hotels in the US; Johns et al. (1997) and Reynolds (2003), among others, employed the traditional DEA models to evaluate the efficiency of hotels. Alongside the development of DEA research, the application of the DEA method has developed in two directions.

First, the original DEA model is combined with other methods: DEA is applied first and the results derived are further processed using a second methodological procedure. For example, Hwang and Chang (2003), Untong et al. (2011), and Sun et al. (2014) combined the DEA model with the Malmquist Index. Barros and Dieke (2008), Assaf and Agbola (2011), and Oliveira et al. (2013) applied the DEA model with a bootstrap approach. Luo et al. (2014) combined DEA with the Malmquist Index and the Tobit regression. The other direction is to revise the original DEA model by modifying the constraints or weighting calculations. For example, Shang et al. (2008), and Hsieh and Lin (2010) proposed a network DEA model; Chiu and Wu (2010) utilized a context-independent DEA model; Wu and Song (2011) utilized a cross-efficiency DEA model; and Wu et al. (2011) utilized a non-radial DEA model. In addition, hotels in different regions, such as Taiwan (Tsai et al., 2011; Chiu and Huang, 2012), Spain (Parte and Alberca, 2015), and the US (Goodrich, 2002), have been assessed for their performance.

While the DEA technique has evolved methodologically and seen wider applicability in hospitality research, the technique is still useful in uncovering business insights that would not have been observed using traditional ways of business appraisal. Besides, most of the existing literature investigated hotel efficiency on an individual firm/unit basis, ignoring assessment of performance on an industrial basis. The current study was conducted in an attempt to offer the stakeholders of the Hong Kong hotel industry another perspective in appraising hotel industrial performance for guiding

future development.

Methodology

The DEA approach was first devised by Charnes et al. (1978) (termed CCR-DEA) and has been widely applied in many sectors—hospitals (Tsai and Molinero, 2002), banks (Cook et al., 2000), universities (Kao and Lin, 2012), and so on. The widespread application of DEA in different fields indicates its significant advantages in the evaluation of efficiency and performance. It allows simultaneous consideration of multiple input and output variables in a model, and is a non-parametric approach. The major advantage of DEA over other tools is that it requires no assumptions to be made on the functional form of the model underpinning the relationships between the input and output variables (Hwang & Chang, 2003). The CCR-DEA is presented in Model (1), for which the linear programming dual problem is presented in Model (2):

$$\begin{aligned} \max & \sum_{r\in R} \mu_r y_{r0} \\ s.t. & \sum_{i\in I} \nu_i x_{i0} = 1 \\ & \sum_{r\in R} \mu_r y_{rj} - \sum_{i\in I} \nu_i x_{ij} \le 0, \quad \forall j \in J, \\ & \mu_r, \nu_i \ge 0, \qquad\qquad \forall r, i \end{aligned} \tag{1}$$

$$\begin{aligned} \min\ & \theta_0 \\ \text{s.t. } & \sum_{j=1}^{n} \lambda_j x_{ij} \le \theta_0 x_{i0}, \ i = 1,...,m. \\ & \sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{r0}, \quad r = 1,...,s. \\ & \lambda_j \ge 0, \qquad j = 1,...,n. \\ & \theta_0 \ge 0. \end{aligned} \tag{2}$$

The optimal result (θ_0^*) of Model (2) is the technical efficiency (TE) of any given decision marking units (DMUs) (i.e., DMU_0). As a result, if DMU_0 is efficient, its TE

will be equal to one, otherwise its TE will be less than one. Based on the efficiency results obtained from Model (2), a ranking of all DMUs can then be derived by comparing the efficiency score of each DMU against that of the others.

TE can be further divided into pure technical efficiency (PTE) and scale efficiency (SE). Owing to an assumed constant return to scale (CRS), Model (2) is incapable of clearly distinguishing between PTE and SE (Seol et al., 2007). Therefore, a subsequent model was advanced by Banker et al. (1984), termed BCC-DEA, which is presented as follows:

$$
\begin{aligned}
&\min \theta_0 \\
&\text{s.t.} \quad \sum_{j=1}^{n} \lambda_j x_{ij} \le \theta_0 x_{i0}, \quad i = 1, \ldots, m. \\
&\qquad \sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{r0}, \qquad r = 1, \ldots, s. \\
&\qquad \sum_{j=1}^{n} \lambda_j = 1. \\
&\qquad \lambda_j \ge 0, \qquad\qquad j = 1, \ldots, n. \\
&\qquad \theta_0 \ge 0.
\end{aligned}
\tag{3}
$$

The BCC-DEA Model (3) considers a variable return to scale [(VRS), $\sum_{j=1}^{n} \lambda_j = 1$], in which the optimal result (θ_0^*) is indicated as PTE; SE can be obtained by dividing TE by PTE and it shows the efficiency level of a DMU against one that is operating at an optimal scale (CRS) over the long term. Since scale refers to size, variables such as revenue and expense amounts could serve as proxy for hotel size (Wang et al., 2006a).

These three efficiency indicators (TE, PTE and SE) were thus chosen as indicators for assessing the performance of the Hong Kong hotel industry from the perspectives of management and scale performance in different years. First, the indicator of TE

shows comprehensive managerial efficiency of hotels (Yang & Lu, 2006), which reflects aggregate efficiency and could be used to examine the overall performance of the hotel industry. Second, the indicator of PTE reflects the efficiency level achieved because of the management itself (Joo et al., 2009), representing the effectiveness of internal controls and monitoring of hotels. Last, the indicator of SE tells the effectiveness of the hotel industrial scale, through which the practitioners could appraise whether the operation scale is at or away from an optimal level.

In achieving the research goal of evaluating the performance of the Hong Kong hotel industry during the period 2002–2013 from a comprehensive, whole-industry perspective, this study employed Models (2) and (3), and obtained performance measures including TEs, PTEs and SEs in the following steps. First, all hotels—irrespective of their tariff category—were treated as individual DMUs in one group，in that all of the hotels offer accommodation to tourists visiting Hong Kong; this enabled an evaluation not only on the performance trend of hotels in one category, but also the performance of hotels relative to those in the other two categories. Second, when conducting the special performance analysis, hotels in each individual tariff category were evaluated in such a way that performance could be assessed for each category on a yearly basis.

Selection of input and output variables

Numerous input resources including inventory, labor, capital, and equipment investments undergo certain transformation processes to become products and services of economic value through front- and back-office operations (Yasin, 1996). Generally speaking, number of employees, expenses of operating the rooms and food and beverage (F&B) departments, and number of guestrooms, are all regarded as input

variables. The revenues from rooms, F&B, and other departments; the occupancy percentage; and ADR are all regarded as output variables (Johns et al., 1997; Tsaur, 2001; Wu et al., 2011). In light of the above, this study initially collected data on number of rooms, number of employees, room expenses, F&B expenses, and other expenses as candidates for input variables; ADR, occupancy percentage, revenues from rooms, F&B revenues, and other revenues were candidates for output variables. The data sources were the Hong Kong Hotel Industry Summary (2002-2013), the Hotel Room Occupancy Report (2002-2013), and the Hotel Supply Situation (2002-2013), all from the HKTB (2015b, 2015c). The sample period was long enough to study the performance trend, and it included some years in which special events such as SARS happened. A correlation analysis of all the input and output variables was performed to (1) eliminate highly-correlated input variables; and (2) retain input and output variables showing medium to high correlations.

According to the results of the correlation analysis, the input variable *number of employees* and the output variable *ADR* were removed. Three input variables and three output variables then remained. The constraint condition between number of DMUs and number of variables was met. Thus, three input and three output variables were included to evaluate the performance of the Hong Kong hotels in our study. The input variables were *room expenses per available room* (X_1), *F&B expenses per available room* (X_2), and *other expenses per available room* (X_3); the output variables included *room revenues per available room* (Y_1), *F&B revenues per available room* (Y_2), and *other revenues per available room* (Y_3). All figures are in Hong Kong dollars.

Dyson et al. (2001) stated that problems may occur when the volume measures are mixed with indices, ratios or percentages in the input/output sets. To tackle this potential

problem, original data were scaled using the sample means (Chen, 2009). The descriptive statistics of the input and output variables of the 36 observations (i.e., three hotel tariff categories each year times 12 years) are presented in Table 2.

[Insert Table 2 here]

Empirical results and discussion

Trend analysis

Hotels from the three tariff categories over the 12-year study period (2002–2013) were pooled for efficiency evaluation. Models (2) and (3) were employed to measure TE, PTE and SE scores, respectively, and the results are shown in Table 3.

[Insert Table 3 here]

As shown in Table 3, there were 20 efficient DMUs (i.e., where their TE equals one) identified by applying the CCR-DEA model, and even more by the BCC model. Even though some DMUs were less efficient, their efficiency values were generally high with the average TE of 0.9740, PTE of 0.9930, and SE of 0.9807. In other words, the overall performance of the Hong Kong hotel industry was quite good because of the close-to-one efficiency values. During the period 2002–2013, the performance trends of high tariff A hotels, high tariff B hotels, and medium tariff hotels were different, as illustrated in Figure 1.

[Insert Figure 1]

While according to the prevailing evaluation and analytical methods in hotel industry such as ADR evaluation (O'Neill, 2003), the average performance (2002-2013) of high tariff A hotels was the best (HKD1,864.75), followed by high tariff B hotels (HKD869.58), and the worst is medium tariff hotels (HKD 548.58); or such as average

occupancy percentage evaluation (Wayne et al., 2008), the best average performers (2002-2013) were high tariff B hotels and medium tariff hotels (86.83%), and the worst was high tariff A hotels (81.67%). The efficiency evaluation results obtained above are different from the ADR and occupancy evaluation, which echoed Tsai et al. (2011) that hotel performance should be evaluated on the basis of a more comprehensive manner instead of simply relying on financial or operating index alone.

As shown in Figure 1, compared to the other tariff categories, high tariff A hotels performed the best during 2002–2013 with an average TE value of 0.9982 and nine out of 12 years of efficient operation where TE equals one. In addition, their performance trend shows strong stability, evident by a lowest standard deviation of 0.0038. On the contrary, high tariff B hotels underperformed the other two tariff categories with a lowest average TE of 0.9482, and their number of efficient years was the least (i.e., three). Their performance trend shows rather strong instability with a largest standard deviation of 0.0428 (ten times more than that of high tariff A hotels). Medium tariff hotels, on the other hand, had an average TE of 0.9756, a standard deviation of 0.0387, and eight years of efficient operation, all of which placing them in the middle of the performance spectrum. Similar performance trends could also be observed by examining the other two indicators, PTE and SE. The performance trends and patterns of the three tariff categories deserve some discussion.

According to HKHCS (HKTB, 2015a), high tariff A hotels had better facilities and location ratings, and higher staff-to-room ratios, and these two attributes were found to significantly affect business travelers' choices of hotel in prior studies (Lewis & Chambers, 2000; McCleary et al., 1993). Their ADR (HK$2,382) and revenues per available room per year (HK$710,756) were the highest among the three tariff

categories, about twice those of high tariff B hotels in 2013. High tariff A hotels targeted mostly western clients who were single, required high-quality services and better/convenient locations, and were not sensitive to room rate (Chu & Choi, 2000). Hotels in this category were able to maintain high-level services through high-level management skills, and to meet customers' needs (Chung, 2000). In other words, by targeting a more homogeneous customer base and providing high-quality services, high tariff A hotels were able to dedicate their resources to maintaining/enhancing their performance effectively.

While medium tariff hotels ranked third in tariff standing per HKHCS, their performance was not as poor as one might expect. Griffin et al. (1997) indicated that factors such as low price and family restaurant could differentiate mid-priced hotels from luxury ones. A lower ADR of HK$758, which was less than one third of that of high tariff A in 2013, made medium tariff hotels more attractive to those customers who are price-sensitive, such as leisure travelers (Lewis, 1985). Also, this group of customers may be less demanding on service quality than those of high tariff A and B hotels. Targeting a homogenous group of customers sensitive to pricing, medium tariff hotels were able to allocate their resources well, so as to match the requirements of their target segments (Hsu et al., 1998), and thus achieved relatively good performance in terms of their TE, PTE, and SE.

Unlike those of the former two tariff categories of hotels, the target customers of high tariff B hotels likely care about both service quality and pricing. In other words, high tariff B hotels compete not only with high tariff A hotels for customers who are not price-sensitive but also with medium tariff hotels for customers who are. Customers of high tariff B hotels may be more practical, taking a cautious approach to

discretionary spending by cutting back their travel budgets and looking for ways to pay less for more (Crawford, 1992). The management of high tariff B hotels might spend their efforts in meeting the needs and wants of a diversified, hybrid customer base (Kandampully & Suhartanto, 2000) by turning input resources into diversified output services. The conversion efficiency was low, resulting in the relatively low and unstable performance of this tariff group.

Special event analysis

In the previous section the performance trends of the Hong Kong hotel industry in the period 2002–2013 were analyzed, during which some particular disastrous events occurred that affected the industry's performance. Wang and Sun (2010) found that important events had significant impacts on tourism flows to Hong Kong; these events included the deterioration of diplomatic relations between China and the UK in 1992, the handover of Hong Kong to China in 1997, and the outbreak of SARS in 2003. In this study the effects of some special events that occurred during 2002–2013 on the performances of each hotel tariff category were also analyzed. In the analysis, DMUs of different hotel categories in different years were not evaluated in one group (Charnes et al., 1978); instead, the performance of each individual tariff category was evaluated.

The analysis first starts with the ADR trends for each hotel category, as well as the trends in the hotel bill per night per person (HBPNP) for each main source market, including the Americas, Europe, and mainland China (HKTB, 2015d). Because the majority of hotel rooms are double occupancy, accounting for 71% of the rooms in high tariff A hotels, 77% in high tariff B hotels, and 83% in medium tariff hotels (HKTB, 2015c), in this study the amount of the hotel bill per night per person were doubled (2HBPNP) for the analysis.

[Insert Figure 2]

As shown in Figure 2, the trend lines of 2HBPNP–America and 2HBPNP–Europe are between those of the ADR of high tariff A hotels (ADR-A) and of high tariff B hotels (ADR-B), and were closer to the former during the period 2002–2006. Wu et al. (2012) reported that after 1989, US tourists to Hong Kong had spent most of their travel budget on hotel accommodations. Unlike those of America and Europe, the trend line of 2HBPNP–Mainland China is lower than the trend lines of medium tariff hotels (ADR-M and ADR-B). In light of Song et al.'s conclusion (2011) and the evidence in Figure 2, this study argues that most customers from source markets like the Americas and Europe prefer to select high tariff A and B hotels, while those from mainland China prefer to opt for high tariff B and medium tariff hotels.

High tariff A hotels. From Figure 3, it can be seen that the performances of high tariff A hotels in 2002, 2006, and 2009 were worse than in other years. The performances of high tariff B hotels in 2002, 2004, 2005, 2008, and 2009 were worse than in other years; all five years show increasing returns to scale (IRS). The performances of medium tariff hotels in 2003 and 2005 were worse than in other years; both years show IRS. This study analyzes the performance of each tariff category below without considering sampling errors or limitations to the models.

[Insert Figure 3]

Figure 3 shows that, compared to other years, high tariff A hotels performed less favorably in 2002, 2006, and 2009 (TE = 0.9899, 0.9990 and 0.9980, respectively). The DEA model results also show that the operations of high tariff A hotels were running at IRS in those three years. That is, the less favorable performances should not be attributed to the management; instead, scale inefficiency was to blame, and meant that

high tariff A hotels could not achieve an optimal operating scale. Further analysis shows that the under-performance in 2002 stemmed largely from the SE (0.9899), not the PTE (equal to one). The scale inefficiency probably resulted from the aftermath of the 9/11 World Trade Center terrorist attack: Goodrich (2002) reported that many Americans canceled their vacation plans and business trips to other parts of the world, and the hospitality industry lost millions of dollars in revenues. Our model shows that the average amount of all the inputs in 2002 was 25.79% less than that for the period 2002–2013, and the average amount of all the outputs in 2002 was 31.09% less than that for the period 2002–2013.

The less favorable performance (TE = 0.9980) observed in 2009 for high tariff A hotels was mainly caused by scale inefficiency (SE = 0.9980, PTE = 1); this was similar to the case in 2002, when the best operating scale was not achieved. The underlying causes of the scale inefficiency were likely the negative effects of the global financial crisis. The average value of all the inputs in 2009 was 15.21% less than that of all the inputs for the period 2002–2013; the average value of all the outputs in 2009 was 19.36% less than for the period 2002–2013. In the aftermath of the global financial crisis, in 2009 the number of travelers to Hong Kong from the America and Europe dropped 6.94% and 5.98%, respectively, compared to the previous year. Even more seriously, the occupancy and ADR of high tariff A hotels both decreased, falling from 79% to 72% and from HK$2,106 to HK$1,808 in the period 2008 to 2009. Special events, such as the global financial crisis, reduced the influx of luxury hotel customers from Americas and Europe, which further lowered the efficiency performance of high tariff A hotels.

In 2006, the TE of high tariff A hotels was 0.9990, almost equal to one, which could

be attributed to their scale inefficiency (SE = 0.9990, PTE = 1). The average value of all the inputs in 2006 was 7.24% less than that of all the inputs for the period 2002–2013, and the average value of all the outputs in 2009 was 10.43% less than that of all the outputs for the period 2002–2013. According to the HKTB (2015b), from 2005 to 2006 the occupancy percentage of high tariff A hotels increased one percentage point to 85%, and ADR also increased by 18.3%. Thus, it can be seen that the operational scale in 2006 was better than in both 2002 and 2009, and was then closest to the best operational scale (the SE was 0.001 less than one). A better operational scale, good ADR and occupancy rate mean that scale inefficiency in 2006 did not result from external factors but from a smaller scale of utilization in resource inputs.

Medium tariff hotels. During the period 2002–2013, medium tariff hotels performed quite well in most years, except for 2003 (TE = 0.9453) and 2005 (TE = 0.9753). The underperformance of medium tariff hotels in 2003 stemmed largely from scale inefficiency (SE = 0.9899), not from inefficient management (PTE equals one), meaning that medium tariff hotels was not operating under an optimal operating scale. The average value of all the inputs in 2003 was 11.88% less than that of all the inputs for the period 2002–2013, and the average value of all the outputs in 2003 was 17.34% less than that of all the outputs during 2002–2013. The outbreak of SARS was the main reason for both the lower inputs and lower outputs. Some hotels in Hong Kong even chose to temporarily close down their properties because revenues were not enough to cover their operating expenses, such as electricity, water, and gas charges (Li, 2003). In 2003, the ADR of all tariff hotels combined, high tariff A hotels, high tariff B hotels, and medium tariff hotels dropped 5.47%, 5.94%, 1.71%, and 9.1%, respectively (HKTB, 2015e). At the same time, the occupancy rates of high tariff A hotels, high tariff B hotels, and medium tariff hotels fell by 13%, 14%, and 15%, respectively. Of the three hotel

categories, medium tariff hotels were the most severely affected by SARS in 2003.

The poor performance of medium tariff hotels in 2005 (TE = 0.9753) mainly resulted from scale inefficiency (SE = 0.9753, PTE = 1). The average value of all the inputs in 2005 was 14.55% less than that of all the inputs for the period 2002–2013, and the average value of all the outputs in 2005 was 15.55% less than that of all the outputs for the period 2002–2013. According to the HKTB (2015f), the 2005 ADR of medium tariff hotels increased 11.3%, and the occupancy rate decreased to 87% compared to 2004. In 2005, the number of overnight visitors from Americas and Europe was a record high of 3.29 million, an 18.40% increase over 2004, while the number of overnight visitors from mainland China was 12.54 million, only a 2.4% increase over 2004. The share of visitors from mainland China dropped to 53.7%, which is probably the cause of the scale inefficiency of medium tariff hotels.

High tariff B hotels. As shown in Figure 3, the worst performing year for high tariff B hotels was 2004 (TE = 0.9316, SE = 0.9316, PTE = 1); the underperformance was caused by scale inefficiency, which meant that their operational scale only achieved 93.16%. The average value of all the inputs in 2004 was 19.01% less than that of all the inputs for the period 2002–2013, and the average value of all the outputs in 2004 was 26.43% less than that of all the outputs during the period 2002–2013.

It should be noted that the underperformance of high tariff B hotels in 2005 and 2008 was caused by the interactions of the scale inefficiency (SE = 0.9726 in 2005, SE = 0.9689 in 2008) and the inefficient management (PTE = 0.9791 in 2005, PTE = 0.9756 in 2008). That is, while the operational scale efficiency was not at their best, the underperformance in these two years was also partially caused by the management: the poor TE in 2005 and in 2008 was caused mainly by both the internal management and

the external environment. A low PTE value indicates that the internal managerial efficiency should be improved. The low SE in 2005 was mainly caused by both room expenses and room revenue, which were 11.38% and 10.53% less than the average value during the period 2002–2013. The low SE in 2008, on the other hand, was mainly caused by other expenses and total revenue, which were, respectively, 2.59% and 8.19% less than their average values during the period 2002–2013.

Theoretical and practical implications

This study has ignited some theoretical implications. First, on the basis of performance evaluation using the DEA technique, this study articulated hotel industrial performance in Hong Kong considering inter-relations among the hotel categorization structure, hotels' market positioning and customer base, not only adding to performance measurement literature but also hoping to stimulate further empirical research to validate the relations. Second, special events' varying degrees of impacts exerted on the different hotel tariff categories signals different customers' dissimilar reactions on their travel/accommodation decision making related to the events, contributing to consumer behavior and risk perception literature. Third, unlike the majority of previous hotel DEA studies employing cross-sectional data, this study applied the technique to panel data spanning a 12-year spectrum, which shows the technique's applicability in processing longitudinal data for trend analysis.

This study also has some implications for practitioners. First, the findings that both high tariff A and medium tariff hotels appeared to perform better in terms of their stable, higher managerial efficiency, and high tariff B hotels seemed to underperform in their operations suggest that managers should aim to match specific customer expectations for each specific segment of the hotel industry to improve the performance (Akbaba,

2006). Second, the efficiency performances of all hotel categories influenced by special events revealed that hotels in Hong Kong performed worse when they operated at an inappropriate scale, rather than because of poor input utilization (Wang et al., 2006b). The inefficiency of resource utilization caused by the external environment could further deteriorate, given that overcapacity of the Hong Kong hotel industry was expected (Tsai & Gu, 2012). It is suggested that managers should react quickly on their resource supply scale (such as labor input) when the external environment changes which could be strong enough to affect some specific customer bases, so that the scale efficiency could be achieved. Third, the existing mechanism of the HKHCS may be re-visited. The HKHCS is essentially a dynamic hotel rating system considering both resource inputs (e.g., facilities) and production outputs (e.g., average achieved room rate) in the composite score calculation. However, compared with the DEA technique adopted in this study, the HKHCS is structured in a summative manner by adding up all the weighted input and output scores, explicitly thinking highly on "the more, the better", "the closer to the city center, the better" and "the higher the ratio, the better" myths. It is suggested that the HKHCS considers production outputs as a result of resource input to more reasonably categorize hotels in Hong Kong.

Conclusions

The study examined the efficiency performance of the Hong Kong hotel industry during the period 2002–2013 by employing both CCR-DEA and BCC-DEA models, and further investigated the influences of special events on the performances of different hotel tariff categories. The results show that among the three Hong Kong hotel tariff categories, in terms of overall managerial efficiency, high tariff A outperformed the other two hotel categories with the strongest stability in performance whereas high tariff B fell behind the other two hotel categories with the most instability in performance;

the impact of special events on the performance of different hotel tariff categories is dependent upon whether those events influence the target customers of the hotel tariff categories.

It should be noted that the study results are limited by the availability of data and by the variables included in the models and therefore, they should be interpreted with caution. While this study examined the performance of the Hong Kong hotel industry from a macro perspective, it is hoped that more performance assessment research on, and for, the Hong Kong hotel industry and its neighboring regions could be stimulated. For instance, Hong Kong hotel performances could be examined from a micro perspective by assessing the management and operations of individual hotel properties. If operational data of individual hotel properties become available, derivative DEA models, such as assurance region DEA or context-dependent assurance region (CAR) DEA, could be applied in better assessing the performance of Hong Kong hotels, thus providing further insights for enhancing the performance of the hotel industry.

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