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EFFICIENCY, PRODUCTIVITY CHANGE AND PROFITABILITY IN TAIWAN’S INTERNATIONAL TOURIST HOTEL INDUSTRY

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EFFICIENCY, PRODUCTIVITY CHANGE AND PROFITABILITY IN TAIWAN'S INTERNATIONAL TOURIST HOTEL INDUSTRY

By

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Abstract

The dissertation is a collection of three separate but related papers which are devoted to the empirical studies of the international tourist hotel industry in Taiwan. In addition to the introduction in chapter 1, three papers are presented in chapters 2 to 4, respectively. The empirical results in chapter 2 indicate that, in the first stage, the data envelopment analysis (DEA) models without the quasi-fixed and adjusted inputs overestimate the technical and pure technical efficiencies, but underestimate the scale efficiency of international tourist hotels so that the necessity of considering the existence of the quasi-fixed input is justified. The second stage uses the stochastic frontier analysis (SFA) model to purge the effects from exogenous variables and statistical noise. The SFA results show that the exogenous variables have significant influences on input slacks and pure technical efficiency. The degree of market concentration and hotel size have positive impacts on labor, food and beverage (F&B) expense and operating expense input slacks, as well as have negative impacts on pure technical efficiency. An international tourist hotel in the resort area has negative relationships with all input slacks and a positive relationship with pure technical efficiency. An international tourist hotel participating in the international and/or domestic hotel chain has positive relationships with labor and F&B expense input slacks, but has a negative relationship with other expense. Severe acute respiratory syndrome (SARS) has positive effects on labor and F&B expense input slacks and has a negative effect on pure technical efficiency. The financial tsunami has positive effects on labor and other expense input slacks and has a negative effect on pure technical efficiency. After adjusting the variable input data from the SFA results in the second stage, the efficiency-evaluation results in the third stage show that the technical inefficiency mainly results from the inappropriate production scale. In addition, international tourist hotels have an ample space to improve their technical and scale efficiencies. The efficiency-evaluation results also show that the conventional DEA models overestimate the technical and scale efficiencies, but underestimate the pure technical efficiency of international tourist hotels so that the usage of the three-stage approach is justified. Finally, international tourist hotels which mainly receive group visitors have the worst performance. In chapter 3, the empirical results show that, in the first stage, the Malmquist index without the quasi-fixed and adjusted inputs underestimates the productivity change so as to justify the necessity of considering the existence of quasi-fixed input. After adjusting the variable input data from the SFA results in the second stage, the productivity index in the third stage shows that the initial increase in productivity has been compensated by a decrease. The productivity growth or deterioration mainly results from the technological progress or regress and the scale efficiency improvement or deterioration. The results also show that the Malmquist index with the quasi-fixed input and without adjusted inputs underestimates the productivity change. The key factors of the productivity changes estimated by the Malmquist productivity index with the quasi-fixed and adjusted inputs are significantly different from those estimated by the Malmquist productivity index with the quasi-fixed input and without adjusted inputs so as to justify the usage of the three-stage approach. Finally, international tourist hotels with mainly receiving group visitors have the better improvement of productivity. The sources of productivity changes among receiving different types of visitors are different, but the scale efficiency change plays an important role in all types. In chapter 4, the empirical results indicate that the scale efficiency hypothesis is supported in Taiwan’s international tourist hotel industry. An international tourist hotel that mainly receives individual visitors and an international tourist hotel that simultaneously receives group and individual visitors have negative impacts on profitability. SARS and financial tsunami have negative effects on profitability.

CONTENTS

FIGURES

TABLES

CHAPTER 1 INTRODUCTION

1.1 Background of Taiwan's International Tourist Hotel Industry

The concepts of a global village and globalization prompt people to easily contact each other and make a tendency of travel around different countries. In addition, with economic growth, the standard of living promotion and the development of international free trade in recent years, international travel activities have a rapid growth, except those decreases in severe acute respiratory syndrome (SARS) in 2003 and financial tsunami in 2009 (see Figure 1.1). The growth of travel activities has promoted the development of tourism industries worldwide. Travel has become an important socio-economic index. The tourism industry is a main source of foreign exchange earnings in many countries. Furthermore, global economic development is stimulated by travel activities (Gonzalez and Moral, 1996).

Taiwan is diverse and rich in the natural landscape and culture. More and more foreign visitors have desires to travel in Taiwan. Since the martial law was lifted in 1985, the removal of limitations for the tourism industry has led tourist activities and foreign visitors further to grow up, except a decrease in SARS in 2003 (see Figure 1.2). In addition, since mainland tourists were allowed to visit Taiwan from 2008, the number of visitor arrivals in Taiwan was increased even during the period of financial tsunamai. Various policies to encourage people to enjoy their leisure life and promote the tourism, such as two-day weekend policy in 2001, the doubling tourist arrivals plan in 2002, the tourism flagship plan in 2005 have been implemented. The liberalization of international tourism in China also promoted the prevalence of tourist activities. Hence, the tourism industry has gradually played an important role in the economic growth in Taiwan. The aggregate tourism revenue has increased from US$11,484 million in 2001 to US$12,385 million in 2009. The ratio of aggregate tourism revenue to Taiwan's gross domestic product (GDP) ranged from 2.94% and 3.91% during the period of 2001-2009 (see Table 1.1). Kim et al. (2006), Jang and Chen (2008), Chen and Chiou-Wei (2009) as well as Chen et al. (2009) also showed that the tourism industry has a greater contribution to Taiwan's GDP than the agriculture industry. Additionally, Kim et al. (2006) as well as Chen and Chiou-Wei (2009) indicated that international tourism development could facilitate the economic growth in Taiwan. These results repeatedly illustrated the importance of tourism industry in Taiwan.

With the expansion of travel activities, the demands for hotels are created. Hotels can be divided into tourist hotels and general hotels in Taiwan. Tourist hotels can provide a variety of activities, such as lodging, catering, social activity, meeting facility, shopping and amusements, which are the most critical function of the tourism industry (Tourist Bureau, 2010). According to the Regulations for Administration of Tourist Hotel Enterprises, two types of tourist hotels are distinguished: international tourist hotels and ordinary tourist hotels. International hotels are usually four-star or five-star tourist hotels and ordinary tourist hotels are three-star tourist hotels. In general, international tourist hotels provide the better quality of service than ordinary tourist and general hotels (Chen et al., 2005). The prohibition of building tourist hotels in Taiwan was deregulated in 1977. Under the expansion of travel activities and the encouragement by the government, the number of international tourist hotels sprang up from 14 in 1970 to 64 in 2009 (Figure 1.3). In addition, 39 new tourist hotels are expected to open during the period of 2011-2017. Under the movement of internationalization, international hotel groups established international tourist hotels in Taiwan or signed cooperation contracts with Taiwan's international tourist hotels one after another. The rising number of international tourist hotels has induced a more highly competitive market environment. Except the initial period, the average occupancy rate decreased in recent years, which means that sales earnings and performance first increased and then decreased. The average net operating profit margin is in the similar trend to the average occupancy rate (see Table 1.2). In addition, the net operating profit margins of individual international tourist hotels are significantly different from each other during the period of 2001-2009. The highest operating profit margin is 45.25% while the lowest is -135.95%. The standard deviation is 18.33%. These above faces show that individual international tourist hotels have to improve their performance in order to survive in this market. However, the average degree of market concentration and the average market share did not significantly change during the period of 2001-2009 (see Table 1.2). The above finding shows that the market structure might not the sole determinant of profitability in the international tourist hotel industry.[1]

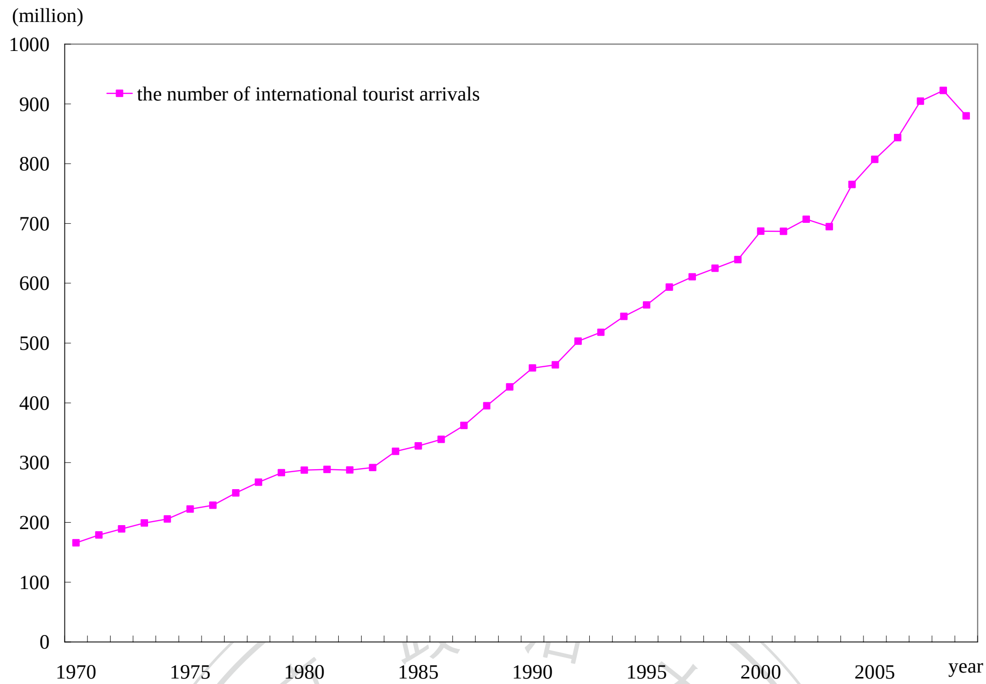
1.2 Purpose and Framework of the Dissertation

The tourism industry has gradually played an important role in the economic growth in Taiwan. International tourist hotels are the most critical part of the tourism industry.

[1] Since the data of ordinary tourist hotels are not available, this paper does not illustrate them.

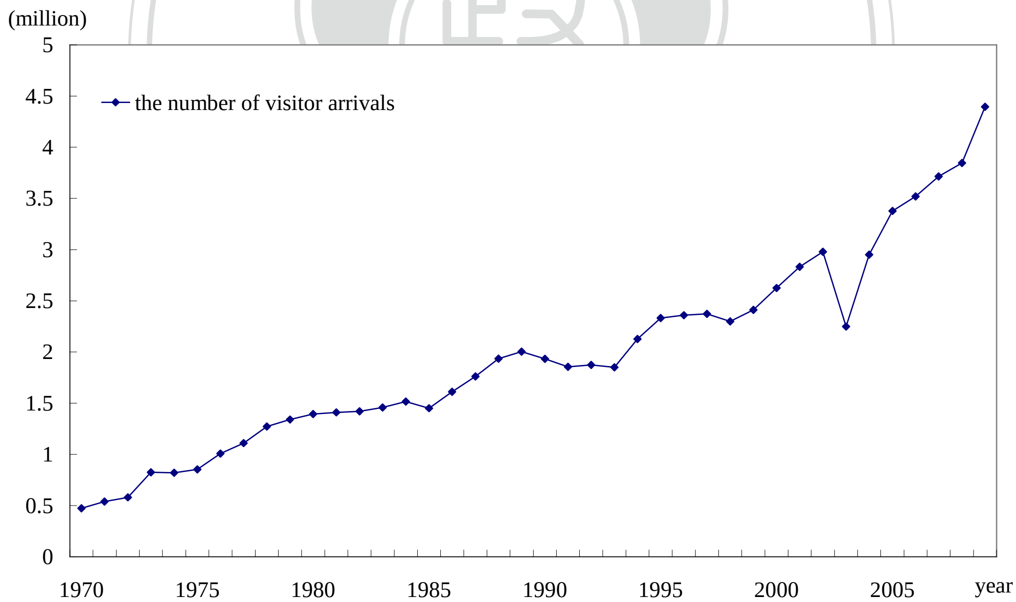
Therefore, this dissertation is to study the efficiency and productivity change, and to investigate the determinants of profitability in the international tourist hotel industry.

The dissertation is a collection of three separate but related papers which are devoted to the empirical studies of the international tourist hotel industry in Taiwan. In addition to the introduction in chapter 1, three papers are presented in chapters 2 to 4, respectively. Chapter 2 is to evaluate the efficiency of international tourist hotels based on the three-stage data envelopment analysis (DEA) model with the quasi-fixed input. Based on the Malmquist productivity index with the quasi-fixed and adjusted inputs, the productivity change in the international tourist hotel industry will be evaluated in chapter 3. In chapter 4, the determinants of profitability in the international tourist hotel industry will be investigated. The last chapter summarizes the empirical results in the previous chapters and their policy implications, as well as provides suggestions for further research.



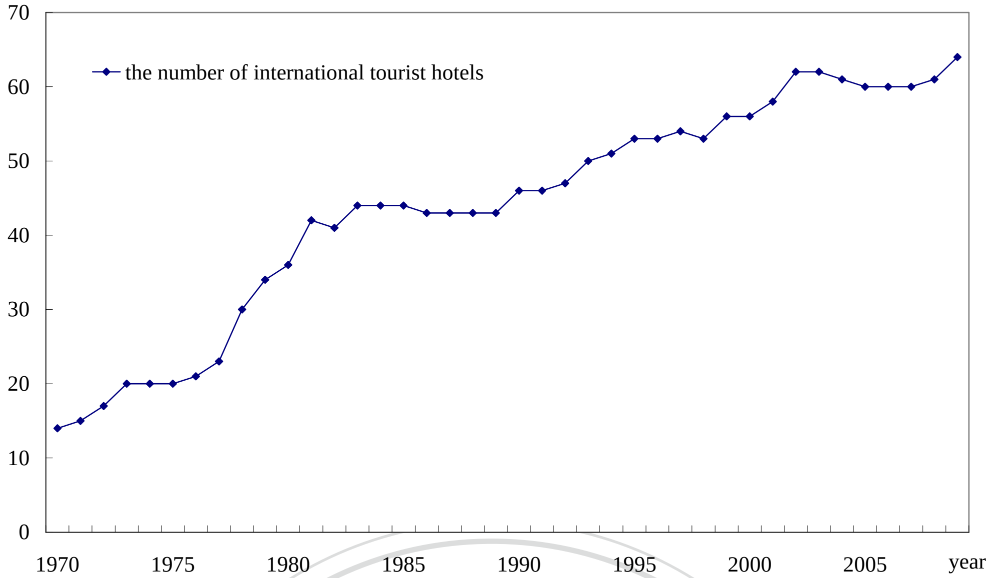
Source: Yearbook of Tourism Statistics, World Tourism Organization, 2009.

Figure 1.1 The Number of International Tourist Arrivals Worldwide



Source: Annual Operation of the International Tourist Hotels, the Tourist Bureau, Ministry of Transportation and Communications, ROC, 2009.

Figure 1.2 The Number of Visitor Arrivals in Taiwan



Source: Annual Operation of the International Tourist Hotels, the Tourist Bureau, Ministry of Transportation and Communications, ROC, 2009.

Figure 1.3 The Number of International Tourist Hotels in Taiwan

Table 1.1 The Aggregate Tourism Revenue and the Ratio of Aggregate Tourism Revenue to Taiwan's GDP

Year	The aggregate tourism revenue (US$ million)	The ratio of aggregate tourism revenue to Taiwan's GDP (%)
2001	11,484	3.91
2002	11,432	3.80
2003	9,281	2.99
2004	11,430	3.36
2005	10,957	3.00
2006	12,021	3.19
2007	11,881	3.02
2008	11,772	2.94
2009	12,385	3.28

Source: 1. Annual Survey Report on Visitors Expenditure, the Tourist Bureau, Ministry of Transportation and Communications, ROC, 2001-2009.

2. Trends in Taiwan and Survey of Travel, the Tourist Bureau, Ministry of Transportation and Communications, ROC, 2001-2009.

3. Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC, www.dgbas.gov.tw.

Table 1.2 The Average Occupancy Rate, the Profitability and the Market Structure in Taiwan's International Tourist Hotel Industry

Year	The average occupancy rate (%)	The average net operating profit margin (%)	The average degree of market concentration	The average market share (%)
2001	62.37	0.53	0.282	23.636
2002	62.17	0.16	0.298	25.000
2003	57.88	0.44	0.290	24.138
2004	66.41	6.33	0.290	24.138
2005	73.54	10.56	0.291	24.561
2006	70.21	9.01	0.306	25.862
2007	68.57	6.90	0.324	27.586
2008	66.26	4.96	0.315	27.119
2009	64.70	0.47	0.317	28.070

Source: Annual Operation of the International Tourist Hotels, the Tourist Bureau, Ministry of Transportation and Communications, ROC, 2001-2009.

Note: 1. The average degree of market concentration is measured by the sum of the squared ratios of revenues from each international tourist hotel to total revenues of all international tourist hotels in the same city or county.

2. The average market share is measured by the ratio of revenues from each international tourist hotel to total revenues of all international tourist hotels in the same city or county.

CHAPTER 2 EFFICIENCY IN TAIWAN'S INTERNATIONAL TOURIST HOTEL INDUSTRY

2.1 Introduction

With economic growth, the improvement of living standards, the rising trend of international free trade in recent years, international travel activities have grown rapidly (see Figure 1.1). However, since the prohibition of building tourist hotels in Taiwan was deregulated in 1977 to encourage building new international tourist hotels, the number of international tourist hotels had the upward trend. Moreover, international hotel groups entered Taiwan's market. Hence, the international tourist hotel industry has become more and more competitive (see Figure 1.3). In addition, individual international tourist hotels' profitability is significantly different from each other. Individual international tourist hotels must more efficiently utilize the input usage and enhance managerial performances for sustainable development. In addition, visitors can be divided into group and individual visitors. International tourist hotels must apply different marketing strategies and service methods to serve various visitors. Whether the decision of receiving different types of visitors may result in the difference of management efficiency or not. Therefore, the managerial efficiency of international tourist hotels in Taiwan is worth to be evaluated and investigated.

The DEA is applied to evaluate the efficiency of international tourist hotels in Taiwan. The concept of DEA was proposed by Farrell (1957).[2] Then, Charnes et al. (1978) developed DEA to the efficiency measure model with multiple inputs and outputs by utilizing the deterministic non-parametric approach and mathematical programming technique. The main advantage of DEA is that it only requires input and output data from each decision making unit (DMU) and does not require a pre-specified parametric production function. A piecewise linear envelopment surface from observed input-output data is yielded through the DEA approach. This envelopment surface is treated as the efficient frontier. DMUs are efficient for lying on the frontier and their technical efficiency measures are 1; the rest of DMUs are termed as inefficient and their efficiency measures do not equal 1. Banker et al. (1984)

[2] Actually, DEA can be used to measure productive efficiency which comprises two parts: the technical (physical) and allocative (price) parts (Farrell, 1957). Since the measurement of the latter requires information on input prices that are often difficult to obtain or measure accurately, this paper will be focused mainly on technical efficiency.

relaxed the assumption of constant returns to scale (CRS) proposed by Charnes et al. (1978) to variable returns to scale (VRS) so that their approach could further decompose technical efficiency into two components: pure technical efficiency and scale efficiency. However, the conventional DEA cannot filter out the external effects. Theoretically, both internal and external factors can affect pure technical efficiency measures. The former is under the control of DMUs. The latter includes exogenous factors and random noise that are not under the control of DMUs. External factors need to be sorted out in order to correctly assess the efficiency of each DMU. Fried et al. (1999) and Fried et al. (2002) proposed modified approaches, called the four-stage DEA and three-stage DEA, to solve this problem, respectively. In the four-stage DEA, the first stage uses the original inputs and outputs to evaluate the efficiency by the conventional DEA model. Then, the second stage applies the Tobit censored regression model to purge the original input-output data from the impacts of exogenous factors. The third stage adjusts the input-output data by the exogenous factors. Finally, the fourth stage uses the adjusted input-output data to re-evaluate the efficiency by the DEA model. Fried et al. (2002) further proposed the three-stage DEA to eliminate the effect of random noise that does not considered in the four-stage DEA. The original inputs and outputs are used to evaluate the efficiency by the conventional DEA model in the first stage. In the second stage, the stochastic frontier analysis (SFA) is applied to purge the original input-output data from the impacts of exogenous factors and statistical noise.[3] The adjusted input-output data are used to re-evaluate the efficiency in the third stage. In addition, the conventional DEA assumes that all inputs can be adjusted, immediately. In practice, firms cannot adjust all inputs in the short run since they may spend many adjustment costs. Banker and Morey (1986) first introduced non-discretionary inputs (or quasi-fixed inputs) in the DEA model to deal with this problem. Then, the presence of quasi-fixed inputs has been applied in the hospital sector (Bilodeau et al., 2004; Ouellette and Vierstraete, 2004; Steinmann et al., 2004), school (Essid et al., 2010; Ouellette and Vierstraete, 2010), etc. In order to acquire more accurate measures, this paper incorporates quasi-fixed inputs into the three-stage DEA model and uses this model to evaluate the efficiency.

A lot of existing literature applies DEA to evaluate the efficiency in the hotel industry.[4]

[3] The stochastic frontier analysis was proposed by Aigner et al. (1977) and Meeusen and van den Broek (1977), respectively.

[4] Johns et al. (1997), Anderson et al. (2000),Tsaur (2001), Brown and Ragsdale (2002), Hwang and Chang (2003), Chiang et al. (2004), Barros (2005), Barros and Mascarenhas (2005), Barros and Santos (2006), Wang and He (2006), Wang et al. (2006), Barros and Dieke (2008), Shang et al. (2008), Shang et al. (2008), Botti et al. (2009), Chen (2009), Neves and Lorenco (2009), Perrigot et al. (2009), Yu and Lee (2009), Hsieh and Lin (2010), Wu et al. (2011), etc.

Most of the literature does not use the three-stage DEA model to investigate the efficiency of hotels except Shang et al. (2008) and Shang et al. (2008). However, the choice of input and output variables in Shang et al. (2008) and Shang et al. (2008) violates the principle of exclusivity suggested by Thanassoulis (2001) that every input or output should not be counted more than once. In addition, no studies incorporate quasi-fixed inputs into the three-stage DEA model to analyze the efficiency of hotels according to the author's best knowledge. This paper may first apply the three-stage DEA with quasi-fixed inputs to evaluate the efficiency of international tourist hotels in Taiwan.

In addition to the introduction, the rest of this chapter is organized as follows. Section 2 establishes the three-stage DEA model with quasi-fixed inputs to evaluate the efficiency of international tourist hotels in Taiwan. A description of the data and empirical results are presented in Section 3. Section 4 is a conclusion.

2.2 Methodology

The DEA approach uses a mathematical programming technique to estimate a piecewise linear envelopment surface from the observed input-output data. This envelopment surface is referred to as the efficient frontier. The frontier is generated from efficient DMUs and the technical efficiency measures of these efficient DMUs are 1; the rest of DMUs are termed as inefficient and their efficiency measures do not equal 1.

There are input-oriented and output-oriented models to evaluate the efficiency in the DEA approach. Lovell (1993) suggested that if DMUs could easily adjust the input usage but were difficult to estimate the amount of outputs, it was more appropriate to use the input-oriented model. Otherwise, the output-oriented model seemed suitable. The input-oriented model is used for this paper due to two reasons: First, international tourist hotels in Taiwan have limited control over their revenues which are highly related to conditions in the external environment. Second, international tourist hotels in Taiwan have the flexibility to adjust their input usages in terms of labor and expenses.

Technical efficiency evaluated by the conventional DEA model may be affected by exogenous factors and random noise. This paper applies the three-stage DEA to purge these external effects. In addition, these managers of international tourist hotels cannot adjust or are unwilling to adjust the entire bundle of inputs, because they may spend many adjustment costs to adjust all inputs to their optimal level in the short run. In other words, there are quasi-fixed inputs in international tourist hotels. This paper incorporates quasi-fixed inputs introduced by Banker and Morey (1986) as well as Ouellette and Vierstraete (2004) in the three-stage DEA model.[5]

In the first stage, the original input-output data is applied to the DEA model. According to Banker and Morey (1986) as well as Ouellette and Vierstraete (2004), suppose that there are *N* international tourist hotels in this market, each using *M* variable inputs and *R* quasi-fixed inputs to produce *S* outputs. Let x_{mn}, k_{rn} and y_{sn} denote the *m*th (*m*=1, 2,…, *M*) variable input usage, the *r*th (*r*=1, 2,…, *R*) quasi-fixed input usage and the *s*th (*s*=1, 2,…, *S*) output production of the *n*th (*n*=1, 2,…, *N*) international tourist hotel. Under the assumptions of the reference technology exhibiting CRS and strong disposability of inputs, technical efficiency (TE_i) can be obtained by solving the following model:[6]

$$\min_{\theta_i^{CRS},\, \lambda_1, \ldots,\, \lambda_N} \theta_i^{CRS} \tag{2-1}$$

subject to

$$\sum_{n=1}^{N} \lambda_n x_{mn} \le \theta_i x_{mi},\ m = 1, 2, \ldots, M \tag{2-2}$$

$$\sum_{n=1}^{N} \lambda_n k_{rn} \le k_{ri},\ r = 1, 2, \ldots, R \tag{2-3}$$

$$\sum_{n=1}^{N} \lambda_n y_{sn} \ge y_{si},\ s = 1, 2, \ldots, S \tag{2-4}$$

$$\lambda_n \ge 0,\ n = 1, 2, \ldots, N \tag{2-5}$$

where θ_i^{CRS} is the technical efficiency of the *i*th international tourist hotel; λ_n is the weight of the *n*th international tourist hotel's production action used. Technical efficiency of an international tourist hotel is evaluated in terms of its ability to radically reduce its inputs usage. If the radical reduction is possible for an international tourist hotel, its optimal $\theta_i^{CCR} < 1$; if the radial reduction is not possible for an international tourist hotel, its optimal $\theta_i^{CCR} = 1$. The difference between this model and the conventional DEA model is that the technical efficiency measure, θ_i^{CRS}, multiplies the variable inputs, but does not multiply

[5] Banker and Morey (1986) first introduced quasi-fixed inputs in the DEA model, but they called them as non-discretionary inputs. Bilodeau et al. (2004) as well as Ouellette and Vierstraete (2004) called them as quasi-fixed inputs.

[6] Strong disposability, or called free disposability, refers to the ability to dispose of unwanted commodity with no private cost. Strong disposability of inputs models the situation in which inputs can be increased without reducing output. That is, this condition excludes "upward sloping" isoquants (Färe et al., 1994).

the quasi-fixed inputs in this model.

The technical efficiency measure obtained from the above model is not only influenced by the pure technical efficiency (i.e., the efficiency in resource usage), but also by the scale efficiency (i.e., the efficiency in production scale). To decompose these two factors, the reference technology assumption of above model is relaxed to VRS by imposing the constraint $\sum_{n=1}^{N}\lambda_n = 1$. Then, the pure technical efficiency (PTE_i) measure, θ_i^{VRS}, can be produced. The scale efficiency (SE_i) measure is computed as $SE_i \equiv TE_i / PTE_i$. $0 < SE_i \leq 1$, since $0 < TE_i \leq PTE_i \leq 1$. If $SE_i = 1$, the international tourist hotel is scale-efficient and operates at the optimal scale which is the point of constant returns on the production frontier; if $SE_i < 1$, the international tourist hotel is scale-inefficient and operates at the inappropriate scale.

In the second stage, SFA is used to decompose input slacks into exogenous effects, random noise, and managerial inefficiency. The input slacks are the difference in the input usage between an international tourist hotel and a hypothetical international tourist hotel on the efficient frontier.[7] The values indicate how much the input usage of the corresponding international tourist hotel needs to be reduced in order to be technically efficient. However, quasi-fixed inputs will not be affected by exogenous effects and random noise since they cannot be adjusted in the short run. Hence, only *M* variable input slacks are decomposed. The dependent variables are the *M* variable input slacks and the independent variables are the *L* observable exogenous variables. The *M* separate SFA regressions are specified as:

$$s_{mn} = f^m(z_n;\beta^m) + v_{mn} + u_{mn}, \quad m = 1, 2, \ldots, M;\ n = 1, 2, \ldots, N \tag{2-6}$$

where $s_{mn} = x_{mn} - \sum_{n=1}^{N}\lambda_n^* x_{mn}$; λ_n^* is the optimal solution of the *n*th international tourist hotel; $z_n = [z_{1n}, z_{2n}, \ldots, z_{Ln}]$ is a vector of the *L* observable exogenous variables of the *n*th international tourist hotel; $f^m(z_n;\beta^m)$ is the deterministic feasible slack frontier with estimated the parameter vector β^m of the *m*th variable input slack; $v_{mn} \sim N(0, \sigma_{vm}^2)$ represents statistical noise; u_{mn} represents the managerial inefficiency which is assumed to be truncated-normal distribution and be independent with v_{mn}.

These adjusted variable inputs are constructed from the results of SFA regressions as

[7] Input slacks include the radial and non-radial input slacks.

follows:

$$\tilde{x}_{mn} = x_{mn} + \left[\max_n \left\{ z_n \hat{\beta}^m \right\} - z_n \hat{\beta}^m \right] + \left[\max_n \left\{ \hat{v}_{mn} \right\} - \hat{v}_{mn} \right], \quad m = 1, 2, \ldots, M;\ n = 1, 2, \ldots, N \quad (2\text{-}7)$$

where $\tilde{x}_{mn}$ and x_{mn} denote the adjusted and original variable input usage, respectively. $[\max_n \{z_n \hat{\beta}^m\} - z_n \hat{\beta}^m]$ forces all international tourist hotels to operate in the least favorable set of external conditions observed in the sample. $[\max_n \{\hat{v}_{mn}\} - \hat{v}_{mn}]$ forces all international tourist hotels to operate in the worst situation observed in the sample.

Finally, the third stage uses the data of the adjusted variable inputs, original quasi-fixed inputs and original outputs to re-evaluate the efficiency in order to yield more accurate measures.

2.3 Data Description and Empirical Results

2.3.1 Data Description

The data used in this paper are based on Taiwan's international tourist hotels operated from 2003 to 2009. They were conducted by the Annual Operation of the International Tourist Hotels, published by the Tourist Bureau, Ministry of Transportation and Communications, ROC. After discarding incomplete observations, 47 international tourist hotels are remained and are listed in Appendix 2A.

Referring to Johns et al. (1997), Anderson et al. (2000), Hwang and Chang (2003), Chiang et al. (2004), Wang and He (2006), Wang et al. (2006) and Shang et al. (2008), the outputs of international tourist hotels are divided into three categories: guest room revenue, food and beverage (F&B) revenue as well as other revenue. Four types of inputs are distinguished: guest room, labor, F&B expense and other expense. The revenues of international tourist hotels are mainly from the guest room revenue and F&B revenue. The average guest room revenue and F&B revenue account for 46% of total revenues, respectively. Although the average other revenue only accounts for around 8% of total revenues, the maximum value among all international tourist hotels is 62%. Hence, the other revenue is considered as a type of output, and is measured in terms of total revenues except guest room revenue and F&B revenue to avoid double-counting. The guest room is represented as the quasi-fixed input and is measured by the number of guest rooms. The quantity of labor is measured by the number of employees. The other expense is measured in terms of total operating expenses except guest room expense, labor-related expense and F&B expense. In addition, guest room revenue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year. The consumer and wholesale price indices are published by the Directorate-General of Budget, Accounting and Statistics of Executive Yuan, ROC.

In the second stage, the variables of market structure, hotel characteristics and external environment are chosen to filter out the impacts of exogenous variables.[8] Market structure is represented by the degree of market concentration. The degree of market concentration is measured by Herfindahl-Hirschman Index (H). An international tourist hotel's H is the sum of the squared ratios of revenues from each international tourist hotel to total revenues of all international tourist hotels in the same city or county.[9] The higher value of H represents the higher market concentration. Hotel characteristics are divided into hotel size, market condition and hotel style. The hotel size is measured by the number of guest rooms. The dummy variable SIZE 1 is equal to 1 for the international tourist hotel with 201 to 400 guest rooms; otherwise, SIZE 1 is equal to 0. The dummy variable SIZE 2 is equal to 1 for the international tourist hotel with more than 401 guest rooms; otherwise, SIZE 2 is equal to 0.[10] The market condition is denoted by the dummy variable which the international tourist hotel belongs to a resort hotel or city hotel. The dummy variable RESORT is equal to 1 for international tourist hotels being resort hotels, and 0 for those being city hotels. The hotel style is denoted by the dummy variable which the international tourist hotel belongs to an international and/or domestic chain hotel or independent hotel. The dummy variable CHAIN is equal to 1 for international tourist hotels being international and/or domestic chain hotels, and 0 for those being independent hotels. External environment is represented by two events: severe acute respiratory syndrome (SARS) in 2003 and financial tsunami in 2008 and 2009. The theoretical foundations of these exogenous variables are illustrated as follows:

Market Structure

The Degree of Market Concentration (H). The lower degree of market concentration is, the

[8] According to Fried et al. (1999), exogenous variables are these factors that may affect pure technical efficiency but are not controlled by DMUs in the short run, such as the form of ownership, location characteristics, labor relations as well as government regulations.

[9] Since an international tourist hotel competes with other international tourist hotel in the same county or city, this paper divides the locations of total international tourist hotels into 13 areas by counties and cities. These 13 areas include Taipei, Kaohsiung, Taichung, Hsinchu, Hualien, Tainan and Taitung cities as well as Kaohsiung, Taoyuan, Hualien, Tainan, Taitung and Pingtung counties.

[10] According to Tourist Bureau (2010), hotel size is divided into eight categories: less than 100, 101-200, 201-300, 301-400, 401-500, 501-600, 601-700 and more than 701 guest rooms. However, this classification is too detail and leads to only two international tourist hotels in some categories.

more competitive pressure among international tourist hotels will be. International tourist hotels have more desire to reduce wasted resources and increase their efficiency in order to survive (Lovell, 1993). Hence, under the same quantities of outputs, if the competitive pressure is higher, the international tourist hotels will use fewer quantities of inputs and lead to fewer input slacks. Therefore, the relationship between the degree of market concentration and input slack is expected to be positive. In other words, the relationship between the degree of market concentration and pure technical efficiency is expected to be negative.

Hotel Characteristics

Hotel Size (SIZE). When the firm size expands, the input usage may be reduced through sharing or joint utilization, but also may be increased through allocative complexity (Baumol et al., 1982). Hence, the impacts of hotel size on input slack and pure technical efficiency are indeterminable.

Market Condition (RESORT). Resort hotels face the more volatile demand than city hotels, but the number of guest rooms cannot be changed in the short run (Baum and Mudambi, 1995). Hence, the effects of the peak season and off-peak season on resort hotels are more serious, and easily lead to waste labor and resources. Therefore, the relationship between the market condition and input slack is expected to be positive. In other words, the relationship between the market condition and pure technical efficiency is expected to be negative.

Hotel Style (CHAIN). Chain hotels could attract more visitors via marketing chain and benefit from the managerial experience of hotel chains via technology transfers, but could increase input usage and costs by requiring standard services and facilities (Wang and He, 2006). Hence, the impacts of hotel style on input slack and pure technical efficiency are indeterminable.

External Environment

Severe Acute Respiratory Syndrome (SARS). SARS is a respiratory disease in humans. It can be spread from person to person through respiratory secretions. In order to reduce contact with others, people will avoid going to public places. Hence, demands for accommodation and F&B in international tourist hotels will be reduced and input slacks will be increased during the period of SARS infection. Therefore, the relationship between SARS and input slack is expected to be positive. In other words, the relationship between SARS and pure technical efficiency is expected to be negative.

Financial Tsunami (FT). During the period of financial tsunami, people will decrease additional expenditures and increase savings because of uncertain incomes and the possibility of unemployment. Hence, the unnecessary tourism expenditure will be lowered and demands for accommodation and F&B in international tourist hotels will be reduced. Therefore, the financial tsunami is expected to have a positive relationship with input slack and a negative relationship with pure technical efficiency.

The definitions of relevant variables are summarized in Appendix 2B. The descriptive statistics of relevant variables is presented in Table 2.1. On the output side, guest room revenues range from 26 million to 1,479 million NT dollars; F&B revenues range from 5 million to 1,250 million NT dollars; other revenues range from 10,758 to 454 million NT dollars. On the input side, guest rooms range from 50 to 873 rooms; labors range from 53 to 982 employees; F&B expenses range from 3 million to 368 million NT dollars; other expenses range from 10 million to 1,085 million NT dollars. These represent that there are extremely different among individual international tourist hotels on the output and input sides. The guest room is represented as the quasi-fixed input because only 12 out of 47 international tourist hotels change the quantities of guest rooms during the period of 2003-2009 and most international tourist hotels change within 10 guest rooms (see Appendix 2C). In addition, 58.7% of international tourist hotels have 201 to 400 guest rooms, indicating that over half international tourist hotels is the middle size. The average value of market condition dummy indicates that 14.9% of international tourist hotels are resort hotels. The average value of hotel style dummy represents that 59.3% of international tourist hotels are chain hotels.

2.3.2 Empirical Results

Before evaluating the efficiency of international tourist hotels, this paper examines the problem of data errors (or influential observations), the correlation of input and output variables and the choice of input-output mix. Since the existence of data errors will distort the DEA efficiency- evaluation results, the method proposed by Wilson (1995) is used to detect influential observations. The process is briefly described in Appendix 2D. The result shows that no observations play a relatively important role in determining the efficient frontier, because the value of total effect by removing any observation is not too high (see Appendix 2E). Hence, no observations need to be deleted from the data.

Golany and Roll (1989) considered that input and output variables should follow the assumption of "isotonicity". It means when an increase in any input variable should not result in a decrease in any output variable. This paper applies the Pearson correlation coefficients to examine the isotonicity relationship between input and output variables. The result indicates that input and output variables are positive relationships at the 1% significant level (see Table 2.2). Hence, the input and output variables conform to the assumption of isotonicity.

Since the results of DEA efficiency-evaluation are sensitive to the input-output mixes, this paper utilizes the Pearson correlation coefficients to perform the stability test. Based on the same input variables, four kinds of input-output mixes are chosen. First, Mix 1 is the original mix and includes 3 output variables: guest room revenue, F&B revenue and other revenue. Second, Mix 2 includes 2 output variables: guest room revenue and F&B revenue. Third, Mix 3 includes 2 output variables: guest room revenue plus other revenue and F&B revenue. Finally, Mix 4 includes 2 output variables: guest room revenue and F&B revenue plus other revenue. The results show that the efficiency-evaluation results among four kinds of input-output mixes are positive relationships at the 1% significant level (see Table 2.3). Hence, the choice of input and output variables in the original mix is appropriate.

The first stage. First, the impact of quasi-fixed input is investigated. The comparison between the efficiency measures estimated by the DEA model without the quasi-fixed and adjusted inputs (Model 1) as well as those estimated by the DEA model with the quasi-fixed input and without adjusted inputs (Model 2) is presented in Table 2.4. Furthermore, this paper uses the Wilcoxon signed rank test to examine whether the efficiency measures estimated by Model 1 and 2 are significantly different or not. Table 2.5 shows that the technical efficiency and pure technical efficiency measures estimated by Model 2 are significantly lower than those estimated by Model 1 at the 1% significant level, implying that the DEA models without the quasi-fixed and adjusted inputs overestimate the technical and pure technical efficiencies of international tourist hotels. The scale efficiency measure estimated by Model 2 is higher than that estimated by Model 1 at the 5% significant level, implying that the DEA model without the quasi-fixed and adjusted inputs underestimates the scale efficiency of international tourist hotels. Hence, the necessity of considering the existence of the quasi-fixed input is justified.

The evaluation results for each efficiency measure estimated by Model 2 are summarized in Table 2.4 and are described in the following paragraph. The mean technical efficiency measure of international tourist hotels is 0.791, implying that international tourist hotels in Taiwan could reduce inputs by 20.9%, on average, and still produce the same level of outputs. In order to investigate the source of technical inefficiency, technical efficiency can be decomposed into pure technical efficiency and scale efficiency. The mean pure technical efficiency measure is 0.835 while the mean scale efficiency measure is 0.946. These results imply that the technical inefficiency mainly results from wasted resources. In addition, the percentage of hotels operating on the frontier is about 11.2 (37 out of 329) in technical efficiency and 15.5 (51 out of 329) in pure technical efficiency. This result implies that an ample space exists for most international tourist hotels in Taiwan to improve their efficiency.

The second stage. The labor, F&B expense and other expense input slacks yielded in the first stage are used as dependent variables, as well as the degree of market concentration, hotel size, market condition, hotel style, SARS and financial tsunami are used as independent variables in the SFA model to purge effects from exogenous variables and statistical noise in the second stage. Before applying the SFA approach, these values of variance inflationary factor (VIF) are calculated to examine the degree of multicollinearity among independent variables. Since the values of VIF are all below 2.45, the multicollinearity problem among independent variables is not serious.[11] Following Fried et al. (2002), the likelihood-ratio test (LR test) is applied to examine the specification of SFA model. The null hypothesis of this test is that the SFA model is equivalent to the traditional model, without managerial inefficiency effect. When there is managerial inefficiency effect, the null hypothesis will be rejected and SFA should be applied. Otherwise, the ordinary least square (OLS) regression should be used (Coelli et al., 1998). The LR test results reject the null hypotheses in all input slack equations at the 1% significant level (see Table 2.6). Hence, the SFA model is adequate to be used in the second stage.

The SFA results are presented in Table 2.6.[12] The degree of market concentration has positive effects on all three input slacks at the 1% significant level, implying that the more competitive pressure can help international tourist hotels to increase their pure technical efficiency. The underlying reason is that when there are more competitors in the market, international tourist hotels are more willing to reduce wasted resources in order to survive (Lovell, 1993). The result also supports the quiet life hypothesis proposed by Hick (1935) that if international tourist hotels have more market power, the manager will pay less attention to improving their efficiency. Two hotel size dummies are positive on all three input slacks at the 1% significant level. Moreover, the bigger hotel size is, the larger coefficient

[11] The VIF value is smaller than 5 for each independent variable with no serious correlation with each other; but there exists serious multicollinearity problem if the largest VIF value exceeds 10 (Greene, 2000).

[12] In order to obtain better result, SARS is deleted from the other expense input slack equation.

will be. The result implies that an expansion in the hotel size may increase the complexity of allocating resources more than decrease the input usage through sharing or joint utilization. Contrary to the expectation, the resort dummy is negative and significant on all three input slack. Two possible explanations for this outcome are that popular visiting spots help international tourist hotels to attract more visitors, or managers of resort hotels may adopt superior managerial strategies to improve their efficiency (Wang and He, 2006). The effects of hotel style are positive on labor and F&B expense input slacks, but is negative on the other expense input slack, indicating that chain hotels could reduce their other expenses by attracting visitors and benefiting from hotel chains' managerial experience, but could increase their labors and F&B expenses in order to require standard services and facilities. The SARS has positive effects on labor and F&B expense input slacks at the 1% significant level, indicating that demands for accommodation and F&B in international tourist hotels could be decreased in order to avoid SARS infection during the period of SARS prevalence. The financial tsunami dummy is positive on labor and other expense input slacks at the 1% significant level, implying that people may reduce the unnecessary tourism expenditure in order to face the uncertainty of the economic environment during the period of financial tsunami.

The contribution of managerial inefficiency is also showed in Table 2.6. The estimated values of parameter γ are all close to 1 in three input slack equations.[13] It means that the inefficiency is mainly due to the managerial inefficiency. Since the variation in input slacks mostly results from the exogenous variables and managerial inefficiency, the impacts of exogenous variables must be eliminated to avoid misleading the efficiency measures of international tourist hotels. Hence, the necessity of adopting the three-stage DEA is justified.

The third stage. The third stage re-evaluates efficiency measures by using the adjusted variable input data calculated in the second stage. Similarly, the test between efficiency measures estimated by Model 2 and estimated by the DEA model with quasi-fixed and adjusted inputs (Model 3) is presented in Table 2.5 to justify the usage of the three-stage approach. This paper also utilizes the Wilcoxon signed rank test to examine whether the efficiency measures estimated by Model 2 and 3 are significantly different or not. The results show that the technical efficiency and scale efficiency measures estimated by Model 3 are

[13] When γ is close to 1, the impact of the managerial inefficiency dominates the statistical noise. Contrarily, when γ is close to 0, the impact of the statistical noise dominates the managerial inefficiency (Coelli et al., 1998).

significantly lower than those estimated by Model 2 at the 1% significant level, implying that the conventional DEA models overestimate the technical and scale efficiencies of international tourist hotels. The pure technical efficiency measure estimated by Model 3 is higher than that estimated by Model 2 at the 1% significant level, implying that the conventional DEA model underestimates the pure technical efficiency of international tourist hotels. Hence, the necessity of adjusting inputs is justified.

The evaluation results for each efficiency measure estimated by Model 3 are also summarized in Table 2.4. The mean technical efficiency measure is 0.541, implying that international tourist hotels in Taiwan could reduce inputs by 45.9%, on average, and still produce the same level of outputs. In addition, the mean pure technical efficiency measure is 0.990 while the mean scale efficiency measure is 0.546. These pure technical efficiency measures of international tourist hotels are very close to 1 after discarding the effects of exogenous variables and statistical noise. These results imply that the technical inefficiency mainly originates in the inappropriate production scale. A possible explanation for this outcome is that international tourist hotels may take a long time to reach the appropriate scale since adjusting the number of guest rooms to attain the optimal level may spend many adjustment costs in the short run. Finally, 173 out of 329 observations are purely technically efficient and only 20 are technically efficient, implying that most international tourist hotels in Taiwan have an ample space to improve their technical and scale efficiencies.

Efficiency comparison among international tourist hotels with different types of visitors. This paper also investigates whether international tourist hotels achieve different efficiencies, when they serve different types of visitors. According to Tsaur (2001), when an international tourist hotel serves group visitors more than 75% in total visitors, the international tourist hotel belongs to TYPE 1 that specializes in receiving group visitors; when an international tourist hotel serves individual visitors more than 75% in total visitors, the international tourist hotel belongs to TYPE 2 that specializes in receiving individual visitors. In addition, this paper adds TYPE 3 that simultaneously receives group and individual visitors, when an international tourist hotel serves group and individual visitor both lower than 75% in total visitors. Table 2.7 shows that the mean technical efficiency measure of TYPE 2 is the highest, and that of TYPE 1 is the lowest. The mean pure technical efficiency measures are all close to 1 among three types. This paper also utilizes the Kruskal-Wallis test (K-W test) to examine whether efficiency measures among different types of visitors are significantly different or not. These results show that technical and scale efficiency measures among different types of visitors are significantly different at the 1% significant level, but the pure technical efficiency measure is not significantly different (see Table 2.7). These imply that the difference of technical efficiency among three types of visitors mainly results from the difference of scale efficiency.

Furthermore, the Wilcoxon rank sum test is used to investigate the multiple comparisons of technical and scale efficiencies among three types (see Table 2.8). These results show that these technical and scale efficiency measures between TYPE 1 and TYPE 2 as well as TYPE 1 and TYPE 3 are significantly different at the 1% significant level, but these technical and scale efficiency measures between TYPE 2 and TYPE 3 are not significantly different. These indicate that if an international tourist hotel mainly receives group visitors, the efficiency will be lower. A possible reason for this outcome is that group visitors book rooms and ask the relative services through travel agencies. However, travel agencies have the better bargaining power and technique to reduce prices or request more services. International tourist hotels which mainly receive group visitors may use more quantities of inputs and still produce the same quantities of outputs. Thus, international tourist hotels which mainly receive group visitors perform lower than others.

2.4 Conclusions

Since the prohibition of building tourist hotels in Taiwan was deregulated in 1977 to encourage building new international tourist hotels, the number of international tourist hotels sprang up. Furthermore, the average occupancy rate of international tourist hotels in Taiwan was the downward trend in recent years. Individual international tourist hotels' profitability is significantly different from each other. The phenomena motivate this paper to evaluate the efficiency of international tourist hotels. To accurately examine the efficiency of international tourist hotels in Taiwan, the three-stage DEA approach with the quasi-fixed input is used to eliminate the effects of external factors and random noise on efficiency measures based on the 2003-2009 data conducted by the Annual Operation of the International Tourist Hotels.

In the first stage, the data of original variable inputs, quasi-fixed input and outputs are used to evaluate the technical efficiency of international tourist hotels. The efficiency-evaluation results show that the DEA models without quasi-fixed and adjusted inputs overestimate the technical and pure technical efficiencies, but underestimate the scale efficiency of international tourist hotels so that the necessity of considering the existence of quasi-fixed input is justified. The second stage uses SFA model to purge the effects from exogenous variables and statistical noise. The SFA results show that the exogenous variables have significant influences on input slacks and pure technical efficiency. The degree of market concentration has positive impacts on labor, F&B expense and operating expense input slacks and has a negative impact on pure technical efficiency because international tourist hotels with the lower degree of market concentration may reduce wasted resources under the competitive pressure. A hotel size has positive effects on all input slacks and has a negative effect on pure technical efficiency because the losses from the complexity of allocating resources dominates the gains from sharing or joint utilization. An international tourist hotel in the resort area has negative relationships with all input slacks and a positive relationship with pure technical efficiency because popular visiting spots can help international tourist hotels to attract more visitors, or managers of resort hotels may adopt superior managerial strategies to improve their efficiency. An international tourist hotel participating in the international and/or domestic hotel chain has positive relationships with labor and F&B expense input slacks, but has a negative relationship with the other expense input slack. Because marketing chain and technology transfers can help international tourist hotels to attract visitors and obtain the managerial experience, but requiring standard services and facilities can cause them to increase more labors and F&B expenses. SARS has positive effects on labor and F&B expense input slacks and has a negative effect on pure technical efficiency because avoiding SARS infection can cause a decrease in demands for accommodation and F&B in international tourist hotels. The financial tsunami has positive effects on labor and other expense input slacks and has a negative effect on pure technical efficiency because the uncertainty of economic environment can lead to a decrease in the unnecessary tourism expenditure.

After adjusting the variable input data from the SFA results in the second stage, the efficiency-evaluation results in the third stage show that international tourist hotels in Taiwan could reduce inputs by 45.9%, on average, and still produce the same level of outputs. The mean pure technical efficiency measure is 0.990 and the mean scale efficiency measure is 0.546, implying that the technical inefficiency mainly results from the inappropriate production scale. In addition, international tourist hotels have an ample space to improve their technical and scale efficiencies. The efficiency-evaluation results also show that the conventional DEA models overestimate the technical and scale efficiencies, but underestimate the pure technical efficiency of international tourist hotels so that the usage of the three-stage DEA approach is justified. Finally, international tourist hotels which mainly receive group visitors have the worst performance because the better bargaining power of travel agencies can cause international tourist hotels to increase the usage of inputs.

Some important lessons may emerge directly from the empirical results in this chapter. First of all, for studies of efficiency to be more informative to decision and policy makers, the three-stage DEA approach with quasi-fixed inputs should be adopted to control the impacts of exogenous factors, statistic noise and quasi-fixed inputs. Second, managers may have to appropriately adjust the operating scale since most of international tourist hotels are still scale inefficient. Third, managers may have to carefully assess the advantage and disadvantage of hotel chains before participating in or developing them. Finally, the information about service qualities, the form of ownership, labor relations and the data of ordinary tourist hotels might be needed for the empirical results to be more reliable and the policy implications to be more meaningful.

Table 2.1 Descriptive Statistics of Relevant Variables

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Taipei City	Guest room revenue	140	3,723.583	3,221.831	14,786.037	255.342
	F&B revenue		4,227.565	3,645.644	12,502.824	51.874
	Other revenue		870.799	1,101.529	4,540.527	2.051
	Guest room		355.607	197.612	873	50
	Labor		416.950	274.061	982	53
	F&B expense		1,362.625	1,064.094	3,682.263	29.743
	Other expense		2,197.203	2,196.285	10,848.029	103.450
	H		0.072	0.004	0.077	0.066
	SIZE 1		0.550	0.499	1	0
	SIZE 2		0.350	0.479	1	0
	RESORT		0.050	0.219	1	0
	CHAIN		0.650	0.479	1	0
Kaohsiung City	Guest room revenue	42	2,329.135	1,116.231	4,712.820	678.775
	F&B revenue		3,486.773	2,192.882	8,489.424	395.214
	Other revenue		687.176	883.693	3,370.388	40.655
	Guest room		391.095	117.025	592	238
	Labor		380.381	195.988	737	100
	F&B expense		1,462.839	887.074	3,136.582	172.856
	Other expense		1,660.465	1,156.373	4,464.824	367.554
	H		0.198	0.007	0.210	0.190
	SIZE 1		0.500	0.506	1	0
	SIZE 2		0.500	0.506	1	0
	RESORT		0	0	0	0
	CHAIN		0.500	0.506	1	0
Taichung City	Guest room revenue	35	1,544.367	641.687	3,109.280	777.683
	F&B revenue		2,045.303	622.977	3,479.178	846.283
	Other revenue		566.177	744.607	2,482.511	7.789

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 2.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Taichung City	Guest room	35	271.714	93.802	404	155
	Labor		259.857	89.365	449	162
	F&B expense		742.620	203.220	1,189.266	430.357
	Other expense		1,108.800	607.066	2,649.340	450.758
	H		0.223	0.005	0.232	0.216
	SIZE 1		0.600	0.497	1	0
	SIZE 2		0.200	0.406	1	0
	RESORT		0	0	0	0
	CHAIN		0.571	0.502	1	0
Taoyuan City	Guest room revenue	7	1,265.633	331.368	1,662.908	752.985
	F&B revenue		744.145	53.440	804.810	635.629
	Other revenue		23.576	1.056	25.443	21.988
	Guest room		390.000	0.000	390	390
	Labor		174.571	11.816	185	155
	F&B expense		423.270	94.993	579.822	326.651
	Other expense		577.957	166.364	856.823	373.214
	H		1	0	1	1
	SIZE 1		1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0	0	0	0
Hsinchu City	Guest room revenue	14	2,035.166	506.606	2,746.688	1,338.384
	F&B revenue		2,423.542	1,096.391	3,925.719	1,305.056
	Other revenue		557.142	575.173	1,748.228	83.146
	Guest room		229.500	27.026	257	198
	Labor		288.571	62.790	374	220
	F&B expense		784.991	361.084	1,238.309	415.419

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 2.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Hsinchu City	Other expense	14	1,165.691	530.295	2,132.364	519.069
	H		0.565	0.019	0.595	0.543
	SIZE 1		0.786	0.426	1	0
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		1	0	1	1
Hualien City	Guest room revenue	21	1,390.102	723.510	2,759.915	745.540
	F&B revenue		1,121.778	259.730	1,509.906	677.846
	Other revenue		57.421	72.068	226.865	0.108
	Guest room		280.714	51.372	343	221
	Labor		190.191	79.880	306	100
	F&B expense		533.895	142.603	840.086	334.224
	Other expense		784.042	430.689	1,712.497	271.772
	H		0.349	0.009	0.365	0.338
	SIZE 1		1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0.333	0.483	1	0
Tainan City	Guest room revenue	14	1,524.206	992.131	2,867.378	390.145
	F&B revenue		2,749.402	855.241	4,184.827	1,534.876
	Other revenue		252.606	221.334	558.004	41.956
	Guest room		231.571	82.640	315	152
	Labor		272.429	88.938	374	179
	F&B expense		1,143.998	205.843	1,517.147	857.243
	Other expense		981.986	363.306	1,644.846	540.997
	H		0.397	0.082	0.562	0.269
	SIZE 1		0.500	0.519	1	0

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 2.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Tainan City	SIZE 2	14	0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0.500	0.519	1	0
Taitung City	Guest room revenue	7	1,464.446	97.762	1,602.836	1,357.690
	F&B revenue		920.820	201.284	1,103.530	543.097
	Other revenue		258.526	74.616	373.670	161.011
	Guest room		276.000	0.000	276	276
	Labor		213.429	28.118	240	166
	F&B expense		338.443	72.697	398.732	184.328
	Other expense		768.185	95.067	884.121	613.531
	H		1	0	1	1
	SIZE 1		1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0	0	0	0
Kaohsiung County	Guest room revenue	7	361.707	47.732	411.718	266.078
	F&B revenue		1,194.060	141.070	1,316.305	930.516
	Other revenue		58.607	28.974	122.866	36.314
	Guest room		107	0	107	107
	Labor		156.714	36.206	235	128
	F&B expense		402.833	52.133	457.317	324.029
	Other expense		477.602	189.555	856.952	234.137
	H		1	0	1	1
	SIZE 1		0	0	0	0
	SIZE 2		0	0	0	0
	RESORT		1	0	1	1
	CHAIN		1	0	1	1

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 2.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Hualien County	Guest room revenue	7	3,922.906	724.305	4,936.942	3,215.874
	F&B revenue		1,851.529	328.194	2,322.083	1,515.907
	Other revenue		418.171	124.050	690.110	322.250
	Guest room		381.000	0.000	381	381
	Labor		381.571	56.909	425	263
	F&B expense		554.282	151.552	864.370	453.689
	Other expense		1,549.637	446.933	2,316.897	1,185.174
	H		0.681	0.142	1	0.598
	SIZE 1		1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0	0	0	0
Tainan County	Guest room revenue	14	1,509.476	975.519	2,676.391	438.893
	F&B revenue		708.843	334.764	1,160.421	319.747
	Other revenue		714.252	790.222	2,173.444	32.255
	Guest room		148.500	54.481	201	96
	Labor		171.571	52.392	234	102
	F&B expense		383.007	154.496	704.904	129.822
	Other expense		960.192	525.444	1,721.423	249.017
	H		0.624	0.138	0.712	0.413
	SIZE 1		0.500	0.519	1	0
	SIZE 2		0	0	0	0
	RESORT		1	0	1	1
	CHAIN		0.500	0.519	1	0
Taitung County	Guest room revenue	7	1,688.476	262.646	2,047.610	1,332.377
	F&B revenue		855.503	113.463	984.588	681.738
	Other revenue		367.479	72.743	459.348	261.177

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 2.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Taitung County	Guest room	7	183.000	0	183	183
	Labor		222.857	12.199	238	204
	F&B expense		287.663	46.893	346.964	227.365
	Other expense		925.564	127.316	1,076.829	764.333
	H		1	0	1	1
	SIZE 1		0	0	0	0
	SIZE 2		0	0	0	0
	RESORT		1	0	1	1
	CHAIN		1	0	1	1
Pingtung County	Guest room revenue	14	2,871.178	493.095	3,512.117	2,166.017
	F&B revenue		1,294.808	194.512	1,575.503	964.045
	Other revenue		295.381	201.377	680.409	95.045
	Guest room		327.500	80.426	405	250
	Labor		249.929	39.943	305	165
	F&B expense		479.520	70.071	580.222	364.415
	Other expense		1,329.978	210.360	1,752.341	975.006
	H		0.517	0.015	0.536	0.500
	SIZE 1		0.500	0.519	1	0
	SIZE 2		0.500	0.519	1	0
	RESORT		1	0	1	1
	CHAIN		1	0	1	1
Total	Guest room revenue	329	2,657.911	2,416.783	14,786.037	255.342
	F&B revenue		2,957.086	2,849.618	12,502.824	51.874
	Other revenue		623.560	888.616	4,540.527	0.108
	Guest room		316.395	158.321	873	50
	Labor		332.027	217.314	982	53
	F&B expense		1,041.146	874.707	3,682.263	29.743

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 2.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Total	Other expense	329	1,595.268	1,623.232	10,848.029	103.450
	H		0.291	0.284	1	0.066
	SIZE 1		0.587	0.493	1	0
	SIZE 2		0.255	0.437	1	0
	RESORT		0.149	0.357	1	0
	CHAIN		0.593	0.492	1	0

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 2.2 Pearson Correlation Coefficients of Input and Output Variables

Output / input	Guest room revenue	F&B revenue	Other revenue
Guest room	0.813***	0.779***	0.466***
	(0.000)	(0.000)	(0.000)
Labor	0.856***	0.930***	0.656***
	(0.000)	(0.000)	(0.000)
F&B expense	0.786***	0.955***	0.625***
	(0.000)	(0.000)	(0.000)
Other expense	0.894***	0.786***	0.680***
	(0.000)	(0.000)	(0.000)

Note: 1. The numbers in parentheses are p-values.

2. *** represents that the coefficients are significantly different from 0 at the 0.01 level.

Table 2.3 Pearson Correlation Coefficients of Input-Output Mixes

	Technical efficiency			
	Mix 1	Mix 2	Mix 3	Mix 4
Mix 1	1			
Mix 2	0.940*** (0.000)	1		
Mix 3	0.967*** (0.000)	0.923*** (0.000)	1	
Mix 4	0.922*** (0.000)	0.854*** (0.000)	0.854*** (0.000)	1
	Pure technical efficiency			
	Mix 1	Mix 2	Mix 3	Mix 4
Mix 1	1			
Mix 2	0.936*** (0.000)	1		
Mix 3	0.962*** (0.000)	0.919*** (0.000)	1	
Mix 4	0.929*** (0.000)	0.860*** (0.000)	0.856*** (0.000)	1

Note: 1. The numbers in parentheses are p-values.

2. *** represents that the coefficients are significantly different from 0 at the 0.01 level.

Table 2.4 Comparison of DEA Models, with and without the Quasi-Fixed Input, as well as with and without Adjusted Inputs

	Model 1			Model 2			Model 3		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Mean	0.797	0.842	0.946	0.791	0.835	0.946	0.541	0.990	0.546
SD	0.135	0.117	0.080	0.135	0.118	0.079	0.257	0.026	0.258
Minimum	0.380	0.525	0.547	0.380	0.525	0.549	0.080	0.839	0.080
Number of observations	37	52	37	37	51	37	20	173	20

Table 2.5 Results of Wilcoxon Signed Rank Test

	Model 2 versus Model 1	Model 3 versus Model 2
TE	-9.133***	-14.547***
	(0.000)	(0.000)
PTE	-10.139***	15.366***
	(0.000)	(0.000)
SE	1.971**	-15.562***
	(0.049)	(0.000)

Notes: 1. The numbers in parentheses are p-values.

2. ** and *** represent that the coefficients are significantly different from 0 at the 0.05 and 0.01 levels.

Table 2.6 SFA Parameter Estimates of Input Slack Equations

Dependent variable	Labor input slack	F&B expense input slack	Other expense input slack
Constant	-35.608***	-78.836***	-190.482***
	(1.048)	(0.715)	(1.009)
H	17.966***	17.989***	34.804***
	(0.688)	(1.035)	(2.274)
SIZE 1	18.174***	63.670***	165.029***
	(1.016)	(0.940)	(2.168)
SIZE 2	22.191***	71.490***	199.155***
	(1.220)	(1.080)	(1.963)
RESORT	-3.423***	-34.023***	-19.339***
	(0.854)	(1.233)	(1.484)
CHAIN	8.761***	5.737***	-14.685***
	(0.699)	(1.079)	(1.722)
SARS	5.808***	4.099***	
	(1.339)	(0.186)	
FT	3.004***	-0.100	3.274***
	(0.821)	(0.176)	(0.991)
σ^2	7,292.517***	131,511.110***	165,477.550***
	(1.000)	(1.000)	(1.000)
$\gamma = \sigma_v^2 / (\sigma_v^2 + \sigma_u^2)$	0.999***	0.999***	0.999***
	(3.080-E04)	(8.105-E07))	(7.670-E06)
Log-likelihood function	-1,730.529	-2,127.501	-2,205.786
LR test	138.030***	251.109***	185.652***
(p-values)	(0.000)	(0.000)	(0.000)

Notes: 1. The numbers in parentheses are standard errors.

2. *** represents that the coefficients are significantly different from 0 at the 0.01 level.

Table 2.7 Summary of the Adjusted Efficiency Measures among Different Types of Visitors

Type	TE	PTE	SE	Number of observations
TYPE 1	0.331	0.983	0.337	28
TYPE 2	0.564	0.990	0.570	100
TYPE 3	0.558	0.992	0.564	201
K-W test	23.357***	1.178	22.509***	
	(0.000)	(0.555)	(0.000)	

Notes: 1. The numbers in parentheses are p-values.

2. *** represents that the coefficients are significantly different from 0 at the 0.01 level.

Table 2.8 Results of Wilcoxon Rank Sum Test

Type	TE	SE
TYPE 1 versus TYPE 2	-5.297***	-5.257***
	(0.000)	(0.000)
TYPE 1 versus TYPE 3	-4.224***	-4.111***
	(0.000)	(0.000)
TYPE 2 versus TYPE 3	0.484	0.489
	(0.629)	(0.625)

Notes: 1. The numbers in parentheses are p-values.

2. *** represents that the coefficients are significantly different from 0 at the 0.01 level.

Appendix 2A

Table 2A The List of 47 Taiwan's International Tourist Hotels in Sample

Ambassador Hotel Hsinchu	Howard Prince Hotel Taichung
Ambassador Hotel-Kaohsiung	Hualien Chateau de Chine Hotel
Ambassador Hotel Taipei	Hualien Farglory Hotel
Brother Hotel	Imperial Hotel Taipei
Caesar Park Hotel Taipei	Kaohsiung Grand Hotel
Caesar Park Hotel Kenting	Lalu Hotel
Emperor Hotel	Landis Resort Yangmingshan Hotel
Evergreen Laurel Hotel Taichung	Landis Taipei Hotel
Formosan Naruwan Hotel and Resort Taitung	Marshal Hotel
Gloria Prince Hotel Taipei	Parkview Hotel
Golden China Hotel	Plaza International Hotel
Grand Hi-Lai Hotel	Regent Taipei Hotel
Grand Hyatt Taipei Hotel	Santos Hotel
Han-Hsien International Hotel	Shangri-La's Far Eastern Plaza Hotel Taipei
Hibiscus Resort Hotel	Sheraton Taipei Hotel
Hotel Holiday Garden	Sherwood Taipei Hotel
Hotel National	Splendor Kaohsiung Hotel
Hotel Riverview Taipei	Splendor Hotel-Taichung
Hotel Royal Chihpen	Taipei Grand Hotel
Hotel Royal Hsinchu	Taoyuan Hotel
Hotel Tainan	Tayih Landis Hotel
Howard Beach Resort Kenting	United Hotel
Howard Plaza Hotel Kaohsiung	Westin Taipei Hotel
Howard Plaza Hotel Taipei	

Appendix 2B

Table 2B Data Descriptions of Relevant Variables

Variables	Definition
Outputs	
Guest room revenue	The revenues from guest room plus service fees multiply the ratio of guest room revenue to guest room revenue and F&B revenue
F&B revenue	The revenues from F&B plus service fees multiply the ratio of F&B revenue to guest room revenue and F&B revenue
Other revenue	Total revenues minus guest room revenue and F&B revenue
Inputs	
Guest room	The number of guest rooms
Labor	The number of employees
F&B expense	F&B expenses
Other expense	Total operating expenses minus guest room expense, labor-related expense and F&B expense
Exogenous variables	
H	The sum of the squared ratios of revenues from each international tourist hotel to total revenues of all international tourist hotels in the same city or county
SIZE	The dummy variable SIZE 1=1 indicates that the number of guest rooms is between 201 to 400 rooms; otherwise, SIZE 1=0. The dummy variable SIZE 2=1 indicates that the number of guest rooms is more than 401 rooms; otherwise, SIZE 2=0
RESORT	The dummy variable RESORT=1 indicates that an international tourist hotel is the resort hotel; RESORT=0 indicates that an international tourist hotel is the city hotel
CHAIN	The dummy variable CHAIN=1 indicates that an international tourist hotel is the international and/or domestic chain hotel; CHAIN=0 indicates that an international tourist hotel is the independent hotel
SARS	The dummy variable SARS=1 indicates the year 2003; otherwise, SARS=0
FT	The dummy variable FT=1 indicates the year 2008 and 2009; otherwise, FT=0

Appendix 2C

Table 2C Quantities of Guest Rooms of Individual International Tourist Hotel in Taiwan during the Period of 2003-2009

Areas	Hotel	2003	2004	2005	2006	2007	2008	2009
Taipei City	A	405	405	405	405	402	402	402
	B	432	432	432	432	432	432	432
	C	336	336	336	336	336	336	288
	D	220	220	220	220	220	220	220
	E	97	97	97	97	97	97	97
	F	201	201	201	201	201	201	201
	G	388	388	388	388	388	388	388
	H	215	215	215	215	215	215	215
	I	250	250	250	250	250	250	250
	J	287	287	287	287	287	287	287
	K	209	209	209	209	209	209	209
	L	243	243	243	243	243	243	243
	M	686	686	686	686	686	692	692
	N	606	606	606	606	606	606	606
	O	873	873	873	873	873	865	865
	P	569	569	569	569	569	569	569
	Q	349	345	345	345	343	343	343
	R	422	422	422	422	420	420	420
	S	288	288	288	288	288	288	288
	T	50	50	50	50	50	50	50
Kaohsiung City	U	274	274	274	274	274	274	274
	V	457	457	457	457	457	457	457
	W	436	436	436	436	436	436	436
	X	238	283	283	283	283	283	283
	Y	592	592	592	592	592	592	592
	Z	311	311	311	311	311	311	311

Table 2C (*Continued*)

	Hotel	2003	2004	2005	2006	2007	2008	2009
Taichung City	AA	404	404	404	404	404	404	404
	AB	226	226	226	226	226	226	226
	AC	354	354	354	354	354	354	354
	AD	155	155	155	155	155	155	155
	AE	205	222	222	222	222	222	222
Tayuan City	AF	390	390	390	390	390	390	390
Hsinchu City	AG	198	198	198	208	208	208	208
	AH	254	254	254	254	257	257	257
Hualien City	AI	289	289	289	270	270	270	270
	AJ	221	221	221	221	221	221	221
	AK	343	343	343	343	343	343	343
Tainan City	AL	152	152	152	152	152	152	152
	AM	306	306	306	315	315	315	315
Taitung City	AN	276	276	276	276	276	276	276
Kaohsiung County	AO	107	107	107	107	107	107	107
Hualien County	AP	381	381	381	381	381	381	381
Tainan County	AQ	96	96	96	96	96	96	96
	AR	201	201	201	201	201	201	201
Taitung County	AS	183	183	183	183	183	183	183
Pingtung County	AT	250	250	250	250	250	250	250
	AU	405	405	405	405	405	405	405
Total		14,830	14,888	14,888	14,888	14,884	14,882	14,834

Appendix 2D

The method that examines the problem of data error proposed by Wilson (1995) is briefly illustrated in this appendix. A more complete description refers to Wilson (1995). First, a modified DEA approach proposed by Lovell et al. (1994) is used to evaluate the super-efficiency that allows the efficiency measure greater than 1. This approach removes the *i*th DMU from the constraint set when the *i*th DMU is evaluated. It is written as follows:

$$\min_{\theta_i^*,\, \lambda_1, \ldots,\, \lambda_N} \theta_i^* \tag{2D-1}$$

subject to

$$\sum_{n=1,\, n\neq i}^{N} \lambda_n x_{mn} \leq \theta_i x_{mi},\ m = 1, 2, \ldots, M \tag{2D-2}$$

$$\sum_{n=1,\, n\neq i}^{N} \lambda_n y_{sn} \geq y_{si},\ s = 1, 2, \ldots, S \tag{2D-3}$$

$$\sum_{n=1}^{N} \lambda_n = 1,\ n = 1, 2, \ldots, N \tag{2D-4}$$

where θ_i^* is the modified pure technical efficiency of the *i*th DMU.

Then, the set is defined as *A*={all DMUs whose θ^* are greater than 1}. For each $j \in A$, the following model is solved.

$$\min_{\theta_{ij}^*,\, \lambda_1, \ldots,\, \lambda_N} \theta_{ij}^* \tag{2D-5}$$

subject to

$$\sum_{n=1,\, n\neq i,\, j}^{N} \lambda_n x_{mn} \leq \theta_{ij} x_{m,\, ij},\ m = 1, 2, \ldots, M \tag{2D-6}$$

$$\sum_{n=1,\, n\neq i,\, j}^{N} \lambda_n y_{sn} \geq y_{s,\, ij},\ s = 1, 2, \ldots, S \tag{2D-7}$$

$$\sum_{n=1}^{N} \lambda_n = 1,\ n = 1, 2, \ldots, N \tag{2D-8}$$

Next, d_j denotes the number of cases where $\theta_i^* \neq \theta_{ij}^*$ as well as θ_i^* and θ_{ij}^* are feasible; d_j^* denotes d_j plus the number of cases where θ_i^* is feasible and θ_{ij}^* is infeasible. The value of total effect, $d_j^* \times \delta_j$, is calculated, where $\delta_j \equiv d_j^{-1} \sum (\theta_{ij}^* - \theta_i^*)$ is the average effect by removing the *j*th DMU.

The higher δ_j indicates that the observation has a great influence on other observations, and the higher d_j^* indicates that the observation impacts more observations in the sample. Hence, the higher $d_j^* \times \delta_j$ represents that the observation will be the potential influential observation and need to be deleted.

Appendix 2E

Table 2E Results of the Identification of Influential Observations

Observations	d_j^*	δ_j	$d_j^* \times \delta_j$
6	6	0.019	0.111
35	30	0.012	0.374
36	33	0.002	0.067
53	117	0.006	0.647
57	0	0	0.000
65	3	0.017	0.051
66	0	0	0.000
82	26	0.007	0.177
83	104	0.013	1.364
84	1	0.158	0.158
96	4	0.000	0.000
104	35	0.016	0.538
111	42	0.008	0.351
113	1	0.106	0.106
114	4	0.006	0.022
125	3	0.004	0.011
129	15	0.007	0.099
130	4	0.265	1.059
131	4	0.030	0.121
144	41	0.007	0.290
146	3	0.003	0.009
151	8	0.003	0.024
157	4	0.000	0.000
158	49	0.004	0.179
159	2	0.011	0.022
160	2	0.005	0.009
161	5	0.014	0.069
178	20	0.006	0.115

Table 2E (*Continued*)

Observation	d_j^*	δ_j	$d_j^* \times \delta_j$
193	8	0.008	0.060
196	60	0.010	0.611
198	25	0.004	0.093
201	34	0.008	0.266
204	31	0.007	0.202
205	169	0.006	1.059
207	2	0.004	0.008
223	34	0.007	0.225
224	10	0.005	0.054
225	28	0.013	0.364
240	4	0.038	0.153
248	68	0.004	0.298
251	60	0.002	0.104
252	3	0.009	0.026
254	53	0.003	0.145
271	55	0.007	0.394
272	1	0.002	0.002
274	35	0.006	0.217
275	2	0.001	0.002
287	32	0.002	0.064
299	4	0.063	0.252
302	28	0.001	0.041
318	23	0.007	0.162

CHAPTER 3　PRODUCTIVITY CHANGE IN TAIWAN'S INTERNATIONAL TOURIST HOTEL INDUSTRY

3.1　Introduction

The growth of travel activities has promoted the upward development of tourism industries worldwide. International tourist hotels are the most critical part of the tourism industry. However, under the rising number of international tourist hotels and the movement of internationalization, the international tourist hotel industry must face the higher and higher competitive pressure. International tourist hotels must improve their managerial performances for sustainable development. Besides investigating the efficiency of international tourist hotels in Taiwan, it is also important to understand the annual changes in the productivity of international tourist hotels. The trend in the productivity of whole international tourist hotel industry needs to be identified. Furthermore, the sources of productivity change need to be investigated. In addition, international tourist hotels must apply different marketing strategies and service methods to serve various visitors. It is worth to study whether the decision of receiving different types of visitors may result in the difference of productivity change or not.

In the multiple-periods, multiple-inputs and multiple-outputs production model, the production technology may change (the efficient frontier may shift) and the partial factor productivity may easily mislead the estimated result of performance. Hence, the total factor productivity (TFP) has to be adopted. The Malmquist productivity approach which is calculated from efficiency scores based on DEA approach has become very popular to estimate the TFP.[14] It is a non-parametric approach that only requires the quantity information and does not need the price information or the assumption on the optimizing behavior. The conventional Malmquist productivity approach was proposed by Caves et al. (1982) and generalized by Färe et al. (1994). Färe et al. (1994) just decomposed the productivity change into two components: technological and efficiency changes, as well as assumed that all variables were variable. The technological change represents that the set of the feasible inputs-outputs combinations expends or contracts. The efficiency change represents that the DMU moves closer to or further away from the efficient frontier. In

[14] The Malmquist productivity approach has been applied in the bank industry (Sathye, 2002; Isik and Hassan, 2003; Park and Weber, 2006a), computer industry (Chen and Ali, 2004), food industry (Kumar and Basu, 2008), semiconductor industry (Liu and Wang, 2008), etc.

addition, they used the conventional DEA approach to compute the distance function in order to measure the Malmquist productivity index (MPI). However, firms cannot adjust all inputs to their optimal value in the short run in practice since they may spend many adjustment costs. If all inputs are assumed to be freely and easily adjusted to their optimal level, firms' adjustments of capacity will be misestimated, the results will be bias, and the DEA approach as working tools will be weakened (Ouellette and Vierstraete, 2004). Banker and Morey (1986) first introduced non-discretionary inputs (or quasi-fixed inputs) into the DEA model to modify the assumption that all variables were variable. Ouellette and Vierstraete (2004) extended the modified DEA approach to calculate the Malmquist productivity index with quasi-fixed inputs in order to correctly measure the productivity change.

Additionally, Grifell-Tatjé and Lovell (1995) showed that if the VRS distance function was directly used to measure the Malmquist productivity index, the results might exist the strong bias. Lambert (1999) further indicated that the results were caused by the neglect of scale effect. The approach proposed by Färe et al. (1994) was doubted that the assumption of production technology was inconsistent in decomposing the factors of productivity change since the measure of scale efficiency implied that the production technology was VRS, but the production technology was measured by CRS. Hence, Ray and Desli (1997) and Balk (2001) suggested that the production technology should be measured by VRS, and then the method of measuring the scale efficiency change should be modified, simultaneously. Balk (2001) also modified the conventional method by applying the bottoms-up method to decompose the factors of productivity change, whereas the conventional Malmquist productivity index used the top-down method. He argued that the input-mix and output-mix also played a special role in measuring the productivity change under the multiple-inputs and multiple-outputs framework. He attempted to develop the meaningful channels of movements from the initial production activity to the final production activity and collected those to construct the encompassing measures of productivity change.

Furthermore, the conventional DEA cannot filter out the external factors. Theoretically, both internal and external factors can affect pure technical efficiency measures. The former is under the control of DMUs. The latter includes exogenous factors and random noise that are not under the control of DMUs. In order to accurately assess the productivity of each DMU, this paper uses the three-stage DEA with quasi-fixed inputs and adopts the decomposition method proposed by Balk (2001) to calculate the Malmquist productivity index.

Although a great deal of existing literature applies the DEA approach to evaluate the efficiency in the hotel industry, a little literature tries to investigate the productivity change in this industry. Hwang and Chang (2003) used DEA to investigate the efficiency and the productivity changes of 45 international tourist hotels in Taiwan based on the 1994-1998 data. Barros and Alves (2004) applied DEA to analyze the efficiency and productivity change of a Protuguese public-owned hotel chain during the period 1999 to 2001. Assaf and Barros (2011) utilized DEA to investigate the productivity growth of hotel chains from the UAE, Saudi Arabia and Oman during the period 2006 to 2008. However, Hwang and Chang (2003), Barros and Alves (2004) and Assaf and Barros (2011) did not consider the existence of quasi-fixed inputs, exogenous factors and random noise. This paper may first apply the three-stage DEA with quasi-fixed inputs and adopt the decomposition method proposed by Balk (2001) to evaluate the productivity change of international tourist hotels.

In addition to the introduction, the rest of this chapter is organized as follows. Section 2 establishes the empirical model to measure the productivity change. A description of the data and empirical results are presented in Section 3. Section 4 is a conclusion.

3.2 Methodology

Since the conventional Malmquist productivity index generalized by Färe et al. (1994) does not consider the impacts of exogenous factors and random noise and the existence of quasi-fixed inputs, this paper adopts the modified Malmquist productivity index with quasi-fixed inputs based on the three-stage DEA model. To carefully illustrate the method of calculating the Malmquist productivity index, this section is divided into two parts. In the first part, the input distance function is introduced to derive the Malmquist index. In the second part, the Malmquist productivity index is described. It is applied to measure the productivity change and decomposed into the technological change (TC), pure technical efficiency change (PTEC), scale efficiency change (SEC) and input-mix effect (IME).

3.2.1 The Distance Function

The distance functions proposed by Shephard (1970) can be divided into the input distance function and output distance function.[15] The input distance function is used for this paper since the revenues of international tourist hotels are highly related to conditions in the

[15] An input distance function considers a minimal proportional contraction of the input vector, given an output vector; an output distance function considers a maximal proportional expansion of the output vector, given an input vector (Coelli et al., 1998).

external environment and the input usages are flexibly adjusted. In addition, there are quasi-fixed inputs in international tourist hotels. This paper incorporates quasi-fixed inputs into the input distance function according to Ouellette and Vierstraete (2004, 2010).[16] Hence, the modified input distance function can be written as follows:

$$D_i(x, k, y) = \max\{\delta : (x/\delta, k, y) \in T\} \tag{3-1}$$

where x is the vector of *M* variable inputs; k is the vector of *R* quasi-fixed inputs; y is the vector of *S* outputs; δ is the ratio of the vector of variable inputs to the frontier of production represented by *T*; $T = \{x, k : x, k \text{ } can \text{ } produce \text{ } y\}$ is the set which represents the feasible inputs-outputs combinations.

Following Färe et al. (1994), the input distance function is the reciprocal of the measure of technical efficiency based on the input-oriented DEA model. Hence, suppose that there are *N* international tourist hotels in this market, each using *M* variable inputs and *R* quasi-fixed inputs to produce *S* outputs. Let x_{mn}, k_{rn} and y_{sn} denote the *m*th (*m*=1, 2,…, *M*) variable input usage, the *r*th (*r*=1, 2,…, *R*) quasi-fixed input usage and the *s*th (*s*=1, 2,…, *S*) output production of the *n*th (*n*=1, 2,…, *N*) international tourist hotel. The input distance function where a production point from period *s* is compared to the technology in period *t* can be obtained by solving the following model:[17]

$$\left[D_i^t(x^s, k^s, y^s)\right]^{-1} = \min_{\theta_i^{CRS}, \lambda_1, \ldots, \lambda_N} \theta_i^{CRS} \tag{3-2}$$

subject to

$$\sum_{n=1}^{N} \lambda_n x_{mn}^t \le \theta_i x_{mi}^s, \; m = 1, 2, \ldots, M \tag{3-3}$$

$$\sum_{n=1}^{N} \lambda_n k_{rn}^t \le k_{ri}^s, \; r = 1, 2, \ldots, R \tag{3-4}$$

$$\sum_{n=1}^{N} \lambda_n y_{sn}^t \ge y_{si}^s, \; s = 1, 2, \ldots, S \tag{3-5}$$

$$\lambda_n \ge 0, \; n = 1, 2, \ldots, N \tag{3-6}$$

[16] Banker and Morey (1986) and Ruggiero (1996, 1998) introduced insights on DEA models including non-discretionary variables.

[17] This model is similar to the technical efficiency model obtained in Section 2.2. The only difference is that this model is added to time subscripts, *t* and *s*, to represent two different time periods.

However, the above model applies the original input-output data to calculate θ_i^{CRS}. In order to purge the impacts from exogenous factors and random noise, SFA is used to obtain adjusted variable inputs, $\tilde{x}$, in the second stage of the three-stage DEA. According to the adjustment process built by Equation (2-6) and (2-7) in Section 2.2, the adjusted variable inputs can be obtained. Finally, in order to yield more accurate values, the data of the adjusted variable inputs, original quasi-fixed inputs and original outputs are used to the input distance function to measure the Malmquist productivity index.

3.2.2 The Malmquist Productivity Index

The modified input distance function that eliminates external effects and considers the existence of quasi-fixed inputs is further applied to calculate the Malmquist productivity index. According to Ouellette and Vierstraete (2004, 2010), quasi-fixed inputs are incorporated into the Malmquist productivity index to measure the productivity change. This paper uses the bottoms-up method to decompose the factors of productivity change according to Balk (2001). First, the technological change that the set of feasible inputs-outputs combinations expends or contracts under the assumption of the reference technology exhibiting VRS can be written as:

$$TC = \left[\frac{D_{iVRS}^{t+1}(\tilde{x}^t, k^t, y^t)}{D_{iVRS}^{t}(\tilde{x}^t, k^t, y^t)} \times \frac{D_{iVRS}^{t+1}(\tilde{x}^{t+1}, k^{t+1}, y^{t+1})}{D_{iVRS}^{t}(\tilde{x}^{t+1}, k^{t+1}, y^{t+1})} \right]^{1/2} \tag{3-7}$$

where $TC > 1$ represents the technological progress, whereas $TC < 1$ represents the technological regress.

Second, the pure technical efficiency change that the DMU moves closer to or further away from the efficient frontier based on the assumption of the reference technology exhibiting VRS can be expressed as:

$$PTEC = \frac{D_{iVRS}^{t}(\tilde{x}^t, k^t, y^t)}{D_{iVRS}^{t+1}(\tilde{x}^{t+1}, k^{t+1}, y^{t+1})} \tag{3-8}$$

where $PTEC > 1$ represents the pure technical efficiency improvement, whereas $PTEC < 1$ represents the pure technical efficiency deterioration.

Third, the scale efficiency change that the DMU moves closer to or further away from the optimal scale can be written as:

$$SEC=\left[\frac{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t+1})/D^{t}_{iCRS}(\tilde{x}^{t},k^{t},y^{t+1})}{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t})/D^{t}_{iCRS}(\tilde{x}^{t},k^{t},y^{t})}\times\frac{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})/D^{t+1}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t})/D^{t+1}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t})}\right]^{1/2} \tag{3-9}$$

where $SEC>1$ represents the scale efficiency improvement, whereas $SEC<1$ represents the scale efficiency deterioration.

Finally, the input-mix effect that represents the difference in input-mix between period *t* and period *t*+1 can be expressed as:

$$IME=\left[\frac{D^{t}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})/D^{t}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t+1})/D^{t}_{iCRS}(\tilde{x}^{t},k^{t},y^{t+1})}\times\frac{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t})/D^{t+1}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t})}{D^{t+1}_{iVRS}(\tilde{x}^{t},k^{t},y^{t})/D^{t+1}_{iCRS}(\tilde{x}^{t},k^{t},y^{t})}\right]^{1/2} \tag{3-10}$$

where $IME>1$ represents that the input combination in period *t+1* lies closer to the optimal scale, whereas $IME<1$ represents that the input combination in period *t+1* lies further away from the optimal scale.

Thus, the productivity change can be combined by the independent factors of technological change, pure technical efficiency change, scale efficiency change and input-mix effect. It can be expressed as:

$$\begin{aligned}
MPI &= TC\times PTEC\times SEC\times IME\\
&=\left[\frac{D^{t+1}_{iVRS}(\tilde{x}^{t},k^{t},y^{t})}{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t})}\times\frac{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}{D^{t}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}\right]^{1/2}\times\frac{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t})}{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}\\
&\times\left[\frac{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t+1})/D^{t}_{iCRS}(\tilde{x}^{t},k^{t},y^{t+1})}{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t})/D^{t}_{iCRS}(\tilde{x}^{t},k^{t},y^{t})}\times\frac{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})/D^{t+1}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t})/D^{t+1}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t})}\right]^{1/2}\\
&\times\left[\frac{D^{t}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})/D^{t}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}{D^{t}_{iVRS}(\tilde{x}^{t},k^{t},y^{t+1})/D^{t}_{iCRS}(\tilde{x}^{t},k^{t},y^{t+1})}\times\frac{D^{t+1}_{iVRS}(\tilde{x}^{t+1},k^{t+1},y^{t})/D^{t+1}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t})}{D^{t+1}_{iVRS}(\tilde{x}^{t},k^{t},y^{t})/D^{t+1}_{iCRS}(\tilde{x}^{t},k^{t},y^{t})}\right]^{1/2}\\
&=\left[\frac{D^{t}_{iCRS}(\tilde{x}^{t},k^{t},y^{t})}{D^{t}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}\times\frac{D^{t+1}_{iCRS}(\tilde{x}^{t},k^{t},y^{t})}{D^{t+1}_{iCRS}(\tilde{x}^{t+1},k^{t+1},y^{t+1})}\right]^{1/2}
\end{aligned} \tag{3-11}$$

where $MPI>1$ represents the productivity growth, whereas $MPI<1$ represents the productivity deterioration.

3.3 Data Description and Empirical Results

3.3.1 Data Description

The data used in this paper are based on Taiwan's international tourist hotels operated from 2003 to 2009. They were conducted by the Annual Operation of the International Tourist Hotels, published by the Tourist Bureau, Ministry of Transportation and Communications, ROC. After discarding incomplete observations, 47 international tourist hotels are remained and are listed in Appendix 2A. Following Section 2.3.1, guest room revenue, F&B revenue and other revenue are chosen as output variables, as well as guest room, labor, F&B expense and other expense are chosen as input variables. The guest room is represented as the quasi-fixed input. Guest room revenue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year. The consumer and wholesale price indices are published by the Directorate-General of Budget, Accounting and Statistics of Executive Yuan, ROC. The definitions of the output and input variables mentioned are summarized in Appendix 2B. The descriptive statistics of output and input variables every year is presented in Table 3.1. The values of variable inputs and outputs first increase and then decrease during the period of 2003-2009, approximately. The average number of guest rooms is within the range of 315 to 317 rooms in the sample period. The number of guest rooms in each international tourist hotel is constant during the period 2004 to 2005.

3.3.2 Empirical Results

The Malmquist productivity index calculated by the three-stage DEA model with the quasi-fixed input is applied to measure the productivity change. Since the result of obtaining adjusted variables is the same with the second stage in Section 2.3.2, only the first and third stages are described in this chapter.

The first stage. First, the effect of quasi-fixed input is investigated. The comparison between the measures of productivity change estimated by the Malmquist productivity index without the quasi-fixed and adjusted inputs (Model 4) as well as those estimated by the Malmquist productivity index with the quasi-fixed input and without adjusted inputs (Model 5) is presented in Table 3.2. Following Atkinson and Wilson (1995) as well as Ferrier and Hirschberg (1997), the bootstrap method proposed by Efron (1979) is applied to test whether the measures are significantly different from 1 or not. The process is briefly described in Appendix 3A. Following the process, the bias-corrected and accelerated (BCa) confidence interval is constructed by repeating 3000 times.[18] The results show that the trend in the mean measures of productivity change estimated by Model 4 and 5 are consistent. The initial increase in productivity during the period of 2003-2005 has been compensated by a decrease during the period of 2007-2009. However, the productivity measures estimated by Model 5 are larger margins in the growth and deterioration than those estimated by Model 4, implying that the productivity change will enlarge when the quasi-fixed input is incorporated into the model. The Malmquist productivity index without quasi-fixed and adjusted inputs underestimates the productivity changes of international tourist hotels. Hence, the necessity of considering the existence of the quasi-fixed input is justified.

For decomposition effects of the change in the productivity, the productivity growth during the period 2003 to 2004 and deterioration during the period 2008 to 2009 result from the technological progress and regress, as well as the productivity growth during the period 2004 to 2005 originates from the pure technical efficiency improvement, regardless of Model 4 or 5. However, the source of productivity deterioration during the period 2007 to 2008 is uncertain based on Model 4, but the productivity deterioration during the period 2007 to 2008 results from the input-mix effect based on Model 5.

The third stage. The third stage re-evaluates the measures of productivity change by using the adjusted variable input data calculated in the second stage. Similarly, the comparison between the measures of productivity change estimated by Model 5 and those estimated by the Malmquist productivity index with quasi-fixed and adjusted inputs (Model 6) is presented in Table 3.3. The bootstrap method is also utilized to test whether the measures are significantly different from 1 or not. The results indicate that the trend in the mean measures of productivity change estimated by Model 5 and 6 are consistent. The initial increase in productivity during the period of 2003-2005 has been compensated by a decrease during the period of 2007-2009. However, the productivity measures estimated by Model 6 are larger margins in the growth and deterioration than those estimated by Model 5, implying that the productivity change will enlarge when the effects of external factors are eliminated from the model. The Malmquist productivity index with the quasi-fixed input and without adjusted

[18] Atkinson and Wilson (1995) argued that the repeated time must more than the square of the sample size, when the BCa confidence interval was estimated. Hence, this paper chooses 3000 times to estimate the confidence interval.

inputs underestimates the productivity changes of international tourist hotels. Hence, the necessity of adopting the three-stage approach is justified.

However, the key factors of the movement in the productivity estimated by Model 5 and 6 are different. The productivity growth or deterioration estimated by Model 6 mainly results from the technological progress or regress and the scale efficiency improvement or deterioration during the period 2003 to 2009. The reasons of an increase or a decrease in the productivity estimated by Model 5 are irrelative with the scale efficiency except during the period 2004 to 2005. It implies that the sources of productivity change will be misestimated when the impacts of exogenous variables and statistical noise are not sorted out. The necessity of adjusting inputs is justified.

Productivity change comparison among international tourist hotels with different types of visitors. This chapter also divides visitors into three types: an international tourist hotel serves group visitors more than 75% in total visitors (TYPE 1); an international tourist hotel serves individual visitors more than 75% in total visitors (TYPE 2) and others (TYPE 3), in order to investigate whether the productivity changes among different types of visitors are different or not. The bootstrap method is also utilized to test whether the measures among different types of visitors are significantly different from 1 or not. In Table 3.4, the results show that the productivities of TYPE 1, TYPE 2 and TYPE 3 are increased during the period of 2003-2005, but the productivity of TYPE 2 is decreased during the period of 2005-2006 and 2007-2009 as well as that of TYPE 3 is decreased during the period of 2007-2009. Moreover, the rate of an increase in the productivity of TYPE 1 is the greatest, and that of TYPE 2 is the lowest. The rate of a decrease in the productivity of TYPE 3 is lower than that of TYPE 2 during the period of 2007-2009. A possible reason for this outcome is that the efficiency of TYPE 1 is lower than other types so that international tourist hotels with mainly receiving group visitors have an ample space to improve their productivity or pay more attention to decreasing the productivity deterioration.

Furthermore, the components of the change in the productivity of three types are decomposed. The productivity growth of TYPE 1 mainly originates in the scale efficiency improvement. The productivity growth or deterioration of TYPE 2 mainly results from the scale efficiency improvement or deterioration, beside the main source of productivity growth during period 2003 to 2004 is the technological progress. The productivity growth or deterioration of TYPE 3 mainly originates in the technological progress or regress and the scale efficiency improvement or deterioration. The results imply that the sources of productivity changes among three types of visitors are different, but the scale efficiency change plays an important role in all types.

3.4 Conclusions

Under the rising number of international tourist hotels and the movement of internationalization, the international tourist hotel industry must face the higher and higher competitive pressure. In order to survive, how to improve managerial performances of international tourist hotels is a more and more important issue. Hence, this paper further evaluates the productivity changes of international tourist hotels. To accurately examine the productivity change of international tourist hotels in Taiwan, the Malmquist productivity index with quasi-fixed inputs computed by the three-stage DEA approach is used to discuss the productivity change based on the 2003-2009 data conducted by the Annual Operation of the International Tourist Hotels.

The first stage uses the data of original variable inputs, quasi-fixed input and outputs to measure the productivity changes of international tourist hotels. The results show that the Malmquist productivity index without quasi-fixed and adjusted inputs underestimates the productivity change so as to justify the necessity of considering the existence of the quasi-fixed input. After adjusting the variable input data from the SFA results in the second stage, the productivity index in the third stage shows that the initial increase in productivity has been compensated by a decrease. The productivity growth or deterioration mainly results from the technological progress or regress and the scale efficiency improvement or deterioration during the period of 2003-2009. The results also show that the Malmquist productivity index with the quasi-fixed input and without adjusted inputs underestimates the productivity change. The key factors of productivity changes estimated by the Malmquist productivity index with the quasi-fixed input and without adjusted inputs as well as those estimated by the Malmquist productivity index with quasi-fixed and adjusted inputs are different so as to justify the usage of the three-stage approach. Finally, international tourist hotels with mainly receiving group visitors have the better improvement of productivity than those with receiving simultaneously group and individual visitors as well as mainly receiving individual visitors, because international tourist hotels have an ample space to improve their productivity or pay more attention to decreasing the productivity deterioration. The sources of productivity changes among three types of visitors are different, but the scale efficiency change plays an important role in all types.

Some important lessons may emerge directly from the empirical results in this chapter. First of all, for studies of the productivity change to be more informative to decision and policy makers, the Malmquist productivity index estimated by the three-stage DEA approach with quasi-fixed inputs should be adopted to control the impacts of exogenous factors, statistic noise and quasi-fixed inputs. Second, managers may have to appropriately adjust the operating scale since the productivity changes of international tourist hotels mainly originate in the scale efficiency changes. Finally, the information about service qualities, the form of ownership, labor relations and the data of ordinary tourist hotels might be needed for the empirical results to be more reliable and the policy implications to be more meaningful.

Table 3.1 Descriptive Statistics of Output and Input Variables

Year	Variables	Mean	SD	Maximum	Minimum
	Guest room revenue	2,232.985	1,874.876	10,374.229	255.342
	F&B revenue	2,763.579	2,506.037	10,322.856	51.874
	Other revenue	516.797	767.392	3,572.228	2.051
2003	Guest room	315.532	160.457	873	50
	Labor	326.021	219.177	945	59
	F&B expense	1,064.289	861.347	3,527.770	32.942
	Other expense	1,496.708	1,394.773	8,114.614	103.500
	Guest room revenue	2,626.100	2,346.445	13,417.715	324.600
	F&B revenue	2,889.335	2,655.362	11,176.602	78.233
	Other revenue	636.729	871.168	3,842.579	2.627
2004	Guest room	316.766	159.863	873	50
	Labor	326.277	214.757	952	59
	F&B expense	1,017.784	787.015	3,232.532	29.743
	Other expense	1,561.376	1,630.939	10,293.711	112.196
	Guest room revenue	2,870.068	2,486.669	14,042.570	368.824
	F&B revenue	3,207.661	2,948.041	12,200.963	85.418
	Other revenue	670.097	904.529	3,799.908	3.404
2005	Guest room	316.766	159.863	873	50
	Labor	334.468	221.219	934	60
	F&B expense	1,185.191	956.586	3,682.263	49.074
	Other expense	1,676.452	1,797.138	10,848.029	240.993
	Guest room revenue	2,918.335	2,672.267	14,684.076	349.236
	F&B revenue	3,083.987	2,954.774	11,514.368	83.767
	Other revenue	650.529	903.480	3,708.486	0.108
2006	Guest room	316.766	159.797	873	50
	Labor	335.660	223.025	982	64
	F&B expense	1,086.191	928.158	3,346.855	45.822
	Other expense	1,654.621	1,774.209	10,571.352	221.786

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 3.1 (*Continued*)

Year	Variables	Mean	SD	Maximum	Minimum
	Guest room revenue	2,868.628	2,761.359	14,786.037	342.959
	F&B revenue	3,049.399	3,125.591	12,019.735	87.150
	Other revenue	660.698	920.901	3,918.250	3.403
2007	Guest room	316.681	159.701	873	50
	Labor	336.255	218.892	912	53
	F&B expense	1,015.647	896.809	3,325.283	33.502
	Other expense	1,638.219	1,751.715	9,890.515	129.830
	Guest room revenue	2,663.324	2,517.997	12,998.162	266.078
	F&B revenue	2,988.088	3,003.055	11,672.933	80.305
	Other revenue	614.072	939.934	4,171.961	3.255
2008	Guest room	316.638	159.403	865	50
	Labor	338.255	222.480	868	53
	F&B expense	980.051	856.293	3,160.315	41.885
	Other expense	1,539.628	1,499.741	8,393.132	124.546
	Guest room revenue	2,425.938	2,221.627	11,149.871	279.082
	F&B revenue	2,717.550	2,858.161	12,502.824	75.026
	Other revenue	570.996	951.474	4,540.527	2.380
2009	Guest room	315.617	159.430	865	50
	Labor	327.255	215.214	856	55
	F&B expense	938.867	860.636	3,671.750	43.568
	Other expense	1,599.875	1,568.680	7,778.290	217.396

Note: 1. Guest room revenue, F&B revenue, other revenue, F&B expense and other expense are measured in terms of hundred thousand NT dollars.

2. Guest room reveneue, F&B revenue and other revenue are deflated by the consumer price index with 2006 as the base year. F&B expense and other expense are deflated by the wholesale price index with 2006 as the base year.

Table 3.2 Comparison of Productivity Indices with and without Quasi-Fixed Input

Year	Model 4				
	MPI	TC	PTEC	SEC	IME
2003/04	1.091**	1.107**	0.993	0.997	0.996
	(0.031, 0.122)	(0.084, 0.134)	(-0.039, 0.018)	(-0.021, 0.015)	(-0.047, 0.013)
2004/05	1.033**	0.983	1.052**	1.003	0.997
	(0.000, 0.078)	(-0.048, 0.005)	(0.028, 0.080)	(-0.014, 0.013)	(-0.012, 0.015)
2005/06	1.012	1.012	0.975**	1.018	1.007
	(-0.025, 0.046)	(-0.069, 0.060)	(-0.056, -0.008)	(-0.013, 0.121)	(-0.011, 0.020)
2006/07	1.026	1.096**	0.975**	0.948**	1.013**
	(-0.006, 0.053)	(0.054, 0.159)	(-0.054, -0.004)	(-0.125, -0.020)	(0.004, 0.025)
2007/08	0.972**	1.005	0.999	0.974	0.994
	(-0.061, -0.000)	(-0.027, 0.114)	(-0.017, 0.014)	(-0.130, 0.002)	(-0.019, 0.004)
2008/09	0.937**	0.920**	1.010	1.000	1.009
	(-0.092, -0.024)	(-0.102, -0.069)	(-0.013, 0.034)	(-0.013, 0.014)	(-0.006, 0.033)
Year	Model 5				
	MPI	TC	PTEC	SEC	IME
2003/04	1.156**	1.184**	0.995	0.978	1.003
	(0.082, 0.227)	(0.118, 0.257)	(-0.037, 0.021)	(-0.082, 0.024)	(-0.035, 0.035)
2004/05	1.046**	1.032	1.051**	0.958**	1.006
	(0.005, 0.096)	(-0.020, 0.130)	(0.027, 0.080)	(-0.127, -0.003)	(-0.044, 0.066)
2005/06	0.995	1.048**	0.969**	0.972	1.009
	(-0.048, 0.034)	(0.007, 0.166)	(-0.065, -0.013)	(-0.133, 0.002)	(-0.014, 0.027)
2006/07	1.033	1.078**	0.973**	0.989	0.995
	(-0.002, 0.063)	(0.040, 0.144)	(-0.055, -0.006)	(-0.075, 0.011)	(-0.051, 0.022)
2007/08	0.958**	0.974	1.004	1.002	0.978**
	(-0.084, -0.011)	(-0.069, 0.019)	(-0.012, 0.018)	(-0.018, 0.028)	(-0.063, -0.002)
2008/09	0.929**	0.903**	1.012	1.003	1.014**
	(-0.104, -0.033)	(-0.137, -0.070)	(-0.011, 0.037)	(-0.023, 0.020)	(0.000, 0.041)

Notes: 1. The values in the table are the geometric mean.

2. The numbers in parentheses are confidence intervals.

3. ** represents that the coefficients are significantly different from 1 at the 0.05 level.

Table 3.3 Comparison of Productivity Indices with and without Adjusted Inputs

Year	Model 5				
	MPI	TC	PTEC	SEC	IME
2003/04	1.156**	1.184**	0.995	0.978	1.003
	(0.082, 0.227)	(0.118, 0.257)	(-0.037, 0.021)	(-0.082, 0.024)	(-0.035, 0.035)
2004/05	1.046**	1.032	1.051**	0.958**	1.006
	(0.005, 0.096)	(-0.020, 0.130)	(0.027, 0.080)	(-0.127, -0.003)	(-0.044, 0.066)
2005/06	0.995	1.048**	0.969**	0.972	1.009
	(-0.048, 0.034)	(0.007, 0.166)	(-0.065, -0.013)	(-0.133, 0.002)	(-0.014, 0.027)
2006/07	1.033	1.078**	0.973**	0.989	0.995
	(-0.002, 0.063)	(0.040, 0.144)	(-0.055, -0.006)	(-0.075, 0.011)	(-0.051, 0.022)
2007/08	0.958**	0.974	1.004	1.002	0.978**
	(-0.084, -0.011)	(-0.069, 0.019)	(-0.012, 0.018)	(-0.018, 0.028)	(-0.063, -0.002)
2008/09	0.929**	0.903**	1.012	1.003	1.014**
	(-0.104, -0.033)	(-0.137, -0.070)	(-0.011, 0.037)	(-0.023, 0.020)	(0.000, 0.041)
Year	Model 6				
	MPI	TC	PTEC	SEC	IME
2003/04	1.172**	1.062**	1.008**	1.099**	0.997
	(0.115, 0.211)	(0.029, 0.120)	(0.003, 0.018)	(0.037, 0.141)	(-0.021, 0.024)
2004/05	1.100**	1.031**	1.002	1.052	1.013
	(0.063, 0.141)	(0.011, 0.090)	(-0.000, 0.007)	(-0.012, 0.101)	(-0.006, 0.065)
2005/06	0.980	0.998	0.999	0.964**	1.019
	(-0.045, 0.033)	(-0.014, 0.014)	(-0.005, 0.000)	(-0.085, -0.018)	(-0.006, 0.108)
2006/07	0.971	1.032**	0.997**	0.967**	0.976**
	(-0.065, 0.003)	(0.007, 0.079)	(-0.011, -0.000)	(-0.080, -0.001)	(-0.061, -0.008)
2007/08	0.936**	1.000	1.000	0.937**	0.999
	(-0.110, -0.044)	(-0.022, 0.047)	(-0.004, 0.001)	(-0.100, -0.040)	(-0.022, 0.011)
2008/09	0.926**	0.983**	1.001	0.943**	0.998
	(-0.118, -0.048)	(-0.037, -0.006)	(-0.002, 0.004)	(-0.090, -0.031)	(-0.008, 0.005)

Notes: 1. The values in the table are the geometric mean.

2. The numbers in parentheses are confidence intervals.

3. ** represents that the coefficients are significantly different from 1 at the 0.05 level.

Table 3.4 Comparison of the Adjusted Productivity Indices among Different Types of Visitors

Year	MPI	TC	PTEC	SEC	IME
			TYPE 1		
Year	MPI	TC	PTEC	SEC	IME
2003/04	1.391**	1.002**	1.005	1.401**	0.986**
	(0.304, 0.362)	(0.001, 0.003)	(-0.000, 0.015)	(0.301, 0.383)	(-0.019, -0.007)
2004/05	1.253**	1.011	1.012	1.231**	0.995
	(0.103, 0.460)	(-0.002, 0.036)	(-0.000, 0.037)	(0.112, 0.388)	(-0.009, 0.000)
2005/06	0.990	0.999	0.988	1.001	1.001
	(-0.041, 0.058)	(-0.002, 0.001)	(-0.023, 0.000)	(-0.033, 0.048)	(-0.001, 0.004)
2006/07	0.924	1.001	0.977	0.959	0.985**
	(-0.213, 0.011)	(-0.001, 0.003)	(-0.046, 0.000)	(-0.116, 0.017)	(-0.028, -0.004)
2007/08	0.935	0.999**	1.005	0.907**	1.027**
	(-0.128, 0.043)	(-0.001, -0.001)	(-0.000, 0.016)	(-0.141, -0.012)	(0.009, 0.057)
2008/09	0.994	0.997**	1.005	1.006	0.985**
	(-0.060, 0.070)	(-0.005, -0.000)	(-0.000, 0.027)	(-0.059, 0.091)	(-0.035, -0.003)
			TYPE 2		
Year	MPI	TC	PTEC	SEC	IME
2003/04	1.154**	1.071**	1.011**	1.064	1.001
	(0.075, 0.213)	(0.027, 0.157)	(0.002, 0.036)	(-0.042, 0.130)	(-0.028, 0.071)
2004/05	1.077**	1.003	1.000	1.083**	0.992
	(0.041, 0.138)	(-0.003, 0.018)	(-0.001, 0.000)	(0.034, 0.155)	(-0.029, 0.006)
2005/06	0.955**	0.997	1.001	0.968**	0.989
	(-0.097, -0.018)	(-0.019, 0.002)	(-0.000, 0.003)	(-0.055, -0.013)	(-0.061, 0.003)
2006/07	0.976	0.997	1.001	0.999	0.980**
	(-0.076, 0.066)	(-0.014, 0.003)	(-0.000, 0.005)	(-0.051, 0.082)	(-0.054, -0.005)
2007/08	0.896**	1.012	1.003	0.903**	0.978
	(-0.282, -0.043)	(-0.043, 0.133)	(-0.000, 0.014)	(-0.188, -0.051)	(-0.113,0.010)
2008/09	0.874**	0.991	1.003**	0.873**	1.006
	(-0.301, -0.064)	(-0.030, 0.003)	(0.001, 0.008)	(-0.270, -0.073)	(-0.002, 0.016)
			TYPE 3		
Year	MPI	TC	PTEC	SEC	IME
2003/04	1.162**	1.062**	1.006**	1.094**	0.995
	(0.093, 0.235)	(0.020, 0.183)	(0.002, 0.014)	(0.002, 0.146)	(-0.028, 0.022)

Notes: 1. The values in the table are the geometric mean.

2. The numbers in parentheses are confidence intervals.

3. ** represents that the coefficients are significantly different from 1 at the 0.05 level.

Table 3.4 (*Continued*)

Year	TYPE 3				
	MPI	TC	PTEC	SEC	IME
2004/05	1.097**	1.047**	1.002	1.022	1.024
	(0.051, 0.159)	(0.016, 0.146)	(-0.000, 0.010)	(-0.062, 0.095)	(-0.004, 0.101)
2005/06	0.995	0.999	1.000	0.956**	1.041
	(-0.042, 0.093)	(-0.024, 0.025)	(-0.002, 0.001)	(-0.127, -0.014)	(-0.001, 0.198)
2006/07	0.974	1.050**	0.999	0.956**	0.973**
	(-0.070, 0.014)	(0.013, 0.124)	(-0.005, 0.000)	(-0.109, -0.005)	(-0.084, -0.003)
2007/08	0.950**	0.996	0.998	0.951**	1.004
	(-0.077, -0.030)	(-0.026, 0.065)	(-0.009, 0.000)	(-0.097, -0.025)	(-0.008, 0.017)
2008/09	0.922**	0.977**	0.999	0.946**	1.000
	(-0.128, -0.052)	(-0.054, -0.006)	(-0.006, 0.002)	(-0.085, -0.032)	(-0.001, 0.009)

Notes: 1. The values in the table are the geometric mean.

2. The numbers in parentheses are confidence intervals.

3. ** represents that the coefficients are significantly different from 1 at the 0.05 level.

Appendix 3A

The bootstrap method is proposed by Efron (1979). According to Atkinson and Wilson (1995) that apply this method to estimate the confidence interval of productivity, the procedure is briefly illustrated in this appendix. A more complete description refers to Atkinson and Wilson (1995). Suppose a random sample $\{z_n\}_{n=1}^{N}$, the following steps derive the bootstrap estimate of the confidence interval of productivity:

1. Calculate the sample mean $\bar{z} = \sum_{n=1}^{N} z_n \Big/ N$.

2. Calculate $\tilde{z}_n = z_n \cdot \sqrt{N/(N-1)} + \bar{z}(1-\sqrt{N/(N-1)})$.

3. Independently and fairly draw and replace N times from the set $\{\tilde{z}_n\}_{n=1}^{N}$ and obtain new set $\{z_n^*\}_{n=1}^{N}$.

4. Calculate the new sample mean $\bar{z}^* = \sum_{n=1}^{N} z_n^* \Big/ N$.

5. Repeat steps 3 to 4 Q times to obtain $\{\bar{z}_q^*\}_{q=1}^{Q}$, where Q is suitably large in the size.

6. Values in $\{\bar{z}_q^*\}_{q=1}^{Q}$ can be arranged by the algebraic value to infer the confidence interval.

The confidence interval for the mean score can be constructed by using the normal based method, the bootstrap percentile method (Efron, 1982) or the BCa method (Efron and Tibshirani, 1993). Following the suggestion of Atkinson and Wilson (1995), the BCa method is used in this paper.

CHAPTER 4 PROFITABILITY IN TAIWAN'S INTERNATIONAL TOURIST HOTEL INDUSTRY

4.1 Introduction

With economic growth, the improvement of living standards, the rising trend of international free trade in recent years, international travel activities have grown rapidly (see Figure 1.1). Since the prohibition of building tourist hotels in Taiwan was deregulated in 1977 to encourage building new international tourist hotels, the number of international tourist hotels had the rising trend and international hotel groups entered Taiwan's market (see Figure 1.3). The average net operating profit margin in the international tourist hotel industry appeared a tendency that first increased and then decreased (see Table 1.2). However, the average degree of market concentration and the average market share did not significantly change during the period of 2001-2009 (see Table 1.2). It shows that the market structure might not the sole determinant of profitability in the international tourist hotel industry. Hence, what are the important determinants of profitability in Taiwan's international tourist hotel industry? Is the market structure in the whole industry, the relative market power of individual hotel, the efficiency of individual hotel or other factors? This paper tries to use a more conscientious method and model to find out possible answers for the above question.

The relationship between the market structure and profitability is investigated in various empirical papers and can be divided into two theories. One is the market power theory. An increase in the profitability is attributed to the rising market power. The market power theory can be further divided into two categories: the structure-conduct-performance and the relative market power hypotheses. The structure-conduct-performance hypothesis asserts that the degree of market concentration is the proxy for market power, and firms can charge higher price to obtain higher profit since the higher degree of market concentration can decrease collusion costs among firms. The relative market power hypothesis states that only firms with higher market shares or product differentiation can apply their market power to set higher prices and obtain extra profits (Shepherd, 1982). It is implied that the firm's market share is the proxy for market power.

Another is the efficient structure theory. The higher profit is due to efficiency improvements. The efficient firms have the competitive advantage to obtain higher market share and profitability, and further lead to the higher degree of market concentration. The efficiency simultaneously affects the market structure and firms' profits, and thus explains the positive relationship between the profitability and market structure (Demsetz, 1973, 1974; Peltzman, 1977). The efficient structure theory also can be divided into two categories: the X-efficiency and the scale efficiency hypotheses. The X-efficiency hypothesis asserts that lower costs and higher profit are achieved through the superior management or production process. The scale-efficiency hypothesis states that firms have the similar production and management technology, but the different scale efficiency. The difference in profitability among firms originates in the difference in scale efficiency.

The implications for the merger and acquisition as well as antitrust policy are different between the market power and efficient structure theories. Under the market power theory, mergers are motivated by enhancing firms' market power so as to reduce the social welfare. Hence, the supporters trend to encourage the antitrust policy. Under the efficient structure theory, mergers are motivated by increasing efficiency so as to enhance the social welfare. Hence, the supporters should not sustain the antitrust policy.

The early literature focused on the structure-conduct-performance hypothesis.[19] However, later papers found that the relationship between the market share and profitability was significantly positive, while the relationship between the market concentration and profitability was not significant. The positive relationship between the market share and profitability has two different interpretations. Smirlock et al. (1984, 1986), Smirlock (1985), Evanoff and Fortier (1988) as well as Molyneux and Forbes (1995) argued that the market share was the proxy for efficiency. An increase in firms' efficiency could reduce their costs and gain more market share, and further increase the profitability. Hence, the efficient structure theory is supported. Shepherd (1982, 1986) as well as Berger (1995) doubted the validity of using the market share as the proxy for efficiency since market share might be affected by other variables rather than the efficiency. Hence, the relative market power hypothesis is supported. Recent papers trended to use direct measures of efficiency in response to this dispute and many empirical results supported the efficient structure theory.[20] These main methods of directly evaluating efficiency measures are SFA and DEA.

[19] Gilbert (1984) collected 44 papers to discuss the relationship between market concentration and profitability in the bank industry, and found that just over half supported the structure-conduct-performance hypothesis.
[20] For example, Berger (1995), Goldberg and Rai (1996), Maudos (1998), Mendes and Rebelo (2003), Choi and Weiss (2005), Park and Weber (2006b), Fu and Heffernan (2009), Tregenna (2009), etc.

Although many papers tried to test the market power theory against the efficient structure theory, a little research examines this issue in the hotel industry according to the author’s best knowledge. Davies (1999), Pan (2005) and Tung et al. (2010) just examined the structure-conduct-performance hypothesis in the hotel industry. In addition, many papers investigated the influences on hotels’ profitability, but they put emphasis on the different issues. For example, Claver-Cortés et al. (2007) investigated the impacts of strategic behaviors on hotels’ performance. Namasivayam et al. (2007) analyzed the effects of human resources management (HRM) practices on hotels’ performance. Chen et al. (2005), Chen (2007a, c) and Chen (2011) investigated the responses of macro factors on hotels’ performance. Chen (2007a, c) and Chen (2011) investigated the relationship between the tourism expansion and stock performance of hotels. Chen et al. (2012) examined the impact of insider managerial ownership on the financial performance of hotels. This paper may be the first research to examine the market power and efficient structure theories in Taiwan’s international tourist hotel industry. In addition, the pure technical and scale efficiencies evaluated by the three-stage DEA with quasi-fixed inputs are applied to examine the efficient structure theory in order to eliminate the impacts of exogenous variables and statistical noise as well as consider the existence of quasi-fixed inputs.

In addition to the introduction, the rest of this chapter is organized as follows. Section 2 establishes the empirical model for the determinants of profitability in the international tourist hotel industry. A description of the data and empirical results are presented in Section 3. Section 4 is a conclusion.

4.2 Methodology

In order to test the efficient structure theory, this chapter adopts the pure technical and scale efficiencies that are obtained from Chapter 2 and are evaluated by the three-stage DEA with the quasi-fixed input. Afterward, the regression model for the relationships among the efficiency, market structure and profitability are constructed.

Following Maudos (1998) as well as Mendes and Rebelo (2003), suppose that there are N international tourist hotels. The regression model for the relationships among the efficiency, market structure and profitability is expressed as:

$$\pi_i = \alpha_0 + \alpha_1 CONC + \alpha_2 MS_i + \sum_{l=3}^{4} \alpha_l EF_{il} + \sum_{j=1}^{K} \beta_j Z_{ij} + \varepsilon_i, \; i = 1, 2, \ldots, N \qquad (4\text{-}1)$$

where, π represents the profitability of an international tourist hotel, and is measured by the net operating profit margin; *CONC* represents the degree of market concentration, and is measured by the concentration ratio of top 4 sellers (CR4);[21] *MS* represents the market share; *EF* represents direct efficiency measures, and is measured by the pure technical and scale efficiencies obtained from the third stage efficiency measures in Chapter 2; *Z* is exogenous variables, and includes the hotel size, market condition, hotel type, visitor type, SARS and financial tsunami. Based on the estimation of Equation (4-1), the different hypotheses can be derived and summarized as follows:[22]

$$\frac{\partial \pi}{\partial CONC} > 0; \quad \frac{\partial \pi}{\partial MS} = 0; \quad \frac{\partial \pi}{\partial EF} = 0 \tag{4-2}$$

$$\frac{\partial \pi}{\partial CONC} = 0; \quad \frac{\partial \pi}{\partial MS} > 0; \quad \frac{\partial \pi}{\partial EF} = 0 \tag{4-3}$$

$$\frac{\partial \pi}{\partial CONC} = 0; \quad \frac{\partial \pi}{\partial MS} = 0; \quad \frac{\partial \pi}{\partial EF} > 0 \tag{4-4}$$

$$\frac{\partial \pi}{\partial CONC} = 0; \quad \frac{\partial \pi}{\partial MS} > 0; \quad \frac{\partial \pi}{\partial EF} > 0 \tag{4-5}$$

$$\frac{\partial \pi}{\partial CONC} > 0; \quad \frac{\partial \pi}{\partial MS} = 0; \quad \frac{\partial \pi}{\partial EF} > 0 \tag{4-6}$$

where, Equation (4-2) represents the structure-conduct-performance hypothesis; Equation (4-3) represents the relative market power hypothesis; Equation (4-4) represents the efficient structure theory; Equation (4-5) represents the modified efficient structure hypothesis; Equation (4-6) represents the hybrid collusion and efficiency hypothesis.

The efficient structure theory is divided into the X-efficiency and scale-efficiency hypotheses. If the coefficient of the pure technical efficiency is significant, the X-inefficiency hypothesis is supported. If the coefficient of the scale efficiency is significant, the scale efficiency hypothesis is supported. The modified efficient structure hypothesis argues that the variance in the profitability is explained by the market share and efficiency, but does not be directly affected by the degree of market concentration. The effect of the market share on the profitability results from other factors unrelated to the efficiency (Shepherd, 1986). The hybrid collusion and efficiency hypothesis argues that the impact of the degree of market

[21] H is displaced by the concentration ratio of top 4 sellers since the multicollinearity problem between H and the market share is serious.

[22] Maudos (1998) as well as Mendes and Rebelo (2003) explained the Equation (4-2) and (4-4) to (4-6), but did not illustrated the situation when the coefficient of market share was significant.

concentration on the profitability results from the market power, and a firm with more efficiency earns more profits. However, the effect of market share can be negligible (Schmalensee, 1987).

In addition, these exogenous variables used to adjust the efficiency are also adopted in the profitability model since these exogenous variables may affect the efficiency and profitability, simultaneously. The description and theoretical foundations of these exogenous variables are illustrated as follows:

Hotel Size (SIZE). The international tourist hotel size is measured by the number of guest rooms. The dummy variable SIZE 1 is equal to 1 for the international tourist hotel with 201 to 400 guest rooms; otherwise, SIZE 1 is equal to 0. The dummy variable SIZE 2 is equal to 1 for the international tourist hotel with more than 401 guest rooms; otherwise, SIZE 2 is equal to 0. When international tourist hotels expand their operating scale, they may have gains from economies of scale so that could low their costs and increase their profits (Evanoff and Fortier, 1988; Molyneu and Forbes, 1995; Goldberg and Rai, 1996; Maudos, 1998). However, they may also have losses from the allocative complexity by expanding the operating scale (Baumol et al., 1982). Therefore, the impact of hotel size on profitability is indeterminable.

Market Condition (RESORT). The market condition is denoted by the dummy variable which the international tourist hotel belongs to a resort hotel or city hotel. The dummy variable RESORT is equal to 1 for international tourist hotels being resort hotels, and 0 for those being city hotels. Resort hotels face the more volatile demand than city hotels, but the number of guest rooms cannot be changed in the short run (Baum and Mudambi, 1995). Hence, the changes of seasons easily cause wasted resources in resort hotels, and then the efficiency and the profitability of resort hotels will be reduced. Therefore, the relationship between the market condition and profitability is expected to be negative.

Hotel Style (CHAIN). The hotel style is denoted by the dummy variable which the international tourist hotel belongs to an international and/or domestic chain hotel or independent hotel. The dummy variable CHAIN is equal to 1 for international tourist hotels being international and/or domestic chain hotels, and 0 for those being independent hotels. Chain hotels can attract more visitors via marketing chain and benefit from managerial experience via technology transfers, but could increase input usage and costs by requiring standard services and facilities (Wang and He, 2006). Hence, the impact of hotel style on profitability is indeterminable.

Visitor Type (TYPE). The dummy variable TYPE 2 is equal to 1 for the international tourist hotel with mainly receiving individual visitors; otherwise, TYPE 2 is equal to 0. The dummy variable TYPE 3 is equal to 1 for the international tourist hotel with simultaneously receiving group and individual visitors; otherwise, TYPE 3 is equal to 0. By specializing in serving the same type of visitors, employees can decrease the possibility of error and wasting time due to the learning effect. The profitability will be increased. However, Brickley et al. (1997) claimed that product or service diversification could produce cost savings by economies of scope. Hence, the impact of visitor type on profitability is indeterminable.

Severe Acute Respiratory Syndrome (SARS). The dummy variable SARS is equal to 1 in 2003; otherwise, SARS is equal to 0. People will reduce contact with others to avoid SARS infection so that will decrease demands for accommodation and F&B in international tourist hotels. Hence, the profitability of international tourist hotels will be lower during this period. Therefore, the relationship between SARS and profitability is expected to be negative.

Financial Tsunami (FT). The dummy variable FT is equal to 1 in 2008 and 2009; otherwise, FT is equal to 0. During the period of financial tsunami, people will decrease the unnecessary expenditure so that will lower demands for accommodation and F&B in international tourist hotels. Hence, the profitability of international tourist hotels will be decreased during this period. Therefore, the financial tsunami is expected to have a negative relationship with profitability.

4.3 Data Description and Empirical Results

4.3.1 Data Description

The data used in this paper are based on Taiwan's international tourist hotels operated from 2003 to 2009. They were conducted by the Annual Operation of the International Tourist Hotels, published by the Tourist Bureau, Ministry of Transportation and Communications, ROC. After discarding incomplete observations, 47 international tourist hotels are remained and are listed in Appendix 2A. The definitions of relevant variables are summarized in Appendix 4A. The descriptive statistics of relevant variables is presented in Table 4.1. Net operating profit margins range from -136.0% to 45.3%; the degrees of market concentration range from 0.409 to 1; the market share ranges from 0.002 to 1; scale efficiencies from 0.080 to 1. These indicate that most variables are extremely different. 58.7% of international tourist hotels have guest rooms between 201 to 400, indicating that over half international tourist hotels are the middle size. 14.9% of international tourist hotels are resort hotels. 59.3% of international tourist hotels are chain hotels. 30.4% of international tourist hotels mainly receive individual visitors and 61.1% simultaneously receive group and individual visitors.

4.3.2 Empirical results

This paper uses the net operating profit margin as the dependent variable, as well as the degree of market concentration, market share, pure technical efficiency, scale efficiency, hotel size, market condition, hotel type, visitor type, SARS and financial tsunami as independent variables to investigate the determinants of profitability and the tests of the market power and efficient structure theories. In order to examine the market power and efficient structure theories, this paper will divide the empirical model into three parts and progressively introduce the variables of the degree of market concentration, market share, as well as pure technical and scale efficiencies. First, the empirical model only uses the degree of market concentration, hotel size, market condition, hotel type, visitor type, SARS and financial tsunami as independent variables to represent the structure-conduct-performance hypothesis and expects the coefficient of the degree of market concentration to have a positive sign (Model 7). Second, the empirical model includes the independent variables used in Model 7 and the market share to represent the relative market power hypothesis and expects the coefficient of market share to have a positive sign (Model 8). Third, the empirical model includes all independent variables to examine hypothesis of Equations (4-2) to (4-6) (Model 9). Furthermore, this paper tries to investigate whether the market share is the proxy for efficiency or not. In other words, when the efficiency is added to the empirical model, whether the coefficient of market share will be transformed into the insignificance or not.

Before proceeding to the empirical work, these values of VIF are calculated to examine the degree of multicollinearity among independent variables. The result shows that the values of VIF are all below 4.77, indicating that the multicollinearity problem among independent variables is not serious.[23] Since the data are the panel data that combine cross-section and time-series data, the Hausman test is applied to judge that the empirical model suits the random effects model or fixed effects model.[24] The null hypothesis of this test is that the random effects model is suitable. The Hausman test results do not reject all the null

[23] The VIF value is smaller than 5 for each independent variable with no serious correlation with each other; but there exists serious multicollinearity problem if the largest VIF value exceeds 10 (Greene, 2000).

[24] Hsiao (1986) indicated that the random effects model or fixed effects model could solve the problem of biased and inconsistent coefficient estimates yielded by the pooled OLS regression.

hypotheses in three models (see Table 4.2). Hence, the random effects model is appropriate to be used in Model 7 to 9.

The empirical results are presented in Table 4.2. The degree of market concentration in Model 7 and the degree of market concentration and market share in Model 8 do not have significant effects on profitability, implying that the structure-conduct-performance and relative market power hypotheses are not supported in Taiwan's international tourist hotel industry. No matter the market power of the whole industry or the relative market power of individual international tourist hotel can not impact the net operating profit margins of international tourist hotels. In Model 9, the degree of market concentration, market share and pure technical efficiency do not have significant effects on profitability, but the scale efficiency has a positive effect on profitability at the 1% significant level. This result supports the scale efficiency hypothesis and indicates that an increase in the profitability results from the improvement of scale efficiency in the international tourist hotel industry. However, the improvement of management efficiency can not impact the profitability. The scale efficiency is a more important determinant of profitability in Taiwan's international tourist hotel industry than either the degree of market concentration, market share or management efficiency. In addition, the pure technical and scale efficiencies increase the explanatory power from 5.6% to 13.6% in the empirical model.

The empirical results of other exogenous variables in Model 7 to 9 are the same. The dummy TYPE 2 that mainly receives individual visitors and the dummy TYPE 3 that simultaneously receives individual and group visitors are negative on the net operating profit margin, implying that gains from specialization in receiving group visitors dominate the gains from specialization in receiving individual visitors and diversification in simultaneously serving individual and group visitors. The specialization in receiving group visitors can help international tourist hotels to obtain the higher profitability. A possible explanation for this outcome is that international tourist hotels with mainly receiving group visitor can obtain more visitors once, and further increase the occupancy rate and profits. Consistent with the findings of Huang and Min (2002), Chen et al. (2005), Kim et al. (2006), Chen (2007b), Chen et al. (2007) and Wang (2009), natural disasters, terrorism and epidemics hurt the international tourism development in Taiwan. The SARS dummy has a negative effect on the net operating profit margin at the 1% significant level, indicating that demands for accommodation and F&B in international tourist hotels could be decreased in order to avoid SARS infection during the period of SARS prevalence. Hence, the profitability will be lower. The financial tsunami has a negative effect on the net operating profit margin at the 1%

significant level, implying that people may reduce the unnecessary expenditure in order to face the uncertainty of economic environment during the period of financial tsunami. Hence, the profitability will be decreased. In addition, the effect of SARS dummy on the profitability is larger than financial tsunami dummy. However, SARS occurred in March 2003 and gradually eased up after June 2006, but the financial tsunami was the most serious financial crisis within ten years and caused world economic recession. A possible explanation for this outcome is that mainland tourists are allowed to visit Taiwan from 2008, and then increase demands for accommodation and F&B in international tourist hotels and weaken the effect of financial tsunami.

4.4 Conclusions

The average net operating profit margin in the international tourist hotel industry does not have consistent trend with the rising trend of travel activities and the number of international tourist hotels. It first increased and then decreased. What are the possible factors? Is the market structure in the whole industry, the relative market power of individual international tourist hotel, the efficiency of individual international tourist hotel or other factors? This paper attempts to use a more conscientious method and model to find out possible answers for the above question. Based on the 2003-2009 data conducted by the Annual Operation of the International Tourist Hotels, the pure technical and scale efficiencies evaluated by utilizing the three-stage DEA with quasi-fixed inputs are included as independent variables of the profitability equation. Then, the determinants of profitability in Taiwan's international tourist hotel industry are investigated.

The empirical results show that the scale efficiency hypothesis is supported in Taiwan's international tourist hotel industry. An international tourist hotel that mainly receives individual visitors and an international tourist hotel that simultaneously receives group and individual visitors have negative impacts on profitability because mainly serving group visitors can help international tourist hotels to obtain more visitors once and increase their profitability. SARS has a negative effect on the profitability because avoiding SARS infection can cause a decrease in demands for accommodation and F&B in international tourist hotels. The financial tsunami has a negative effect on profitability because the uncertainty of economic environment can cause a decrease in demands for accommodation and F&B in international tourist hotels. In addition, the effect of SARS dummy on the profitability is larger than financial tsunami dummy because the effect of financial tsunami is weakened by allowing mainland tourists to visit Taiwan.

Some important lessons may emerge directly from the empirical results in this chapter. First, managers may have to pay more attention to appropriately adjusting the operating scale since an increase in scale efficiency can enhance the profitability of international tourist hotels. Second, mangers must be more careful to face the changes of external environments because the negative changes of external environments hurt the efficiency and profitability of international tourist hotels. Finally, the information about service qualities, financial structure and the data of ordinary tourist hotels might be needed for the empirical results to be more reliable and the policy implications to be more meaningful.

Table 4.1 Descriptive Statistics of Relevant Variables

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Taipei City	Net operating profit margin	140	0.113	0.148	0.453	-0.457
	CR4		0.432	0.018	0.454	0.409
	MS		0.045	0.038	0.140	0.002
	PTE		0.996	0.018	1	0.966
	SE		0.636	0.296	1	0.080
	SIZE 1		0.550	0.499	1	0
	SIZE 2		0.350	0.479	1	0
	RESORT		0.050	0.219	1	0
	CHAIN		0.650	0.479	1	0
	TYPE 2		0.236	0.426	1	0
	TYPE 3		0.643	0.481	1	0
Kaohsiung City	Net operating profit margin	42	0.021	0.079	0.158	-0.177
	CR4		0.787	0.019	0.817	0.762
	MS		0.154	0.094	0.348	0.031
	PTE		0.971	0.044	1	0.839
	SE		0.534	0.187	0.916	0.202
	SIZE 1		0.500	0.506	1	0
	SIZE 2		0.500	0.506	1	0
	RESORT		0	0	0	0
	CHAIN		0.500	0.506	1	0
	TYPE 2		0.238	0.431	1	0
	TYPE 3		0.714	0.457	1	0
Taichung City	Net operating profit margin	35	0.060	0.177	0.292	-0.351
	CR4		0.880	0.008	0.890	0.868
	MS		0.200	0.070	0.305	0.094
	PTE		0.998	0.008	1	0.954
	SE		0.457	0.193	1	0.223
	SIZE 1		0.600	0.497	1	0
	SIZE 2		0.200	0.406	1	0
	RESORT		0	0	0	0

Table 4.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Taichung City	CHAIN	35	0.571	0.502	1	0
	TYPE 2		0.486	0.507	1	0
	TYPE 3		0.514	0.507	1	0
Taoyuan City	Net operating profit margin	7	0.137	0.080	0.241	0.040
	CR4		1	0	1	1
	MS		1	0	1	1
	PTE		0.930	0.044	0.999	0.869
	SE		0.345	0.080	0.446	0.220
	SIZE 1		1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0	0	0	0
	TYPE 2		0	0	0	0
	TYPE 3		0	0	0	0
Hsinchu City	Net operating profit margin	14	0.077	0.060	0.157	-0.063
	CR4		1	0	1	1
	MS		0.500	0.187	0.718	0.282
	PTE		0.968	0.029	1	0.913
	SE		0.499	0.103	0.672	0.341
	SIZE 1		0.786	0.426	1	0
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		1	0	1	1
	TYPE 2		1	0	1	1
	TYPE 3		0	0	0	0
Hualien City	Net operating profit margin	21	0.022	0.064	0.102	-0.160
	CR4		1	0	1	1
	MS		0.319	0.121	0.504	0.206
	PTE		0.998	0.004	1	0.979
	SE		0.355	0.149	0.613	0.213

Table 4.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Hualien City	SIZE 1	21	1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0.333	0.483	1	0
	TYPE 2		0.095	0.301	1	0
	TYPE 3		0.857	0.359	1	0
Tainan City	Net operating profit margin	14	-0.027	0.363	0.359	-0.672
	CR4		1	0	1	1
	MS		0.433	0.317	0.826	0.098
	PTE		1	0	1	1
	SE		0.525	0.382	1	0.134
	SIZE 1		0.500	0.519	1	0
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0.500	0.519	1	0
	TYPE 2		0.357	0.497	1	0
	TYPE 3		0.571	0.514	1	0
Taitung City	Net operating profit margin	7	-0.042	0.092	0.080	-0.210
	CR4		1	0	1	1
	MS		1	0	1	1
	PTE		0.964	0.011	0.988	0.955
	SE		0.373	0.017	0.399	0.352
	SIZE 1		1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0	0	0	0
	TYPE 2		0.286	0.488	1	0
	TYPE 3		0.714	0.488	1	0
Kaohsiung County	Net operating profit margin	7	-0.403	0.403	0.225	-1.360
	CR4		1	0	1	1

Table 4.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Kaohsiung County	MS	7	1	0	1	1
	PTE		1	0	1	1
	SE		0.234	0.025	0.255	0.182
	SIZE 1		0	0	0	0
	SIZE 2		0	0	0	0
	RESORT		1	0	1	1
	CHAIN		1	0	1	1
	TYPE 2		0	0	0	0
	TYPE 3		1	0	1	1
Hualien County	Net operating profit margin	7	0.167	0.052	0.226	0.103
	CR4		1	0	1	1
	MS		0.787	0.096	1	0.721
	PTE		0.997	0.007	1	0.981
	SE		0.786	0.062	0.865	0.714
	SIZE 1		1	0	1	1
	SIZE 2		0	0	0	0
	RESORT		0	0	0	0
	CHAIN		0	0	0	0
	TYPE 2		0	0	0	0
	TYPE 3		1	0	1	1
Tainan County	Net operating profit margin	14	0.088	0.062	0.164	-0.061
	CR4		1	0	1	1
	MS		0.372	0.172	0.677	0.150
	PTE		0.996	0.015	1	0.943
	SE		0.453	0.106	0.604	0.293
	SIZE 1		0.500	0.519	1	0
	SIZE 2		0	0	0	0
	RESORT		1	0	1	1
	CHAIN		0.500	0.519	1	0
	TYPE 2		0.786	0.426	1	0

Table 4.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Tainan County	TYPE 3	14	0.214	0.426	1	0
Taitung County	Net operating profit margin	7	0.073	0.057	0.144	-0.007
	CR4		1	0	1	1
	MS		1	0	1	1
	PTE		1	0	1	1
	SE		0.418	0.053	0.491	0.346
	SIZE 1		0	0	0	0
	SIZE 2		0	0	0	0
	RESORT		1	0	1	1
	CHAIN		1	0	1	1
	TYPE 2		0.286	0.488	1	0
	TYPE 3		0.714	0.488	1	0
Pingtung County	Net operating profit margin	14	0.149	0.062	0.264	0.035
	CR4		1	0	1	1
	MS		0.500	0.095	0.636	0.364
	PTE		0.996	0.004	1	0.989
	SE		0.641	0.077	0.725	0.523
	SIZE 1		0.500	0.519	1	0
	SIZE 2		0.500	0.519	1	0
	RESORT		1	0	1	1
	CHAIN		1	0	1	1
	TYPE 2		0.286	0.469	1	0
	TYPE 3		0.714	0.469	1	0
Total	Net operating profit margin	329	0.068	0.177	0.453	-1.360
	CR4		0.718	0.256	1	0.409
	MS		0.259	0.302	1	0.002
	PTE		0.990	0.026	1	0.839
	SE		0.546	0.258	1	0.080
	SIZE 1		0.587	0.493	1	0

Table 4.1 (*Continued*)

Areas	Variables	Observations	Mean	SD	Maximum	Minimum
Total	SIZE 2	329	0.255	0.437	1	0
	RESORT		0.149	0.357	1	0
	CHAIN		0.593	0.492	1	0
	TYPE 2		0.304	0.461	1	0
	TYPE 3		0.611	0.488	1	0

Table 4.2 Parameter Estimates of Profitability Equations

Independent variable	Model 7	Model 8	Model 9
Constant	0.199**	0.231**	0.212
	(0.091)	(0.096)	(0.377)
CR4	-0.080	-0.163	-0.090
	(0.094)	(0.117)	(0.116)
MS		0.110	0.018
		(0.090)	(0.093)
PTE			-0.094
			(0.364)
SE			0.216***
			(0.071)
SIZE 1	0.042	0.044	0.029
	(0.043)	(0.043)	(0.043)
SIZE 2	0.043	0.046	-0.026
	(0.065)	(0.066)	(0.068)
RESORT	-0.049	-0.065	-0.030
	(0.071)	(0.073)	(0.071)
CHAIN	0.045	0.042	0.012
	(0.046)	(0.046)	(0.046)
TYPE 2	-0.110***	-0.106**	-0.107**
	(0.042)	(0.042)	(0.042)
TYPE 3	-0.109***	-0.108***	-0.103***
	(0.038)	(0.038)	(0.038)
SARS	-0.086***	-0.087***	-0.074***
	(0.026)	(0.026)	(0.018)
FT	-0.057***	-0.055***	-0.049***
	(0.020)	(0.020)	(0.013)
$Adj.\ R^2$	0.053	0.056	0.136
Hausman test	4.08	7.14	4.35
(p-value)	(0.538)	(0.308)	(0.930)

Notes: 1. The numbers in parentheses are standard errors.

2. ** and *** represent that the coefficients are significantly different from 0 at the 0.05 and 0.01 levels, respectively.

Appendix 4A

Table 4A Data Descriptions of Relevant Variables

Variables	Definition
<u>Dependent variable</u>	
Net operating profit margin	The ratio of the net operating profit to total operating revenues
<u>independent variables</u>	
CR4	The ratio of revenues from top 4 international tourist hotels to total revenues of all international tourist hotels in the same city or county
MS	The ratio of revenues from each international tourist hotel to total revenues of all international tourist hotels in the same city or county
PTE	The pure technical efficiency estimated by the third stage of the three-stage DEA with the quasi-fixed input in Chapter 2
SE	The scale efficiency estimated by the third stage of the three-stage DEA with the quasi-fixed input in Chapter 2
SIZE	The dummy variable SIZE 1=1 indicates that the number of guest rooms is between 201 to 400 rooms; otherwise, SIZE 1=0. The dummy variable SIZE 2=1 indicates that the number of guest rooms is more than 401 rooms; otherwise, SIZE 2=0
RESORT	The dummy variable RESORT=1 indicates that an international tourist hotel is the resort hotel; RESORT=0 indicates that an international tourist hotel is the city hotel
CHAIN	The dummy variable CHAIN=1 indicates that an international tourist hotel is the international and/or domestic chain hotel; CHAIN=0 indicates that an international tourist hotel is the independent hotel
TYPE	The dummy variable TYPE 2=1 indicates that international tourist hotels mainly receive individual visitors; otherwise, TYPE 2=0. The dummy variable TYPE 3=1 indicates that international tourist hotels simultaneously receive group and individual visitors; otherwise, TYPE 3=0.
SARS	The dummy variable SARS=1 indicates the year 2003; otherwise, SARS=0
FT	The dummy variable FT=1 indicates the year 2008 and 2009; otherwise, FT=0

CHAPTER 5 CONCLUDING REMARKS

Three empirical studies are presented in chapters 2 to 4 on the basis of the 2003-2009 data of international tourist hotel industry in Taiwan. The empirical results in chapter 2 indicate that, in the first stage, the DEA models without quasi-fixed and adjusted inputs overestimate the technical and pure technical efficiencies, but underestimate the scale efficiency of international tourist hotels so that the necessity of considering the existence of the quasi-fixed input is justified. The second stage uses the SFA model to purge the effects from exogenous variables and statistical noise. The SFA results show that the exogenous variables have significant influences on input slacks and pure technical efficiency. The degree of market concentration has positive impacts on labor, F&B expense and operating expense input slacks and has a negative impact on pure technical efficiency because international tourist hotels with the lower degree of market concentration may reduce wasted resources under the competitive pressure. A hotel size has positive effects on all input slacks and has a negative effect on pure technical efficiency because the losses from the complexity of allocating resources dominates the gains from sharing or joint utilization. An international tourist hotel in the resort area has negative relationships with all input slacks and a positive relationship with pure technical efficiency because popular visiting spots can help international tourist hotels to attract more visitors, or managers of resort hotels may adopt superior managerial strategies to improve their efficiency.

An international tourist hotel participating in the international and/or domestic hotel chain has positive relationships with labor and F&B expense input slacks, but has a negative relationship with other expense. Because marketing chain and technology transfers can help international tourist hotels to attract visitors and obtain the managerial experience, but requiring standard services and facilities can cause them to increase more labors and F&B expenses. SARS has positive effects on labor and F&B expense input slacks and has a negative effect on pure technical efficiency because avoiding SARS infection can cause a decrease in demands for accommodation and F&B in international tourist hotels. The financial tsunami has positive effects on labor and other expense input slacks and has a negative effect on pure technical efficiency because the uncertainty of economic environment can lead to a decrease the unnecessary tourism expenditure.

After adjusting the variable input data from the SFA results in the second stage, the efficiency-evaluation results in the third stage show that international tourist hotels in Taiwan could reduce inputs by 45.9%, on average, and still produce the same level of outputs. The mean pure technical efficiency measure is 0.990 and the mean scale efficiency measure is 0.546, implying that the technical inefficiency mainly results from the inappropriate production scale. In addition, international tourist hotels have an ample space to improve their technical and scale efficiencies. The efficiency-evaluation results also show that the conventional DEA models overestimate the technical and scale efficiencies, but underestimate the pure technical efficiency of international tourist hotels so that the usage of the three-stage approach is justified. Finally, international tourist hotels which mainly receive group visitors have the worst performance because the better bargaining power of travel agencies can cause international tourist hotels to increase the usage of inputs.

In chapter 3, the empirical results show that, in the first stage, the Malmquist productivity index without quasi-fixed and adjusted inputs underestimates the productivity change so as to justify the necessity of considering the existence of quasi-fixed input. After adjusting the variable input data from the SFA results in the second stage, the productivity index in the third stage shows that the initial increase in productivity has been compensated by a decrease. The productivity growth or deterioration mainly results from the technological progress or regress and the scale efficiency improvement or deterioration during the period of 2003-2009. The results also show that the Malmquist productivity index with the quasi-fixed input and without adjusted inputs underestimates the productivity change. The key factors of the productivity changes estimated by the Malmquist productivity index with the quasi-fixed input and without adjusted inputs as well as those estimated by the Malmquist productivity index with quasi-fixed and adjusted inputs are different so as to justify the usage of the three-stage approach. Finally, international tourist hotels with mainly receiving group visitors have the better improvement of productivity than those with receiving simultaneously group and individual visitors as well as mainly receiving individual visitors, because international tourist hotels have an ample space to improve their productivity or pay more attention to decreasing the productivity deterioration. The sources of the productivity changes among three types of visitors are different, but the scale efficiency change plays an important role in all types.

In chapter 4, the empirical results indicate that the scale efficiency hypothesis is supported in Taiwan's international tourist hotel industry. An international tourist hotel that mainly receives individual visitors and an international tourist hotel that simultaneously receives group and individual visitors have negative impacts on profitability because mainly serving group visitors can help international tourist hotels to obtain more visitors once and increase their profitability. SARS has a negative effect on profitability because avoiding SARS infection can lead to a decrease in demands for accommodation and F&B in international tourist hotels. The financial tsunami has a negative effect on profitability because the uncertainty of economic environment can lead to a decrease in demands for accommodation and F&B in international tourist hotels. In addition, the effect of SARS dummy on the profitability is larger than financial tsunami dummy because the effect of financial tsunami is weakened by allowing mainland tourists to visit Taiwan.

The tourism industry has gradually played an important role in the economic growth in Taiwan. International tourist hotels are the most critical part of the tourism industry. Therefore, studying the efficiency and productivity change and investigating the determinants of profitability in the international tourist hotel industry become more and more important. Some important lessons may emerge directly from the empirical results. First of all, for studies of efficiency and productivity change to be more informative to decision and policy makers, the three-stage DEA approach with considering quasi-fixed inputs should be adopted to control the impacts of exogenous factors, statistic noise and quasi-fixed inputs. Second, managers may have to appropriately adjust the operating scale since most of the international tourist hotels are still scale inefficient and they can enhance their productivity and profitability by improving their scale efficiency. Third, managers may have to carefully assess the advantage and disadvantage of hotel chains before participating in or developing them. Fourth, mangers must be more careful to face the changes of external environments because the negative changes of external environments hurt the efficiency and profitability of international tourist hotels. Finally, the information about service qualities, the form of ownership, labor relations, financial structure and the data of ordinary tourist hotels might be needed for the empirical results to be more reliable and the policy implications to be more meaningful.

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