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Effect of Hotel Size on Hotel Operational Performance: Case Study from Taiwanese Hotels

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Abstract: This research is to evaluate the operational performance of International Tourist Hotels in Taiwan. In the face of a highly competitive environment, a hotel's operational performance plays a crucial role in determining the hotel's profitability and competitiveness. Performance measures can provide hotel managers with benchmarking information and insights into how the hotel can improve performance with its current resources, or through changing resource allocation. Therefore, it is very important for managers to evaluate their hotels' operational performance. Different approaches and techniques have previously been employed to conduct such evaluations, however, the often-used mechanisms for measuring and analyzing performance of hotels do not capture the relevant performance issues necessary for the hotel sector. Data Envelopment Analysis (DEA) provides a framework that integrates several relatively disparate inputs and outputs, producing a single productivity index to help analysts identify which hotel is the most efficient. This technique has been used in this study to assess the relative productivity efficiency of Taiwanese hotels. However, this DEA index only indicated the relative efficiency of all sample hotels and did not consider the role of hotel size. This shortcoming was rectified through the construction of an adjustment to reflect the effect of hotel size on DEA efficiency. Implications for hotel management arising from this adjustment are discussed.

Key words: Data envelopment analysis, operational performance, hotel Size

INTRODUCTION

The purpose of this research was to evaluate the operational efficiency of international tourist hotels in Taiwan and find out which hotels have good performance and have become a benchmark for other hotels; which hotels are inefficient and should improve their operation. The hotel industry in Taiwan is encountering a highly competitive environment due to the rapid expansion of hotels. For example, the total number of international tourist hotels has increased from 44 in 1985 to 68 in 2010 (Taiwan Tourism Bureau, 2012). However, due to inappropriate hotel management (Sun and Lu, 2005; Hwang and Chang, 2003), eight international tourist hotels have closed down over the last six years. Average occupancy rate has decreased from 73 to 69% between 2009 and 2010 which is surprising given the surge in new demand entering the market.

On the other hand, according to monthly report on international tourist hotel operations in Taiwan in 2010, the occupancy rate and average room rate of international hotels in 2010 were 69% and US\$ 95, respectively, (Taiwan Tourism Bureau, 2012). Compared with Hong Kong (87%, US\$ 140) (Hong Kong Tourism

Board, 2007), the occupancy rate and average room rate in Taiwan is much lower. Most of the hotel owners were not satisfied with this result. Furthermore, according to Taiwan Tourism Bureau, 43 hotels and approximately 12165 rooms have been scheduled to open between 2010 and 2014. This will make the hotel industry in Taiwan encounter a highly competitive environment.

Accordingly, this research used DEA to measure the operational efficiency of 57 international tourist hotels in Taiwan. DEA is a linear programming based method that can integrate several relatively disparate input and output variables simultaneously; then produce a single productivity index that compares all units to the most-efficient units in the sample, helping analysts to identify which unit is most efficient.

Although DEA can be used to evaluate hotel operational efficiency, the results only indicate the relative efficiency of all sample hotels and do not consider the role of hotel size. This shortcoming was rectified through the construction of an adjustment to reflect the effect of hotel size on DEA efficiency. Implications for hotel management arising from this adjustment are discussed.

This paper reports how DEA was used to investigate:

- The relative operational efficiency of international tourist hotels in Taiwan
- Which hotels have good performance and become a benchmark for other hotels and which hotels are inefficient and should improve their operation
- The effect of hotel size on operational efficiency of international tourist hotel as measured by DEA efficiency

Data envelopment analysis: DEA is a linear programming based method that integrates several relatively disparate input and output variables simultaneously. It then produces a single productivity index that compares all units to the most-efficient units in the sample, helping analysts to identify which unit is most efficient given its own set of variables, which are then compared with others in the set (Reynolds, 2003).

Apart from the measure of the relative efficiency of each unit, DEA also distinguishes the most productive unit or units within the competitive set, describes the relatively less-productive units and calculates the excess resources used by each of those less-productive operations (Anderson *et al.*, 2000). As such DEA has become increasingly popular as a tool for assessing the relative productivity efficiency of companies, including hotels.

Morey and Dittman (1995) were the first researchers to apply the DEA approach in the hotel industry. They employed DEA to analyze the efficiency of 54 hotels in the United States and found that managers were operating at 89% efficiency and the least efficient hotels were 64%. Consequently, the results deemed the lodging market to be operating efficiently in U.S.A. Using the DEA approach anderson *et al.* (2000) measured the managerial efficiency of 48 hotels in the United States and provided evidence that the hotel industry was operating inefficiently with a mean overall efficiency measure of 42%. Hwang and Chang (2003) also adopted DEA to analyze the efficiency of 45 international tourist hotels in Taiwan in 1998. The results indicated that managers were operating at 79.16% efficiency with only 20 of the 45 hotels improving their managerial efficiency over time. Consequently, the market for lodging services seemed to be operating efficiently in Taiwan.

Although DEA has been used in previous researches to evaluate hotel operational efficiency, the results only indicate the relative efficiency of all sample hotels and do not consider the role of location. As Morey and Dittman

(1995) observed, “sometimes one must look past the numbers and take into account qualitative factors”. For example a hotel might be scored relatively inefficient if it is located in the area with a difficult competitive environment, whilst another hotel gains a good DEA score because the area this hotel is located in has a favorable environment. If only comparing the relative efficiency of all hotels without considering the factor of the area hotel is located in, inaccurate benchmarks for operational efficiency will be generated.

METHODOLOGY

To understand the operational efficiency of Taiwan international tourist hotels, this paper adopts DEA, developed by Charnes *et al.* (1978), using multiple inputs and outputs to measure the relative operational efficiency of international hotels in Taiwan. This research uses a sample of the 57 international tourist hotels in 2005 to conduct efficiency evaluation via DEA. Each of these hotels was treated as a Decision Making Unit (DMU) in DEA analysis. The 57 hotels were selected for this research because the degree of competitiveness in this marketplace is high and were operating during the period of this investigation.

Calculating hotel DEA: DEA produces a single measure of performance. In contrast to parametric approaches whose purpose is to optimize a single regression plane through the data, DEA optimizes on each individual observation with an objective of calculating a discrete piecewise frontier occupied by the most efficient units. This frontier and the associated measure for each unit, which is generally referred to as relative efficiency or productivity has particular managerial relevance in that it allows for comparison of disparate operating units (Reynolds and Thompson, 2007). The term “relative” is rather important here since an organization identified by the DEA technique as an efficient unit in a given set may become an inefficient one when evaluated in another set of organizations:

There are different mathematical forms of the DEA model. The model used in this study is CCR input-oriented model developed by Charnes, Cooper and Rhodes in 1978. The formulation is based on the following form Maximize:

$$E_k = \frac{\sum_{r=1}^s u_r y_{rk}}{\sum_{i=1}^m v_i x_{ik}} \quad (1)$$

Subject to:

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1 \quad \text{for } j = 1, 2, \dots, n$$

$$u_r, v_i \geq \varepsilon \geq 0 \quad r = 1, \dots, s \quad i = 1, \dots, m$$

where:

y_{rj} = observed quantity of output r produced by hotel j
 x_{ij} = observed quantity of input i produced by hotel j
 u_r = the weight given to output r by the hotel j
 v_i = the weight given to input i by the hotel j
 ε = non-Archimedean quantity, a sufficiently small positive number

This DEA model has the following interpretation within the context of hotels. There are n hotels in the observation set K , each of which producing r different outputs using i different inputs and we are interested in determining the relative efficiency E_k of hotel $k \in K$ with respect to all other hotels in the set K . The relative efficiency E_k is nothing but the ratio of outputs of the hotel k to its inputs. Such a definition of efficiency transforms the multidimensional nature of input and outputs into a single scalar ratio of single output to a single input.

For computational convenience, the efficiency of any hotel, j , can be solved by the dual of (1). The dual of (1) can be written as follows Minimiz:

$$E_k = \theta - \varepsilon \left(\sum_{i=1}^m s_i^- + \sum_{r=1}^s s_r^+ \right) \quad (2)$$

Subject to:

$$\sum_{j=1}^n \lambda_j x_{ij} - \theta x_{ik} + s_i^- = 0, \quad i = 1, \dots, m$$

$$\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{rk}, \quad r = 1, \dots, s$$

θ unconstrained:

$$\lambda_j, s_i^-, s_r^+ \geq 0, \quad j = 1, \dots, n, \quad i = 1, \dots, m, \quad r = 1, \dots, s$$

An analysis provides the following type of information for decision making purposes:

- Each hotel being evaluated will have a value E_k , $0 < E_k \leq 1$, obtained from the DEA model indicating its

efficiency level. If $E_k < 1$, the hotel is inefficient compared to 'best practice' units in the observation set K . If $E_k = 1$, this is a relatively 'best practice' hotel and therefore is identified as an efficient one

- The DEA model will identify, from the viewpoint of a hotel k , the 'efficiency reference set' K_k or 'efficient frontier' which is a subset of K that includes only those hotels with $E = 1$ from the observation set K . The hotel k is compared against the hotels in K_k to find the sources of its inefficiency. This allows a hotel manager to locate and understand the nature of the existing inefficiencies by comparing his/her hotel with a select subset of more efficient hotels. It therefore avoids the need to investigate all hotels to understand the existing inefficiencies and consequently helps allocate limited managerial resources to areas where efficiency improvements are most likely to be achieved
- The above model hence produces information with which managerial measures (reducing the inputs used, or increasing the outputs produced) can be formulated to make an inefficient hotel relatively efficient. For example, the necessary and sufficient conditions for any hotel, j , to reach efficiency are $K_j = 1, s_{ij}^- = s_{ij}^+ = 0$; therefore, the efficiency score is 1 and there is no input surpluses or output shortfalls. On the contrary, if a hotel j does not achieve 100% efficiency, then an improvement, $x'_{ij} = \theta x_{ij} - s_{ij}^-, y'_{rj} = y_{rj} + s_{rj}^+$, could be applied so that a 100% efficient hotel can be achieved. That is, the input is decreased by $\Delta x_{ij} = x_{ij} - x'_{ij}$ and the output is increased by $\Delta y_{rj} = y'_{rj} - y_{rj}$.

Construction of hotel size correction factor: Hotel operational efficiency is influenced by many factors. Some factors can be controlled by management but others are outside the control of hotel. Hotel size is one of these uncontrolled factors and has great influence on hotel operation. As mentioned above, DEA score only indicates the relative operational efficiency of all hotels but does not consider hotel size factor. Therefore, this paper will adjust a hotel's DEA score according to its size. The adjustment score is the ratio of original DEA score to average DEA score for all hotels in different size:

$$\text{Adjusted DEA} = \frac{\text{Original DEA score}}{\text{Average DEA for all hotels in different size}}$$

Through this adjustment, the effect of hotel size on DEA efficiency will be found. By comparing each hotel's adjusted score, a more objective operational efficiency, as opposed to overall hotel efficiency, will be determined.

RESULTS

Dea efficiency analysis: Results of DEA analysis are shown in Table1. Hotel with the value of 1 are relatively best practice' hotels and therefore identified as efficient.

Those hotels with the value less than one are inefficient compared to 'best practice' hotels. For example the efficiency score of Howard Hotel Taipei is 0.916, which means that Howard Hotel Taipei has only attained about 92% efficiency in relation to the most efficient hotels.

Table 1: Rank-ordered list of DEA efficiency score and the score after hotel size adjustment

Hotel	No. of room	DEA score	DEA rank	Adjustment score	New rank
No. of hotel room: 80-160					
Tainan Hotel	152	1.000	1	1.179	8
Lalu Hotel	96	1.000	1	1.179	8
Howard Hotel Taichung	155	0.860	19	1.014	17
Landies Resort Yanminsan	50	0.788	28	0.929	39
Emperor Hotel	97	0.779	31	0.919	41
Grand Hotel Kaohsiung	107	0.658	36	0.776	55
No. of hotel room: 161-260					
Brother Hotel	250	1.000	1	1.328	1
Royal Hotel Chipen	183	1.000	1	1.328	1
Caesar Park Hotel Kenting	250	1.000	1	1.328	1
Gloria Prince Hotel	220	0.987	14	1.311	6
Landies Hotel Taipei	209	0.960	15	1.275	7
Royal Hotel Taipei	202	0.838	21	1.113	18
Golden China Hotel	215	0.837	22	1.112	19
Riverview Hotel	201	0.800	27	1.062	22
United Hotel	243	0.783	30	1.040	24
Plaza Int'l Hotel	226	0.776	32	1.031	26
Splendor Hotel Taichung	222	0.767	34	1.019	27
China Trust Hotel Hualeng	221	0.750	37	0.996	31
Ta Shee Resort	208	0.742	39	0.985	32
Ambassador Hotel Hsinchu	254	0.716	42	0.951	35
Royal Hotel Hsinchu	198	0.716	42	0.951	35
Evergreen Plaza Hotel	197	0.659	49	0.875	43
Crown Plaza Hotel	228	0.627	53	0.833	48
Grand Formosa Taroko	224	0.594	56	0.789	54
Hibiscus Resort	201	0.477	57	0.633	57
No. of hotel room: 261-360					
Sherwood Hotel	345	1.000	1	1.318	4
Westin Hotel	288	1.000	1	1.318	4
Evergreen Laurel Hotel	354	0.876	17	1.154	15
Howard Hotel Kaohsiung	283	0.844	20	1.112	19
Marshal Hotel	289	0.821	24	1.082	21
San Want Hotel	268	0.788	29	1.038	25
Tayih Landis Hotel Tainan	306	0.771	33	1.016	28
Han-Hsien Hotel	311	0.760	35	1.001	30
Imperial Hotel	336	0.729	40	0.960	34
Holiday Garden	274	0.708	45	0.933	38
Parkview Hotel	343	0.679	46	0.895	42
Kingdom Hotel	302	0.660	48	0.870	45
Fortuna Hotel	304	0.652	51	0.859	47
Naruwan Hotel	276	0.632	52	0.833	48
Astar Hotel	293	0.621	54	0.818	52
Santos Hotel	287	0.603	55	0.794	53
No. of hotel room: 360 and over					
Grand Formosa Hotel Taipei	569	1.000	1	1.157	10
Caesar Park Hotel Taipei	388	1.000	1	1.157	10
Grand Hyatt Hotel	873	1.000	1	1.157	10
Ambassador Hotel Taipei	432	1.000	1	1.157	10
Shangri-La's Hotel	422	1.000	1	1.157	10
Sheraton Hotel	686	0.990	13	1.146	16
Howard Hotel Taipei	606	0.916	16	1.060	23
Howard Hotel Kenting	405	0.871	18	1.008	29
Taoyuan Hotel	390	0.833	23	0.964	33
Ambassador Hotel Kaohsiung	457	0.818	25	0.947	37
Grand Hi-Lai Hotel	436	0.802	26	0.928	40
Grand Hotel Taipei	405	0.753	36	0.872	44
Farglory Hotel	381	0.749	38	0.867	46
Holiday Iun Hotel	755	0.719	41	0.832	50
Splendor Hotel Kaohsiung	592	0.615	44	0.824	51
Hotel National	404	0.665	47	0.770	56

Hotel size adjustment: Table 1 above is a rank-ordered list of the hotels after the adjustment according to the number of hotel rooms. Table 1 reveals that hotels with more than 360 and between 80 and 160 has been reduced after adjustment. This indicates that having a larger room quantity (more than 360) or a smaller one (between 80 and 160) is more positively influential to hotel performance. Without this advantage, the hotels' performance will be affected and rank will be reduced. This is because finding a clear position is very easy for hotels having 80 to 160 rooms. For example, the Lalu Hotel, which has only 96 rooms, is clearly set to be a top-level resort hotel. The Tainan Hotel is positioned as a business hotel. With a clear market position, these hotels can maximize the effect of marketing and provision of services. Most important of all, they can easily fill all the rooms even in low business seasons. For hotels with more than 360 rooms, as long as the market demand is large, the more rooms they have, the more profits they can make from these rooms. Moreover, the land cost can be shared by a large quantity of rooms and there is the benefit of economy of scale. As shown in Table1, hotels with more than 360 rooms and a good DEA score are mostly located in Taipei, where a large market demand is ensured. The large quantity of rooms has become an advantage for these hotels to enhance operational performance. Therefore, these hotels with good DEA score do not necessarily have better operational efficiency just because they have favorable number of rooms. Without the advantage of such hotel size, their operation will be affected and they may not have good operational efficiency.

On the other hand, the rank in hotels with the number of room between 161 and 260 and between 261 and 360 has been increased after adjustment. This indicates that hotel size has a negative influence on the operational efficiency of hotels whose rooms range between 161 and 360. Hotels having rooms within this range of quantity can neither find a clear position to enhance operating efficiency nor reduce cost through economy of scale. Therefore, these hotels may have better operational efficiency but are scored poorly by DEA because these hotels have unfavorable number of room. Without the limits of this factor, their operational efficiency may be increased.

Most of the hotels with 160 to 360 rooms have suffered from limited performance due to their size. However, the Brother Hotel, Royal Hotel Chipen and Caesar Park Hotel Kenting seem to be the exceptions. All these hotels have been established for more than 20 years. Having earned a return on their physical facilities investment long ago, they now run their hotels

at a relatively lower cost. Additionally, they also possess very experienced employees. Even though their room quantities cannot bring them the benefits of economies of scale, their low operating cost and experienced employees have offset the negative effect of their hotel size. As a result, after hotel size adjustment, these hotels still remain at the top of the ranking. On the other hand, after hotel size adjustment, the Sherwood Hotel and Westin Hotel slip from the first place to the fourth. Both Taipei-based hotels have a large quantity of rooms. Having a clear position in the market is not a good choice for large hotels, but the two hotels have been clearly positioned as business hotels. The demand for business hotels is sufficient in Taipei and the two hotels have established a good reputation. Therefore, their room quantities have not caused any negative effect on their performance. They could probably exhibit better performance if they had more rooms. Hotel size adjustment is intended to exclude the effect of hotel size, both positive and negative. Without the advantage of hotel size, these two hotels' ranks would certainly drop after hotel size adjustment.

CONCLUSION AND IMPLICATION

The aim to use DEA to measure hotel's operational efficiency is to provide hotel managers with benchmarking information and further insight of how a hotel can improve efficiency with its current resource, or change resource allocation. There are many factors and resources influencing hotel's operation. Some factors are under hotel's control such as operational expenditures, the number of employees and salaries expenses but some factors such as hotel size and location are outside the control of hotel management. If using DEA to evaluate hotel's efficiency without considering these uncontrolled factors, the result would be inaccurate and cannot provide the real information of operational efficiency. Therefore, based on the DEA result, this paper further divided it by average DEA score for hotels in different size. Through this adjustment, the effect of hotel size on DEA efficiency has been found.

After hotel size adjustment, the rank of the hotels with more than 360 and between 80 and 160 has been reduced. This indicates that having a larger room quantity (more than 360) or a smaller one (between 80 and 160) is more positively influential to hotel performance. Without this advantage, the hotels' performance will be affected and rank will be reduced. This is because finding a clear position is very easy for hotels having 80 to 160 rooms. With a clear market position, these hotels can maximize the effect of marketing and provision of services. For hotels with more than 360 rooms, as long as the market

demand is large, the more rooms they have, the more profits they can make from these rooms. Moreover, the land cost can be shared by a large quantity of rooms and there is the benefit of economy of scale. Therefore, these hotels with good DEA score do not necessarily have better operational efficiency just because they have favorable number of rooms. Without the advantage of such hotel size, their operation will be affected and they may not have good operational efficiency.

To improve business performance, managers should benchmark themselves against hotels with superior operating efficiency. This paper offers a guide to managers to select suitable benchmark hotels.

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