2019

Managerial Efficiency in the Food and Beverage Industry in Taiwan

Jin-Li Hu
National Chiao Tung University, jinlihu@mail.nctu.edu.tw

Chia-Ning Chiu
National Ilan University

Hou-Tang Chu
National Chiao Tung University

Follow this and additional works at: https://scholarworks.umass.edu/jhfm

Managerial Efficiency in the Food and Beverage Industry in Taiwan

Jin-Li Hu

Institute of Business and Management, National Chiao Tung University, Taiwan

Chia-Ning Chiu

Department of Leisure Industry and Health Promotion, National Ilan University, Taiwan

Hou-Tang Chu

Institute of Business and Management, National Chiao Tung University, Taiwan

ABSTRACT

This study evaluates the managerial efficiency of food and beverage companies by employing the output-oriented data envelopment analysis (DEA) approach. Consequently, the input and output variables of ten Taiwanese listed food and beverage companies were collected from 2011 to 2014. Then the Mann-Whitney U test was used to examine the difference in efficiency between restaurant companies and beverage and dessert companies. The major findings are as follows: (1) An inverse relationship exists between the scale and managerial efficiencies of the food and beverage industry. (2) The Mann-Whitney U test shows that the beverage and dessert companies are statistically more efficient. The results not only offer different managerial insights into the food and beverage industry's operating efficiency but also determine which factors have a significant and direct impact on these restaurants' or beverage and dessert shops' success or failure, which is the considerable contribution of this study for the service industry.

Key words: data envelopment analysis (DEA), technical efficiency, Mann-Whitney U test, restaurant, food and beverage

Introduction

The restaurant industry in Taiwan offers food and beverage, and this industry is very diverse. Restaurants range from high-end fine dining restaurants to bakery-style coffee shops. There are two ways of classification: first, restaurants can be classified by service types, such as fast food restaurants, casual dining, fine dining, etc. Second, restaurants can be sorted by the type of cuisine that restaurants serve, such as Thai, Chinese, Indian, or American style restaurants. No matter what type of restaurant, eating at restaurants is a part of the lifestyle of Taiwanese people. Even when the global economy suffered its deepest recession from 2008 to 2009, restaurants in Taiwan were still experiencing considerable growth.

According to the statistical figures from the Ministry of Finance in Taiwan, the total number of restaurants in Taiwan was up from 94,224 in 2008 to 98,932 in 2009, which is growth of 4.46%. Moreover, in the past five years, the number of restaurants has kept growing; it increased from 106,287 restaurants in 2011 to 124,124 restaurants in 2015. The growth rate for these five years is about 16.78%. Furthermore, the investigation from the Taiwanese Ministry of Economic Affairs reports that the restaurants' sales have increased from NT$394.5 billion dollars in 2012 to 439.4 billion dollars in 2016. The reasons why the restaurant business sales are up is that people in the modern world change their eating habits; for example, they do not spend time cooking food as they believe they always are too busy for the hassle. In addition, people in today's world spend much more time eating out at restaurants than they did in the past. It has been well known that Taiwanese have shifted toward the life of dining out more and cooking at home less. Meanwhile, nowadays restaurant business models have been changed such that more

food courts have been housed in shopping malls; this can successfully bring shopping and eating together to increase sales and reduce some expenses to improve their profits.

All the reasons above cause the consumption of food and beverage for an entire household to be much higher than in the past. As a result, many restaurant companies went public in the past five years, including Wowprime Corp., Thai Town Cuisine, Gourmet Master Co. Ltd., New Palace International Co. Ltd., etc. There are still more potential restaurants that would look to go public in the near future. However, little is known about the Taiwanese restaurant industry and what trends the restaurant industry will move toward. Therefore, this research aims to measure the technical efficiency of the Taiwanese food and beverage companies with their benchmarks by using the output-oriented DEA model with one output and three inputs. Data collection includes ten publicly traded Taiwanese food and beverage companies. Because 90% of restaurants in Taiwan are snack bars, and less than 10% of restaurants belong to a chain, these ten companies are split into two groups: the restaurant companies and beverage and dessert ones. As mentioned above, the process of going public is discussed in more detail for each restaurant company.

Ever since Gourmet Master Co. was listed on Taiwan's emerging stock market in 2010, more and more companies have followed to list themselves, such as Wowprime Corp. and Thai Town Cuisine. In order to expand their market and upgrade their business, those chain restaurants have to raise more capital through IPO. Hence, this research selects ten Taiwanese listed restaurants: Wowprime Corp., Thai Town Cuisine, Gourmet Master Co. Ltd., New Palace International Co. Ltd., An-Shin Food Services Co. Ltd., Renjie OldSichuan Catering, Mr. Onion Corp., La Kaffa International Co. Ltd., Shanghai Min, and Yummy Town Holdings Corporation. Additionally, as more people are concerned about the quality of what they eat and drink, more companies that are associated with food and beverage have the goal of issuing stock. Although this trend is occurring in the food and beverage industry and the importance of understanding business strategies of restaurants is even greater, very few studies have explored how to optimize and allocate limited resources for the food and beverage industry, which is vital for a company

to be successful and make profits. With this gap, this research focuses on evaluating the managerial efficiency and finding the benchmarking information for these food and beverage companies, which can explain the main factors that determine a restaurant's success or failure and determine the difference between restaurant business models and beverage and desserts business models. Moreover, to date, this industry has not reached the maturity stage, so this research first evaluates the managerial efficiency of these food and beverage companies. Second, we examine the difference in efficiency between restaurant companies and beverage and dessert companies because these companies do not adopt the same business models or strategies in the number of employees, store locations, total revenue, etc. Consequently, the purpose of this study is to evaluate the efficiency of ten food and beverage companies in Taiwan and to explore their operational efficiencies. The important contribution of this research has two aspects: first, this study enriches the theory and practice of productive efficiency with application of DEA model. Second, the managerial efficiency of each food and beverage company is evaluated to determine which factors have a significant or direct impact on restaurants' and beverage and desserts companies' business performances. In addition, the sources of inefficiency of these companies are sought so business models can be adjusted to make companies more successful and lower the riskiness of failure.

Literature Review

Food and Beverage Industry

Kiefer (2002) noted that the origin of a restaurant is "a cup of soup"—a place that people can eat and drink. Based on religion, economy, and tourism, there are different types of restaurants. In early times, the function of an inn was to provide travelers with simple edibles and a little space for lunch and/or dinner. Modern restaurants now not only pay attention to their own styles, such as offering better tableware or silverware, but also provide gourmet food or meals, invest in elegant and luxury interior design, and focus on service quality. Modern restaurants' functions include meetings, business, entertainment, family get-togethers, etc. The concept of a

chain restaurant comes from the U.S. In Taiwan, the concept came directly from McDonald's. In order to have purchase power, establish the brand, and meet modern people's needs, McDonald's adopted the business strategies of huge inventory, unified commercial products, and a clean environment. Because of the above reasons, the operation mode of restaurants has changed over time. Based on these functions, Table 1 lists restaurant services.

Tsai and Su (2009) pointed out that Taiwanese chain restaurants have been growing rapidly because of the increase in the number of people dining out. Moreover, because of the rise of more conscious consumers and their increasing awareness of their rights, it is important to develop and maintain good relationships with customers. Therefore, Tsai and Su collected and classified a total of 431 incidents to explore service failures and recovery strategies of Taiwanese chain restaurants. They identified 17 categories of service failure and found that the most common categories of service failure are product defects, unavailable or slow service, and employees' behavior. This finding implies that managing standardization can provide customers with consistent products and high-quality service to reduce service failure. Andersson and Carlbäck (2009) examined the relationship between an accounting system and the production of customers' experiences. First,

they defined total costs generated from four major types of restaurant experiences: basic food, culinary finesse, atmosphere, and service. According to the results of this study, they suggested that the restaurants should reallocate their resources from service and basic food expenses to invest in the restaurants' interior atmosphere and environment to reach customers' expectations. Su (2011) investigated the role of service innovation and customers' experience in ethnic restaurants. In addition, this study also sought the relationship between service innovation and customers' behavioral intention through customers' experience. The results showed that service innovation has significant impact on both customers' behavioral intention and customers' experience. This indicates that servicescape, service delivery, and service products can boost customers' satisfaction. In other words, ethnic restaurants with better servicescape, service delivery process, and product combinations receive more positive feedback from customers' behavioral intentions. The relationship of customers' experience to service innovation and customers' behavioral intentions was supported in this study as well.

DEA Applied in Food and Beverage and Related Industries Efficiency Evaluation

With globalization and the change of dietary needs, some research studies have explored topics on the food and beverage industry, yet few studies apply Data Envelopment Analysis (DEA) to this industry, as most previous studies utilize DEA to measure efficiency in the hotel industry. DEA may apply to both the hotel and restaurant industries because hotels in Taiwan provide customers with lunch and/or dinner banquets.

Reynolds and Thompson (2007) suggested comparing restaurants' efficiency and examining their best practices through a three-step process DEA approach when focusing on the impact of uncontrollable variables with multi-unit restaurant productivity. Reynolds and Biel (2007) asserted that productivity analyses might be possible through the application of a holistic productivity metric that would benefit multi-unit operators by maximizing their desirable operational outcomes while minimizing expenses and other detrimental conditions, such as low job satisfaction. Choi, Roh, and Yoon (2007)

Table 1. Categories of Restaurant Service in Taiwan

Service	Content	Example
Table Service	All food and beverage customers' needs are served by the waiter.	Western restaurant
Buffet Service	Customers have to pick up their meal by themselves.	Buffet in a domestic tourism hotel
Counter Service	Customers have a seat outside the counter and the waiter serves from inside the counter.	Iron broiled food, hot pot
Cafeteria Service	The waiter will offer the meal chosen by customers.	Chinese Cafeteria
Fast-food Service	The restaurant prepares the meal to the customers order, and then customers pick up the order.	McDonald's
Take-out Service	Customers call their order in, pay the bill at the store, and take the meal from the store.	Domino's

examined the efficiency of a chain restaurant with DEA and then illustrated the applicability of DEA to the specifics of restaurant operations by identifying the best performing units benchmarked against the less efficient units. Hadad, Friedman, and Hanani (2007) suggested not to rank units based on DEA because optimal weights differ from unit to unit; as a result, the range could be very large. In addition, one can only distinguish between an efficient unit and an inefficient one. The authors referred to several ranking methods in the DEA context and illustrated all the ranking methods. Sanjeev (2007) discussed the purpose of providing exploratory insights on the efficient evaluation for both hotel and restaurant companies operations in India by DEA, a linear programming-based approach. In addition, the research explored more about the relationship between the efficiency and size of the hotel and restaurant companies and found that managers have important insights for their strategic and operational decisions on performance improvement. Assaf, Deery, and Jago (2010) adopted bootstrapped DEA to measure the technical efficiency and scale properties of Australian restaurant operations. The results showed that Australian restaurants have an average efficiency of 46.17%, indicating these restaurants are at a low level of efficiency. Gharakhani, Maghferati, and Jalalifar (2012) evaluated the efficiency on fifteen restaurants in Iran and tried to improve their efficiency by a DEA model. Brotherton (2004) investigated critical success factor for UK corporate hotels. The empirical findings showed that only 3 of 59 critical success factors (CSFs) are not statistically significant. The results also suggest that "there is more commonality than difference between the hotels operated by UK Corporate Hotel companies regarding the human and technical factors critical to their success."

Min, Min, and Joo (2009) employed the DEA to develop performance benchmarks and to seek the best practical hotels and successful hotel business and operating models. The samples of 31 Korean luxury and budget hotels were used to support how DEA is useful in determining the factors of improving hotels' operation. They summarized several main findings to develop practical guidelines so that hotels can follow these suggestions to improve their financial efficiency. First, the economies of scale of the hotel can lead to an increase in hotel efficiency through income generation. However, the hotel size does not necessarily increase the hotel's revenue. Second, location has an impact on revenue, especially in the Seoul metropolitan area. Third, they did not find that franchising benefits a hotel's financial status. De Jorge and Suárez (2014) evaluated the total factor of productivity and efficiency. They also determined which factors have significant impacts on hotel performance. The Spanish hotel sector from 1999 to 2007 was analyzed in this study. The results concluded several key factors that lead to more efficiency for hotels. First, more concentrated market share can reach higher efficiency scores for the hotel industry. Second, there is a curvilinear U shape between hotel size and hotel efficiency. Third, there is a positive relationship between the organizational autonomy degree and efficiency, whereas there is an inverse relationship between organizational autonomy degree and the commitment to quality.

Methodology

The objective of this study is to apply Data Envelopment Analysis (DEA) to Taiwanese food and beverage companies for the period 2011–2014 for the measurement of technical efficiency. This efficiency measures how a given set of inputs is utilized to produce an output. The study examines the relationship between the technical efficiency and the size of these companies.

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) utilizes a linear programming approach to establish a frontier consisting of multiple inputs and outputs of decision-making units (DMUs) in the same period. The efficiencies of DMUs are measured on the frontier. Farrell (1957) developed the work from Debreu and Koopmans (1951) and introduced the concept of a frontier production function that assumes constant returns to scale (CRS). Charnes, Cooper, and Rhodes (1978) (CCR) proposed a model that generalizes an input orientation and assumes constant returns to scale (CRS). Subsequently, there have been many extensions to this model such as the Banker, Charnes, and Cooper (1984) (BCC) model,

which extends the CRS DEA model to handle the situation of variable returns to scale (VRS).

The major difference between the BCC model and the CCR model is the treatment of returns to scale; N1'λ = 1 is added to the BCC model from CRS DEA model. If the efficiency of a DMU is less than 1, then the DMU located inside of the frontier is deemed inefficient. If the DMU is located right on the frontier, then this indicates that the efficiency of the DMU is 1. The VRS DEA model with output orientation represents, without adjusting the inputs, how much outputs can be generated. Therefore, this study assumes that there are K inputs and M outputs for each of the N firms. X matrix is made up of K × N input, and Y matrix is composed of M × N output. The output-oriented VRS DEA model is as follows:

$$\max_{\lambda, \theta} \theta$$
$$\text{s.t.} - q_i + Y\lambda \geq 0,$$
$$\theta x_i - X\lambda \geq 0,$$
$$N1'\lambda = 1$$
$$\lambda \geq 0 \quad\quad\quad (1)$$

Here, θ is scalar, λ is an N × 1 vector of constants, and the value of θ is viewed as the efficiency score for the ith firm that meets $0 \leq \theta \leq 1$.

The relationship among OTE, PTE, and SE is that OTE = PTE × SE. This indicates that Overall Technical Efficiency (OTE) can be decomposed into Pure Technical Efficiency (PTE) and Scale Efficiency (SE).

Mann-Whitney U Test

This paper divides ten companies into two groups according to their category because we find that restaurants and beverage stores have obvious efficiency disparity. Brockett and Golany (1996) indicated that a group of DMUs typically share certain joint characteristics. As the Mann-Whitney U test is a non-parametric test, it does not assume any assumptions related to the distribution. This study tests the efficiency between these two independent groups, group A (n samples) and group B (m samples), to explore whether they belong to the same population and then ranks all scores together without considering to which group they belong. The ranking scores for each group are summed up to compute the U value.

Empirical Results

We adopt the output-oriented approach and Professor Coelli's computer program DEAP V2.1 to measure the efficiency scores of each firm from 2011 to 2014. The study sample consists of ten food and beverage listed companies. According to available financial information in the annual reports of the companies, we select companies that have all the financial information required for this research, which is collected from their year-end financial statement.

Following an extensive review of the literature on the restaurant industry, we choose the research variables; revenue and profit are regarded as output variables from five out of seven studies and four of seven studies, respectively. For the input, three of the studies utilized the number of employees, and one adopted assets.

Based on the above literature review, this study analyzes one output and three inputs associated with the operational characteristics of restaurant operations. In other words, total assets, number of employees, and total salary are viewed as inputs, while total revenue is considered an output. A few data issues are of concern in this study; first, we remove one output variable such as earnings before interest and tax (EBIT), because the value of New Palace International Co. Ltd. is negative in both 2013 and 2014. Second, we do not employ the number of stores because it is hard to collect the data from Yummy Town (Cayman) Holdings Corporation. Third, we discard the data from Evergreen Sky Catering Co. because its business model and strategy are different from the other companies we study. Table 2 provides the descriptive statistics. The computed average monthly salary per employee is $914, which is consistent with the conversion of units shown by Table 2.

Correlation Analysis of Inputs and Output

The output and inputs cannot violate the principle of isotonicity when DEA is employed. Table 3 is the correlation matrix. The results indicate that there are high correlations between each of the input variables, and the same is true for the output and each

Table 2. Descriptive Statistics
(Real $ million, thousand people)

Source		Mean	Max	Min	Median	Standard
Output	Revenue	120.3746	543.6427	6.0643	43.6544	148.1453
Input	Assets	85.5197	297.9744	9.0933	42.1905	91.32551
	Employee	37.1338	142.0000	2.4700	10.3100	44.76638
	Salary	33.9494	142.9261	0.8388	9.8257	42.63201

Table 3. Correlation Matrix of Output and Inputs

	Revenue	Assets	Salary	Employee
Revenue	1.000	0.988	0.953	0.975
Assets	0.988	1.000	0.941	0.970
Salary	0.953	0.941	1.000	0.963
Employee	0.975	0.970	0.963	1.000

of the input variables. The lowest value in the correlation matrix, a correlation of 0.941 between assets and salary, is still higher than 0.9. Therefore, these variables are highly correlated.

Efficiency Analysis Using DEA

This study employs the CCR model to analyze the total technical efficiency of ten food and beverage companies in Taiwan. The BCC model analyzes pure technical efficiency and scale efficiency. We find that three out of ten food and beverage companies are completely technically efficient and hit a score of 1, implying that these companies do optimally utilize the inputs (assets, salary, and number of employee) to produce the output (revenue). The fully efficient companies are Mr. Onion Corp., La Kaffa International Co., Ltd., and Shanghai Min.

In 2011 and 2012, three out of seven companies are fully efficient; this indicates that they reached a score of 1 (or 100%). The lowest score of 0.864 is by Wowprime Corp. in 2011, and Thai Town Cuisine scores the lowest value of 0.670 in 2012. However, the year before in 2011, Thai Town Cuisine is completely technically efficient.

In 2014, only Wowprime Corp. scores the low value of 0.666, while the rest of the companies experience an efficiency value higher than 0.800. In 2013, Thai Town Cuisine gets the lowest value of 0.795, while the other companies score higher than 0.848. In general, the food and beverage companies have an average score of 0.919. Wowprime Corp. and Thai Town Cuisine are the two companies that perform the worst. We find that both beverage and dessert

company (La Kaffa International Co. Ltd.) and the companies that have gone public (Mr. Onion Corp. and Shanghai Min) are fully efficient.

Table 4 reports the efficiency scores and shows that five out of ten food and beverage companies are fully efficient in 2013, and three out of these companies are completely efficient in 2014. The results imply that these companies optimally exploited the inputs (assets, number of employees, and total salary) to maximize the output (revenue). The fully efficient companies in 2014 are Mr. Onion Corp., La Kaffa International Co. Ltd., and Shanghai Min. In 2013, they are Gourmet Master Co. Ltd., An-Shin Food Services Co. Ltd., Mr. Onion Corp., La Kaffa International Co. Ltd., and Shanghai Min.

The average score of these food and beverage companies is 0.756 (approximately 76%). This implies that for the whole industry, the inputs can be reduced by 24% to produce the same level of outputs. The best performing company is La Kaffa International Co. Ltd. because it reaches the score of 1 from 2011 to 2014. The scores of both Mr. Onion Corp. and Shanghai Min have a value of 1 as well in 2013 and 2014.

Mann-Whitney U Test

This study employs the Mann-Whitney U Test to confirm whether the efficiency between a restaurant and non-restaurant is different. The procedure can be summarized in general as follows:

$$U = n \times m + \frac{n(n + 1)}{2} - w1$$
$$\text{or } U = n \times m + \frac{n(n + 1)}{2} - w2$$
(2)

1. Split the group of all DMUs into two, restaurants and beverage and dessert companies, and adopt DEAP V2.1 to evaluate the efficiency from 2011 to 2014 separately for the two groups.

Table 4.   Efficiency Scores of Listed Food & Beverage Companies in Taiwan from 2011 to 2014

Year	Efficiency Scores	Wowprime Corp.	Thai Town Cuisine	Gourmet Master Co. Ltd.	New Palace Intl. Co. Ltd.	An-Shin Food Services Co. Ltd.	La Kaffa Intl.Co. Ltd.	Yummy Town Holdings Corporation	Renjie OldSichuan Catering	Mr. Onion Corp	Shanghai Min	Mean
2011	OTE	0.864	1.000	0.916	1.000	0.886	1.000	0.892	-	-	-	0.937
	PTE	1.000	1.000	1.000	1.000	0.978	1.000	1.000	-	-	-	0.997
	SE	0.864	1.000	0.916	1.000	0.906	1.000	0.892	-	-	-	0.940
	RTS	DRS	CRS	DRS	CRS	DRS	CRS	IRS	-	-	-	
2012	OTE	0.803	0.670	0.891	1.000	0.966	1.000	1.000	-	-	-	0.904
	PTE	0.905	0.845	1.000	1.000	1.000	1.000	1.000	-	-	-	0.964
	SE	0.887	0.793	0.891	1.000	0.966	1.000	1.000	-	-	-	0.934
	RTS	DRS	DRS	DRS	CRS	DRS	CRS	CRS	-	-	-	
2013	OTE	0.848	0.795	1.000	0.934	1.000	1.000	0.981	0.924	1.000	1.000	0.948
	PTE	0.868	0.920	1.000	0.934	1.000	1.000	0.991	1.000	1.000	1.000	0.971
	SE	0.977	0.865	1.000	1.000	1.000	1.000	0.990	0.924	1.000	1.000	0.976
	RTS	DRS	DRS	CRS	CRS	CRS	CRS	DRS	IRS	CRS	CRS	
2014	OTE	0.666	0.825	0.955	0.881	0.876	1.000	0.852	0.823	1.000	1.000	0.888
	PTE	0.838	0.962	1.000	1.000	0.977	1.000	0.911	1.000	1.000	1.000	0.969
	SE	0.794	0.857	0.955	0.881	0.897	1.000	0.935	0.823	1.000	1.000	0.914
	RTS	DRS	DRS	DRS	IRS	DRS	CRS	DRS	IRS	CRS	CRS	

Note: OTE denotes technical efficiency scores obtained by the CCR (1978) model. PTE denotes technical efficiency scores from the BCC (1984) model. SE = OTE/PTE. RTS implies returns to scale. IRS, CRS, and DRS imply increasing, constant, and decreasing returns to scale, respectively.

2. Rearrange the data from the lowest to highest score while keeping track of group membership and assign a rank to each score. If there is a tie, all of the scores that tie receive the average rank of that set of scores.
3. Calculate w1 and w2, the sum of the ranks for the samples.
4. Use formula 4 to determine the value of the test statistic U and compare this with the U-critical value. (Normal distribution is unusable because n is below 10.)
5. Two-tailed hypothesis under significant level α=0.05 in 2011–2014:

H_{01}: OTE scores for the two groups in 2014 are equal.

H_{02}: OTE scores for the two groups in 2013 are equal.

H_{03}: OTE scores for the two groups in 2012 are equal.

H_{04}: OTE scores for the two groups in 2011 are equal.

The companies are divided into two groups in this study. One group contains restaurant companies such as Wowprime Corp., Thai Town Cuisine, New Palace International Co. Ltd., An-Shin Food Services Co. Ltd., Renjie OldSichuan Catering,

Mr. Onion Corp. and Shanghai Min. The other is beverage and dessert companies, including Gourmet Master Co. Ltd., La Kaffa International Co. Ltd., and Yummy Town Holdings Corporation. The results of the Mann-Whitney U test indicate that the two groups are from different populations. Table 5 is the result of the Mann-Whitney U test and the following are test statistics:

$$U_{0.05,7,3} = 2, U_{0.05,4,3} = 0$$

Three out of seven restaurant companies in 2014 and four out of seven restaurant companies in 2013 considered in the sample emerged as fully efficient, while two beverage and dessert companies considered in the sample emerged as fully efficient. The average scores of restaurant companies are 0.933 and 0.969 in 2014 and 2013, while those of beverage and dessert companies are 0.954 and 1, respectively. The scale efficiency scores of Wowprime Corp. are 0.699 and 0.852 in 2014 and 2013, respectively, which are the lowest in these two years. Table 6 summarizes the results of the efficiency scores of the two groups.

Although for the technical efficiency, Thai Town Cuisine scores 0.939 in 2012, while Wowprime Corp. scores 0.864 in 2011, Thai Town Cuisine and Wowprime Corp. still have presented worse. On the other hand, Gourmet Master Co. Ltd. has decreasing

Table 5. Results of Mann-Whitney U test
(Real $ million)

Hypothesis	Year	Group	Sample	U test	P-value
H_{01}	2014	Restaurants	7	8	$p < 0.025$
		Beverage and dessert companies	3		
H_{02}	2013	Restaurants	7	8	$p < 0.025$
		Beverage and dessert companies	3		
H_{03}	2012	Restaurants	4	5	$p < 0.025$
		Beverage and dessert companies	3		
H_{04}	2011	Restaurants	4	4.5	$p < 0.025$
		Beverage and dessert companies	3		

returns to scale when compared with the beverage and dessert group.

The results of the Mann-Whitney U test are rejected, meaning that the population of the two groups is different and the business models between restaurants and beverage and dessert companies are completely different. A restaurant needs many employees to serve customers, while beverage and dessert companies might need fewer employees. In addition, Town Cuisine and Wowprime Corp. score the lowest among all companies and in just the restaurant group.

BCG Matrix

This study employs the Boston Consulting Group (BCG) matrix to understand the stars among the ten companies. The X-axis is total revenue, while the Y-axis is total efficiency. The results conclude that Gourmet Master Co. Ltd. and An-Shin Food Services Co. Ltd. are considered stars, because both of them provide customers with food and beverage quickly. Wowprime Corp. and Thai Town Cuisine might be viewed as cows because of their lower efficiency. Due to their scale efficiency, the other companies are regarded as question marks. Only Renjie OldSichuan Catering belongs to dogs. In sum, the results indicate that the types of food and beverage have an impact on both revenue and efficiency.

Discussion

In summary, this research has two main findings. First, an inverse relationship exists between the scale of a company and its operational efficiency. The beverage and dessert companies reach the efficiency

Table 6. Efficiency Scores of Two Categories in Taiwan from 2011 to 2014

| Year | Efficiency Scores | Restaurant | | | | | | | | Beverage and dessert companies | | | |
		Wowprime Corp.	Thai Town Cuisine	New Palace Intl. Co. Ltd.	An-Shin Food Services Co. Ltd.	Renjie OldSichuan Catering	Mr. Onion Corp	Shanghai Min	Mean	Gourmet Master Co. Ltd.	La Kaffa Intl. Co., Ltd.	Yummy Town Holdings Corp.	Mean
2011	OTE	0.864	1.000	1.000	1.000	-	-	-	0.966	0.997	1.000	0.892	0.963
	PTE	1.000	1.000	1.000	1.000	-	-	-	1.000	1.000	1.000	1.000	1.000
	SE	0.864	1.000	1.000	1.000	-	-	-	0.966	0.997	1.000	0.892	0.963
	RTS	DRS	CRS	CRS	CRS					DRS	CRS	IRS	
2012	OTE	1.000	0.939	1.000	1.000	-	-	-	0.904	0.891	1.000	1.000	0.964
	PTE	1.000	0.993	1.000	1.000	-	-	-	0.964	1.000	1.000	1.000	1.000
	SE	1.000	0.946	1.000	1.000	-	-	-	0.934	0.891	1.000	1.000	0.964
	RTS	CRS	DRS	CRS	CRS					DRS	CRS	CRS	
2013	OTE	0.852	1.000	0.986	1.000	0.947	1.000	1.000	0.969	1.000	1.000	0.999	1.000
	PTE	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	SE	0.852	1.000	0.986	1.000	0.947	1.000	1.000	0.969	1.000	1.000	0.999	1.000
	RTS	DRS	CRS	IRS	CRS	IRS	CRS	CRS		CRS	CRS	IRS	
2014	OTE	0.699	1.000	0.907	0.967	0.960	1.000	1.000	0.933	1.000	1.000	0.861	0.954
	PTE	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.914	0.971
	SE	0.699	1.000	0.907	0.967	0.960	1.000	1.000	0.933	1.000	1.000	0.941	0.980
	RTS	DRS	CRS	IRS	DRS	IRS	CRS	CRS		CRS	CRS	DRS	
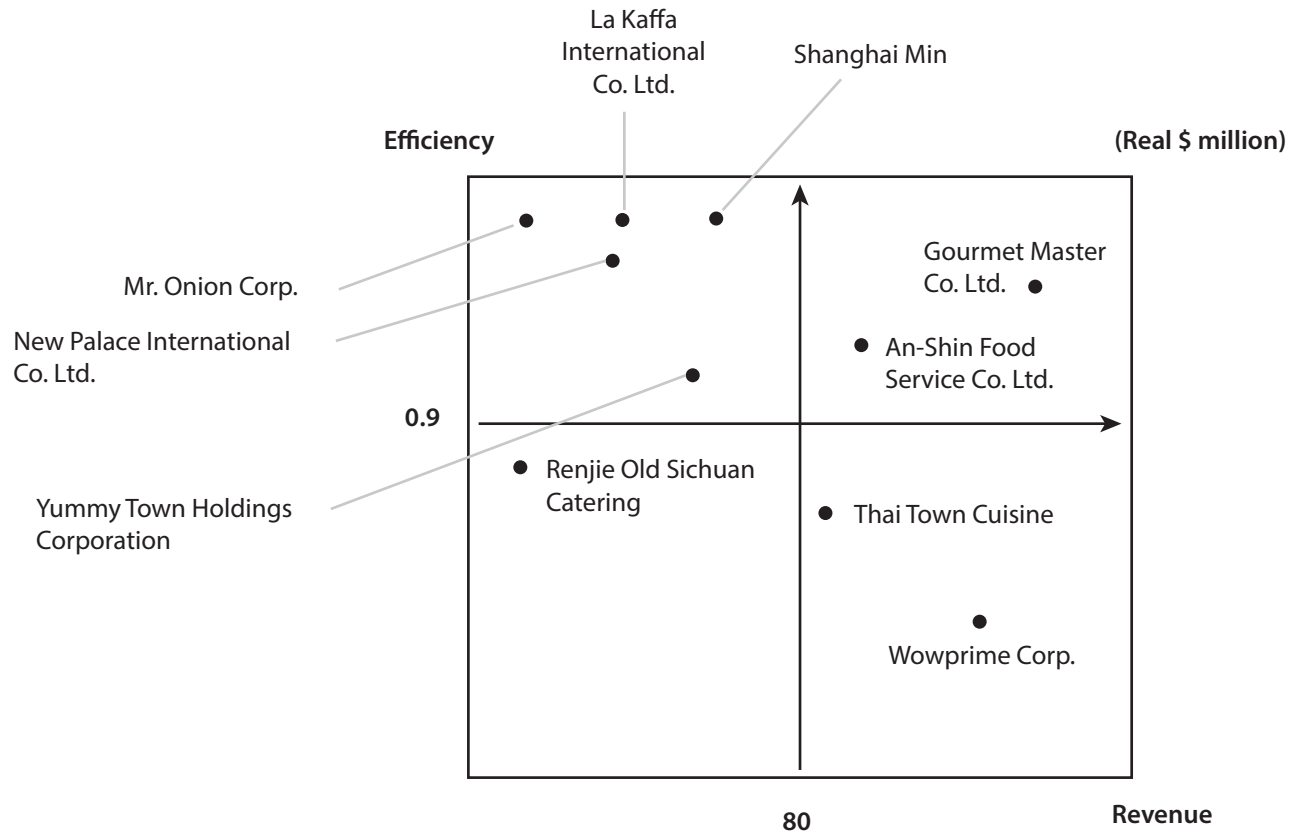
Figure 1. BCG Matrix of Listed Food and Beverage Companies in Taiwan.

frontier, while Town Cuisine and Wowprime Corp. performed the worst. Town Cuisine is the worst in 2012 because of its increasing assets. Second, the result of the Mann-Whitney U test presents that beverage and dessert companies are statistically more efficient than restaurant companies. It implies that the operations of restaurants and beverage and dessert companies are different. Third, increasing the number of employees does not benefit Wowprime Corp. to improve operational efficiency; increasing the number of employees lowered their efficiency.

This research contributes greatly to both academia and industry. For academia, we evaluate the efficiency in the food and beverage industry, in which limited research studies have been conducted on this field. Moreover, the Mann-Whitney U Test is applied to examine whether the efficiency between two groups (restaurant vs. non-restaurant) is different. This indicates that efficiency can be an important and useful index to determine companies with different characteristics, and through the Mann-Whitney U test, the food and beverage

industry can be clearly categorized into two groups, which is a new application and provides better evidence to support these categories in the food and beverage industry. The companies can adjust their business models and generate higher technical efficiency under the same inputs. Moreover, companies can have benchmarking information through this research so that they can have a standard to improve their efficiency. Furthermore, the BCG-like model can benefit the companies in our research by offering new strategic insights in order to create higher revenues and increase the total efficiency scores.

Although this research contributes to the DEA in food service management, there are some limitations. First, since EBIT for one company is negative, we are unable to use it as output because of the rule of the DEA approach. We instead use revenue and assume that it is a reasonable proxy for profitability. Second, since we are not able to collect data about the number of part-time and full-time employees, we adopt the total number of employees to understand the business of food and beverage companies.

Finally, the number of food and beverage listed companies is relatively small because this industry in Taiwan is still an emerging market, and most listed companies did not issue stock until 2010. Therefore, future studies could select more variables to evaluate managerial efficiency, such as the number of stores and number of full-time employees. In addition, a case study could be applied to further determine the difference in business practices among different enterprises. Moreover, including companies from other Asian economies to compare with the companies in Taiwan could present a better understanding of the Asian food and beverage market overall.

References

Andersson, T. D., & Carlbäck, M. (2009). Experience accounting: an accounting system that is relevant for the production of restaurant experiences. *Service Industries Journal, 29*(10), 1377–1395.

Assaf, A. G., Deery, M. & Jago, L. (2011). Evaluating the performance and scale characteristics of the Australian restaurant industry. *Journal of Hospitality & Tourism Research, 35*(4), 419–436.

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

Brockett, P. L., & Golany, B. (1996). Using rank statistics for determining programmatic efficiency differences in data envelopment analysis. *Management Science, 42*(3), 466–472.

Brotherton, B. (2004). Critical success factors in UK corporate hotels. *Service Industries Journal, 24*(3), 19–42.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision-making units. *European Journal of Operational Research, 2*(6), 429–444.

Choi, K. W., Roh, Y. S., & Yoon, J. H. (2007). An empirical examination of productivity of a chain restaurant using data envelopment analysis (DEA). *International Journal of Quality and Productivity Management, 7*(1), 47–67.

De Jorge, J., & Suárez, C. (2014). Productivity, efficiency and its determinant factors in hotels. *Service Industries Journal 34*(4), 354–372.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society Series A (General), 120*(3), 253–290.

Gharakhani, D., Maghferati, A. P. & Jalalifar, S. (2012). Evaluation of the efficiency of restaurants using DEA method (the case of Iran). *Life Science Journal, 9*(4), 530–534.

Hadad, Y., Friedman, L., & Hanani, M. Z. (2007). Measuring efficiency of restaurants using the data envelopment analysis methodology. *Computer Modelling and New Technologies, 11*(4), 25–35.

Kiefer, N. M. (2002). Economics and the origin of the restaurant. *Cornell Hotel and Restaurant Administration Quarterly, 43*(4), 58–64.

Min, H., Min, H. & Joo, S. J. (2009). A data envelopment analysis on assessing the competitiveness of Korean hotels. *Service Industries Journal, 29*(3), 367–385.

Reynolds, D., & Biel, D. (2007). Incorporating satisfaction measures into a restaurant productivity index. *International Journal of Hospitality Management, 26*(2), 352–361.

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

Sanjeev, G. M. (2007). Measuring efficiency of the hotel and restaurant sector: the case of India. *International Journal of Contemporary Hospitality Management, 19*(5), 378–387.

Su, C. S. (2011). The role of service innovation and customer experience in ethnic restaurants. *Service Industries Journal, 31*(3), 425–440.

Tsai, C. T., & Su, C. S. (2009). Service failures and recovery strategies of chain restaurants in Taiwan. *Service Industries Journal, 29*(12), 1779–1796.