Evaluating Firm Performance with Balanced Scorecard and Data Envelopment Analysis

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Abstract: - The evaluation of firm performance is very important for a firm since it is associated with the determination of corporate strategy, operating performance, and managerial compensation. This study aims to propose a complete framework for evaluating firm performance with the application of balanced scorecard (BSC) and data envelopment analysis (DEA). We first construct a measurable BSC indicator to examine the causal relationship between balanced scorecard and firm performance. The BSC indicator and its four components are shown to be critical corporate resources, thus leading to a significantly positive impact on firm performance. The DEA method, the Malmquist productivity index (MPI), and the Boston Consulting Group's (BCG) matrix model are then included in the framework to investigate industrial operational efficiency. The main contributions of the study are that it shows empirical evidence for the positive association between BSC and firm performance and that it provides a complete framework for evaluating firm performance by integrating the BSC, the DEA, and the BCG matrix model. More importantly, this framework sheds light on managerial implications regarding how a firm could improve its operational efficiency via the application of the BCG matrix model.

Key-Words: - firm performance, balanced scorecard, data envelopment analysis, Malmquist productivity index, matrix model

1 Introduction

The evaluation of firm performance is an important task for a firm since it is associated with corporate strategy, operating performance, and managerial compensation. The top priority of a firm in constructing its firm performance system is to establish an objective evaluative indicator for performance outcome. Following the development of corporate management skills, traditional performance evaluation system, which mainly utilizes a single measure in assessing firm performance, can no longer meet the needs of corporate management and the trends for future development. Since a single indicator could have a biased effect on corporate development, constructing a complete, unbiased performance evaluation system is very important for a firm.

Moreover, the performance measurement of firms had been highly dependent on financial measures. However, overdependence on dominant financial measures as a method of performance measurement may lead a firm's long-term development to deviate from the usual route. For instance, over-utilization of financial ratios, such as earnings per share (EPS) or return on equity (ROE) as a firm performance indicator, will mostly direct the corporate policies towards the major shareholders' benefit, especially the shareholders who are influential on the company's decision-making process. Consequently, the benefits resulting from corporate growth may not be fully shared with all the stakeholders.

In order to evaluate corporate performance objectively and to benefit corporate development in all its aspects, the balanced scorecard (BSC) concept of performance evaluation is widely adopted. The BSC, proposed by Kaplan and Norton in 1992 , measures a firm's performance through four dimensions, i.e., financial, customer, internal operating processes and learning and growth, and lays emphasis on the comprehensiveness and integrity of evaluation. The theory of the BSC remains one of the most popular management systems in the business world. This study argues that the adoption of critical performance measures should be aligned with organizational strategic goals, which would avoid overreliance on financial measures such that organizational capability would be developed for corporate growth and for creating economic value. For these purposes, the BSC was regarded not only as a performance measure, but also as a tool for internal management and strategic development.

The theory of BSC has at least two advantages over the traditional approach to performance evaluation. First, the BSC is a complete, compound tool for evaluating firm performance with four dimensions, including finance, customer, internal process, and learning and growth. These four dimensions could not only be seen as performance measures, but also as corporate input resources. Second, the BSC shifts the conventional focus on physical assets to the emphasis on both of physical and intangible resources in a firm for a purpose of corporate long-term development. Therefore, the BSC is constructed to be a full-range framework for performance evaluation to meet the corporate goal of perpetual growth.

Since the four dimensions of the BSC could be viewed as corporate input resources, the study aims to explore how the corporate resources could be applied with the data envelopment analysis (DEA) method to improve firm performance. We first build up measurable variables based on available data to measure the four dimensions of the BSC. We then examine the association between the BSC and firm performance is verified by the regression of ordinary least squares (OLS). Based on the analysis, the causal relationship between the BSC and the measures of firm performance could be verified, which leads to the application of the DEA. The DEA is used to evaluate how the inputs could be allocated to reach Pareto optimum. The result of the DEA could not only serve as a measure for performance evaluation, but also shed light on whether corporate input resources have operated in full capacity and how management could improve to achieve optimal operation efficiency. Accordingly, in recent years, the DEA has gradually become the mainstream of contemporary industry research regarding efficiency improvement. Furthermore, the matrix model proposed by the Boston Consulting Group Co. (BCG) is also introduced to conduct the industry analysis. The matrix model is based on the two dimensions of market share and market growth, which could be used to analyze the competitive status of interested firms and provide insight into how the firms could be directed to improve their operating efficiency.

In the study, the Taiwan tourism industry is of special interest for three reasons. First, the industry is comprised of a few publicly listed companies (7 firms to the end of 2008). The small number of firms is especially advantageous for the application of the DEA and thereafter the analysis of the matrix model. Second, since the application of the BSC needs various types of financial data for analysis, the publicly listed firms in the tourism industry provide sufficient public information needed as it is required by law. Third, since earlier studies of the DEA and the BSC were conducted mostly in the technology industry, this study attempts to fill the research gap by showing how the tourism and other service industries could improve their operating efficiency by the framework proposed in the study. Third, earlier literature on the BSC has mostly emphasized case studies, which are conducted in a qualitative sense in terms of questionnaires or interviews, but paid less attention to quantitative analysis especially in a sample of the service-related industry. Therefore, we would like to explore how the BSC would influence on the measures of firm performance by sampling from the Taiwanese tourism industry to conduct a quantitative analysis. The measures of firm performance are chosen according to the convention which is commonly employed in capital market.

To sum up, built on the proposed framework based on integrating the BSC, the DEA, and the matrix model, the research purposes of the study are three-fold: First, the study would like to demonstrate how the BSC would impact on firm performance. Specifically, we propose a practical method to standardize the BSC and its four major components, i.e., finance, customer, internal operating processes and learning and growth, to measure corporate input resources. It then follows that the OLS regression is applied to describe the casual relationship between the BSC and firm performance. Second, we intend to demonstrate how the BSC and the DEA could be integrated to conduct an analysis of operating efficiency. The DEA uses two measures, overall technical efficiency (OTE) and scale efficiency (SE), to evaluate corporate operating efficiency. Third, based on the analysis of the matrix model, we intend to provide useful managerial implications regarding how management could enhance operating efficiency by improving certain dimensions of the balanced scorecard.

2 Problem Formulation

As this study relies highly on the BSC theory and the DEA approach, literature review is presented with an emphasis on their relationships with firm performance.

2.1 The BSC and Firm Performance

Traditionally, performance evaluation is placed particular emphasis on the measurement of the accounting or financial aspect in line with the idea of maximizing stockholder's wealth. However, with the long-term goal of a firm shifted to the benefits of corporate stakeholder, traditional measures are no longer sufficient to meet the needs of modern organizations. Management of a firm should strive to satisfy their stockholders, customers, employees, and any other stakeholders to induce an efficient connection with firm performance. Under such a concept, Kaplan and Norton (1992) conduct a study on a variety of industries, and propose a theory for complete performance evaluation, the balanced scorecard and its four dimensions. In an attempt to over-depending on financial measures, they add three non-financial dimensions for the evaluation of firm performance: customers, internal operating process, and learning and growth, hoping that the new complete measurement system would aim at the goals of corporate vision. They argue that the BSC should be integrated into a firm's action plans, strategies, and visions.

The BSC, which refers to the measurement method driving future performance, is a set of performance evaluation tools developed to accomplish the corporate vision and strategy. Through its four dimensions, i.e., financial, customer, internal operating processes and learning and growth, the BSC assesses the organizational operational performance, integrates the internal physical and intangible assets of the enterprise and expects to establish a strategic performance evaluation system in accordance with cost efficiency. The design of the four dimensions deliberately coordinates with the business functions of a firm.
More concisely, the financial dimension is associated with the accounting function of the organization, the customer dimension with the marketing function, the internal operating processes with the integral value chain, and the learning and growth dimension with the human resources. Meanwhile, these four dimensions share the resources that a firm should input and the functions that a firm should have.

Since traditional accounting/financial measures that were used as the indicators for assessing firm performance can express past economic gains of a firm, the accounting/financial measures are still of importance in the performance measurement. In regard to the customer dimension, according to Kaplan and Norton (1996), management should determine the market segmentation and the target customers they expect the strategic business unit to compete for. Hence, the five core measures of the customer dimension are comprised of customer satisfaction, customer winning, customer retention, and customer profitability, and market and customer shares in the target segmentation.

The internal operating processes dimension shows the improvement in performance in the customer and financial dimensions, and mainly refers to how internal resources are integrated and processed into outputs. Thus, the primary purpose of this dimension is to meet the shareholder's demands and fulfill the objectives in the customer dimension. Based on this definition, Kaplan and Norton (1996) proposed a universal internal value chain model, which includes three major operating processes: the first one is the innovation process developing new solutions to satisfy the needs of customers; the second one is the operating process that provides existing products and services for customers; and the third one is the after-sale service process, which is defined as the service provided for customers after the sale to increase the value from the firm's products and services.

Lastly, the learning and growth dimension, which is considered to be the leading indicator of the first three dimensions, emphasizes the measurement for employee performance. As human resources are normally referred to as intangible assets of a firm, management should make every effort to maximize the value of the intangible assets. The main objective of the learning and growth dimension, which provides the foundation for the objectives of the other three dimensions, is to drive the first three dimensions to accomplish excellent achievement. According to Kaplan and Norton (1996) and Kaplan and Norton (2001), the consolidated balanced scorecard would not only promote the value of intangible assets and further improve the performance of internal operating process, but also fulfill the objectives of customers and shareholders. Therefore, Fletcher and Smith (2004) further argue that the balanced scorecard could be streamlined into a strategic tool for value creation.

Since the BSC theory was proposed in 1992, studies on the BSC have mostly emphasized on its applications with practical case studies. For example, Kaplan and Norton (1993), through case studies, demonstrated that the BSC could be applied to the management system for performance measurement as well as the business circle. Clarke (1997) explored how the BSC could make an improvement in production efficiency in the manufacturing industry. In addition, the study of the BSC was directed at qualitative research. For instance, in an attempt to construct the optimal indicators of the BSC's four dimensions, Maisel (1992) found that the BSC was helpful to corporate integrity development by taking the CEOs of the global companies as the subjects of a survey study.
The study of the BSC is also widely used in relation to corporate strategic management. Wagner and Kaufmann (2004) combined the BSC with purchasing strategies to enhance the firms' competitive advantages and to lower their operational cost. Chen (2005) integrated the BSC and a strategy map into a new decision-making model to promote the enterprise's core value. Fernandes, Raja, and Whalley (2006) studied the small-to-medium-sized enterprises in the UK and suggested that that applying the BSC to their assessment systems of corporate strategies could substantially improve their decision-making quality and competitiveness. Based on the literature, the BSC has been applied extensively in assisting management to make a timely, effective, and correct decision.

2.2 The DEA Method

As performance evaluation remains an important issue in management science, the DEA method was proposed to evaluate the relative efficiency of a decision-making unit (DMU) according to the Pareto optimality. Since the relative efficiency, instead of the absolute efficiency, is utilized to evaluate operation efficiency, the DEA could show the relatively inefficient DMUs the ways to improve their efficiency. Therefore, the DEA provides the greatest advantage regarding how the DMU could enhance their relative efficiency.

The idea of the relative efficiency was early applied by Farrell (1957), who employed the iso-quant curve and the envelope curve in economics, proposing the efficiency frontier as the criteria for performance measurement. Charnes Cooper, and Rhodes (1978) further argued that efficiency could be defined as the ratio of output to input, hence the efficiency should be less than or equal to 1. Meanwhile, they utilized the technique of linear programming to evaluate the relative efficiency of multiple corporate inputs to outputs, which is now named the CCR model. By principle, the CCR model is based on the assumption that there is a constant return to scale (CRS) in the production frontier. However, many studies applying the CCR model placed a great deal of stress on the relaxation of the assumption, such as the famous BCC model, proposed by Banker, Charnes, and Cooper (1984). Since both the CCR and the BCC models are to measure the relative efficiency, they are characterized mainly by the high sensitivity of the efficiency amount to the data. Therefore, the key to applying DEA lies in the measurement of the data, in which both input and output items must be measured in numerical values.

The efficiency frontier proposed by Farrell (1957) measures the productive efficiency in terms of the non-default production function instead of the default one, by which the production efficiency frontier is calculated without taking the default production function into account. Farrell suggested that the efficiency of a DMU consists of two parts: technical efficiency and allocative efficiency. Technical efficiency (TE) refers to the maximum output capability achieved by the DMU under the fixed input combination, while allocative efficiency, also called price efficiency, reveals the DMU's ability to exercise the optimal ratio input combination at the fixed input price and production technology; in other words, it refers to whether the DMU conducts production at the minimal cost. Total economic efficiency, which is also known as overall efficiency (OE), is established by combining the above-mentioned two efficiencies.

The essence of the model brought up by Charnes et al. (1978) is that this model introduces Pareto optimality, emphasizing that when each unit's efficiency is to be calculated, the optimal factor weight can be chosen; however, the only restriction is that when the chosen weight is used to calculate the efficiency of every unit, the upper limit for the efficiency value is not allowed to exceed 1. This is the common DEA method. The CCR model assumes that if there are n appraised objects (decision-making units), there will be n DMUs applying m inputs to produce s outputs, then the efficiency measurement model for the k-th DMU is as follows:

$$Max\ H_k = \frac{\sum_{r=1}^{S} U_r Y_{rk}}{\sum_{i=1}^{m} V_i X_{ik}} \tag{1}$$

$$s.t.\ \frac{\sum_{r=1}^{S} U_r Y_{rk}}{\sum_{i=1}^{m} V_i X_{ik}} \le 1,\quad U_r, V_i \ge \varepsilon$$

where H_k serves as relative efficiency,
U_r as the output weight of the r item,
Y_{rk} as the output value of the r item in the k unit,
V_i as the input weight of the i item,
X_{ik} as the input value of the i item in the k unit,
n as the number of the DMU,
m as the number of inputs,
s as the number of outputs,
ε as the minimum positive.

Under all the restriction conditions, the CCR model takes the input and output items of every DMU as the target function and other DMUs' input and output items as constraint item to compute the maximum efficiency value: the ratio of outputs to inputs. *Yrk* and *Xik* in the model are all known. Moreover, DEA decides the optimal weights (*Ur* and *Vi*) according to the solvable combination formed by the DMU, and manages to maximize the efficiency value of the DMU as far as possible, namely the value is 1. As Equation (1) is non-linear and difficult to solve, this equation can be transformed into the following linear model:

$$Max\ H_k = \sum_{r=1}^{s} U_r Y_{rk} \tag{1}$$

$$s.t. \sum_{i=1}^{m} V_i X_{ik} = 1,$$

$$\sum_{r=1}^{s} U_r Y_{rk} - \sum_{i=1}^{m} V_i X_{ik} \le 0,$$

$$U_r \ge \varepsilon > 0, V_i \ge \varepsilon > 0,$$

$$k = 1,2,....,n;\ r = 1,2,....,s;\ i = 1,2,....,m$$

The CCR model is identical to Farrell's model in the assumption that all DMUs operate under constant return to scale, which is applicable to the measurement of the productive efficiency. In view of the fact that an improper operation scale instead of inefficient technology sometimes induces inefficient production, Banker et al. (1984) revised the assumption such that when the return to scale changes, the technical efficiency measured excludes the influence of scale efficiency. This is known as the BCC model. Therefore, the BCC model relaxes the assumption about constant return to scale in the CCR model, suggesting three types of return to scale, i.e. increasing return to scale (IRS), constant return to scale (CRS), and decreasing return to scale (DRS).

The CCR model and the BCC model only measure the output efficiency of a single period. Thus, in order to understand the inter-temporal change in the output, Caves, Christensen and Diewert (1982) applied the quantitative index proposed by Malmquist (1953) to define the Malmquist productivity index (MPI) as the fluctuation of the output efficiency in the second phase. They took variable returns to scale (VRS) into consideration, but unfortunately they failed to conduct an empirical study to demonstrate its applications. Färe, Grosskopf, Norris and Zhang (1994) further defined the MPI as the changes in total factor productivity (CTFP), which was broken into the changes in technical efficiency (CTE) and the shifts in technology (ST). Under the assumption of VRS, CTE is subdivided into the changes in pure technical efficiency (CPTE) and the changes in scale efficiency (CSE).

In summary, the efficiency values derived from the DEA could provide relative efficiency about the utilization of corporate resources, point out the inefficient units that need to be improved, and then present them to management for decision-making. Therefore, the DEA method has at least four advantages: First, it can deal with the efficiency evaluation model involving multi-inputs and -outputs, in which a variety of inputs and outputs are measured in terms of different units without facing the problems of default productive function and parameter estimation. Secondly, it shows the relationship between the DMU's input and its output with only one value (more than 0, less than or equal to 1), and the result of evaluation efficiency is an overall indicator that is expressed as the total factor productivity in economic terms. Third, it conforms to the principle of fairness and excludes many people's subjective judgment, as mathematical programming is applied to decide the weights of the input and output indicators. Fourth, it has a flexible data processing mechanism that can handle the ratio scale and the ordinal scale at the same time, and the efficiency value of the assessment result does not vary from the different measurement units for the input and output.

As the DEA method mainly analyzes operational efficiency of a DMU, such a method is therefore especially suitable for analyzing operational efficiency in a relatively small sample. In fact, many studies have applied the DEA to analyze the efficiency of firms in a specific industry. For example, Thore, Phillips, Ruefli, and Yue (1996) analyze the US computer industry to explore their operation efficiency in the production cycle. They conclude that most firms in the U.S. computer industry are in the optimal production efficiency, while their product efficiencies are relatively low.

3 Methodology

As mentioned earlier, the primary purpose of this study was to propose a framework for evaluating firm performance. There are three major steps in our framework: First, the BSC indicator and its four dimensions are quantized with specific measurable variables in order to bridge the connection between the BSC and firm performance. Particularly, the regression of ordinary least square (OLS) is used to explain how the balanced scorecard would impact on firm performance. Second, the four dimensions of the BSC are regarded as corporate input resources and applied to the DEA method to evaluate corporate operating efficiency. Third, the BCG's matrix model is utilized to analyze a firm's competitive status and development strategy.

3.1 The Measurement of the BSC

With regard to the measurement of the BSC, the variables are chosen as suggested by literature as well as on the ground of data availability. In the financial dimension, there are at least eight according measures to describe a firm's financial health, suggested by Kaplan and Norton (1996). Current Ratio and Quick Ratio are proposed for describing a firm's liquidity, Total Asset Turnover for efficiency of asset utilization, Debt Ratio for capital structure, Net Profit Margin for profitability, and Operating Leverage and Financial Leverage for the degree of leverage.

As for the customer dimension, Kaplan and Norton (1996) also propose five variables, i.e., Market Share, New Customer Rate, Customer Retention Rate, Customer Satisfaction and Customer Margin. Since the data of the variables are mostly not available, only Market Share and Sales Growth (a proxy of Customer Retention Ratio) are used to measure the customer dimension, as suggested by Debusk and Crabtree (2006).

Concerning the dimension of the internal operating process, Kaplan and Norton (1996) point out that the internal operating process would consist of three procedures, i.e., innovation, operation and after-sale service. The innovation capability refers to a firm's ability to develop new services and products. Thus, the R&D Expense Ratio could serve as an indicator to measure corporate innovation capability. In addition, the operation procedure refers to a value-creation process from taking order to delivering products. Kaplan and Norton (1996) therefore suggest Employee Productivity could serve to measure a firm's operation capability. Also, they suggest Inventory Turnover, Accounts Receivable Turnover, Fixed Assets Turnover, and Equity Turnover to measure the capability of corporate operation procedure. Since this study sampled from the tourism industry, Inventory Turnover should be excluded from the measurement. Finally, to measure a firm's capability of its after-sale service, Kaplan and Wisner (2009) argue that product failure rate and maintenance quality should be taken into account. Unfortunately, the information regarding after-sale service is not publicized and thus not included in the dimension of internal operating process.

When it comes to the learning and growth dimension, Kaplan and Norton (1996) propose employee satisfaction, employee profitability, and employee sustainability to measure a firm's capability of learning and growth. Employee satisfaction, a main incentive to arouse the employee's work morale, is an important internal factor for strengthening consistency between stimulation, authorization and corporate goals. Employee productivity refers to the degree to which the employee's potential is exploited to achieve corporate goal. Thus, in the study we use the Ratio of Employee's Average Salary to Sales and Average Salary Growth to proxy for employee satisfaction and the Ratio of Net Income to the Number of Employees to measure employee profitability. Furthermore, Youngblood and Collins (2003) contend that employee sustainability is to describe the degree to which employees have made long-term commitment to the firm. Hence, the Employee Retention Rate is used to proxy for employee sustainability.

To sum up, corporate input resources, in terms of the BSC and its four dimensions, are estimated from the proposed proxy variables. Table 1 summarizes the preceding discussion as follows:

Table 1 The List of Variables in the Four Dimensions of the Balanced Scorecard

Dimensions of the BSC	Variable	Definition	Relationship with Performance	Reference
Financial (FIN)	Debt Ratio	$\frac{Debts}{Assets}$	−	Kaplan and Norton (1996)
	Current Ratio	$\frac{Current\ Assets}{Current\ Liabilities}$	+	
	Quick Ratio	$\frac{Quick\ Assets}{Current\ Liabilities}$	+	
	Operating Leverage	$\frac{\Delta EBIT / EBIT}{\Delta Sales / Sales}$	−	
	Financial Leverage	$\frac{\Delta NI / NI}{\Delta EBIT / EBIT}$	−	
	Total Assets Turnover	$\frac{Sales}{Assets}$	+	
	Net Profit Margin	$\frac{NI}{Sales}$	+	
Customer (CUS)	Market Share	$\frac{Company\ Sales}{Industry\ Sales}$	+	Kaplan and Norton (1996); Debusk and Crabtree (2006)
	Sales Growth	$\frac{Sales_t / Sales_{t-1}}{Sales_{t-1}}$	+	
Internal Business Processes (INT)	R&D Expense Ratio	$\frac{R\&D\ Expense}{Operating\ Income}$	+	Kaplan and Norton (1996); Kaplan and Wisner (2009)
	Accounts Receivable Turnover	$\frac{Cost\ of\ Goods\ Sold}{Average\ A.R.}$	+	
	Fixed Assets Turnover	$\frac{Sales}{Fixed\ Assets}$	+	
	Equity Turnover	$\frac{Sales}{Equity}$	+	
	Employee Productivity	$\frac{Sales}{Number\ of\ Employees}$	+	
Learning and Growth	Average Salary Ratio	$\frac{Average\ Salary}{Sales}$	+	Kaplan and Norton (1996);

After the variables in the balanced scorecard are measured, we apply a method of percentile ranking to score each variable ranging from 0 to 10 points. If the variable is positively related to firm performance, the points are given from 10 to 0 as the variable is descendingly ranked. On the contrary, if the variable is negatively related to firm performance, the points are given from 10 to 0 as the variable is ascendingly ranked. Therefore, the BSC variable is computed from the mean of the scores of four dimensions. The main advantage of this method is that the magnitude of each variable is standardized, which provides convenience for handling in the DEA analysis since the DEA implicitly assumes that all the input variables are positively related to the output variables.

3.2 Regression Analysis

To explore the causal relationship between the BSC and firm performance, the OLS regression is conducted by treating the composite BSC and its four dimensions as the independent variables and the measures of firm performance as dependent variables. Firm performance is measured from four aspects, i.e., operating performance, firm value, corporate profitability, and stock return. In addition, we add control variables to control its influence on dependent variables and to increase the explaining power of the regression models. There are three control variables under consideration, firm size, market return, and price-to-earning ratio. The common control variable is firm size, proxied by the logarithm of total assets whereas market return and price-to-earning ratio are included in the regression model when the dependent variables are affected by stock return. The research scheme of the regression analysis is exhibited in Figure 1 as follows:

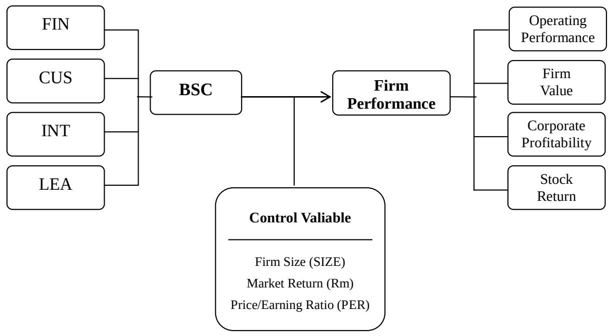

Figure 1 The Research Scheme of the OLS Regression

Literature has suggested that the measurement of firm performance could be obtained from four aspects, i.e., operating performance, firm value, corporate profitability, and stock return. According to Griffin and Mahon (1997), operating performance of a firm finds the best expression in return on assets (ROA) and return on equity (ROE). Furthermore, McConnell and Servaes (1990) and Morck, Shlerifer and Vishny (1998) argue that firm value could be estimated by Tobin's q ratio. For corporate profitability and stock return, the common measures are earning per share (EPS) and the sum of capital gain yield and dividend yield, respectively.

According to Kaplan and Norton (1992) and Kaplan and Norton (1996), the BSC could pave the way of balanced, comprehensive growth for a firm, and the four dimensions of the BSC could be regarded as corporate input resources. As a result, it is argued that the BSC as well as its four dimensions have a positive impact on firm performance. To test the argument, two hypotheses are proposed, one of which argues that the composite BSC indicator has positive impact on firm performance and the other argues that the four dimensions of the BSC have a positive impact on firm performance. The hypotheses and the empirical models are set up as follows:

H1: The composite BSC indicator has a positive impact on firm performance.

Model 1-1:

$$ROA_{it} = \beta_0 + \beta_1 BSC_{it} + \beta_2 SIZE_{it} + \beta_3 Years + \varepsilon_{it} \quad (2)$$

Model 1-2:

$$ROE_{it} = \beta_0 + \beta_1 BSC_{it} + \beta_2 SIZE_{it} + \beta_3 Years + \varepsilon_{it} \quad (3)$$

Model 1-3:

$$Tq_{it} = \beta_0 + \beta_1 BSC_{it} + \beta_2 SIZE_{it} + \beta_3 Rm_t + \beta_4 Years + \varepsilon_{it} \quad (4)$$

Model 1-4:

$$EPS_{it} = \beta_0 + \beta_1 BSC_{it} + \beta_2 SIZE_{it} + \beta_3 Years + \varepsilon_{it} \quad (5)$$

Model 1-5:

$$Ri_{it} = \beta_0 + \beta_1 BSC_{it} + \beta_2 SIZE_{it} + \beta_3 Rm_t + \beta_4 PER_{it} + \beta_5 Years + \varepsilon_{it} \quad (6)$$

where ROA_{it} denotes return on asset for firm *i* at time *t*,
BSC the composite BSC indicator,
SIZE company size, taking the natural logarithm of the total assets,
Years the dummy variables for years 2005 to 2008,
ε the error term,
ROE return on equity,
Tq Tobin's *q*,
Rm market return,
EPS earnings per share,
Ri: stock return for firm *i*,
PER price-to-earnings ratio.

H2: The BSC's four dimensions have a positive impact on firm performance.

Model 2-1:

$$ROA_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 CUS_{it} + \beta_3 INT_{it} + \beta_4 LEA_{it} + \beta_5 SIZE_{it} + \beta_6 Years + \varepsilon_{it} \quad (7)$$

Model 2-2:

$$ROE_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 CUS_{it} + \beta_3 INT_{it} + \beta_4 LEA_{it} + \beta_5 SIZE_{it} + \beta_6 Years + \varepsilon_{it} \quad (8)$$

Model 2-3:

$$Tq_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 CUS_{it} + \beta_3 INT_{it} + \beta_4 LEA_{it} + \beta_5 SIZE_{it} + \beta_6 Rm_t + \beta_7 Years + \varepsilon_{it} \quad (9)$$

Model 2-4:

$$EPS_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 CUS_{it} + \beta_3 INT_{it} + \beta_4 LEA_{it} + \beta_5 SIZE_{it} + \beta_6 Years + \varepsilon_{it} \quad (10)$$

Model 2-5:

$$Ri_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 CUS_{it} + \beta_3 INT_{it} + \beta_4 LEA_{it} + \beta_5 SIZE_{it} + \beta_6 Rm_t + \beta_7 PER_{it} + \beta_8 Years + \varepsilon_{it} \quad (11)$$

where *FIN* denotes the score of the financial dimension,
CUS the score of the customer dimension,
INT the score of the internal business processes dimension,
LEA the score of the learning and growth dimension.

3.3 Data Evolvement Analysis

After confirming the causal relationship between the BSC and firm performance, we further analyze operating efficiencies of sample firms by applying the DEA analysis, in which the four dimensions of the BSC are viewed as inputs and the measures of firm performance as outputs. The outputs of the DEA are exactly the same as the dependent variables of the OLS regression. Figure 2 shows the research scheme of the DEA analysis as follows:

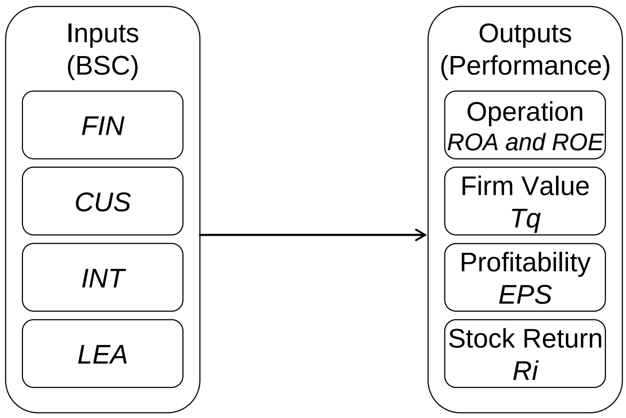

Figure 2 The Research Framework of DEA

While putting the DEA model into application, the selected input items must be positively correlated with the outputs item to meet the basic requirement of production possibility frontier. For that reason, when the correlation analysis is conducted, an input item should be deleted if there is a negative correlation with the output item. In addition, since the data is based on scoring and thus not normally distributed, the test of Spearman correlation should be conducted instead of the Pearson correlation. The outputs of interest The result of the correlation analysis is shown in Table 2.

According to Table 2, the four dimensions of the BSC are almost positively correlated with the measures of firm performance. The input, LEA, is negatively correlated with Tq while it is insignificant. Thus, it is concluded that the four dimensions of the BSC are the acceptable, dominant inputs in the DEA analysis.

Table 2 The Spearman Correlation Analysis

Outputs \ Inputs	Financial (*FIN*)	Customer (*CUS*)	Internal Operating Processes (*INT*)	Learning and Growth (*LEA*)
Return on Assets (*ROA*)	0.306*	0.336*	0.254*	0.103
Return on Equity (*ROE*)	0.274**	0.496**	0.167*	0.248*
Tobin *q* (*Tq*)	-0.384*	0.619**	0.107	-0.249
Earnings per Share (*EPS*)	0.239*	0.586**	0.230*	0.219*
Stock Return (*Ri*)	0.047	0.256	0.051	0.257

Note: * denotes $p < 0.10$ and ** $p < 0.05$.

To quantify operating efficiencies of the DMUs, three measures must be calculated in the DEA analysis, i.e., overall efficiency (OE), technical efficiency (TE), and scale efficiency (SE). The OE refers to any point on the production possibility curve that indicates sufficient and efficient utilization of all the resources. If any point on the curve shows a maximized possible production, the DMU is said to reach technical efficiency. On the contrary, any deviation from the maximized possible production is seen as technical inefficiency. OE is a product of TE and SE. Since TE takes no account of the premise of the scale factor, SE is used to describe the scale factor. SE refers to the degree to which an increase in the inputs is proportional to the outputs. There are three possible situations to describe the scale efficiency, i.e., increasing return to scale (IRS), constant return to scale (CRS), and decreasing return to scale (DRS). CRS indicates that the scale of the DMU has reached an optimum to expand the outputs, while IRS and DRS mean that there is room for an adjustment of the inputs to obtain a better efficiency.

Moreover, to compare the inter-temporal efficiency of the sample data further, this study applied the MPI to analyze the change in productivity in the period from 2004 to 2008. The MPI is defined as the product of the CTFP, the product of CTE and ST. When CTE is more than 1, the efficiency increases; otherwise, it decreases. When CT is greater than 1, the technique progresses; inversely, it retrogresses. Under the condition of VRS, CTE is subdivided into changes in pure technical efficiency (CPTE) and changes in scale efficiency (CSE).

Finally, this study utilized the matrix model proposed by the Boston Consulting Group (BCG) to conduct a matrix analysis of industry efficiency in terms of the changes in the current and inter-temporal efficiency, and then analyzed the relative competitive advantages of each branch industry.

3.4 Data Source

The industrial structure in Taiwan has changed substantially as its economy grows. Ever since 1990 the dominant industries in economy have shifted from technology-oriented to service-oriented industries. As mentioned earlier, the DEA analysis is mostly applied on the sample of technology-related firms, the study intends to fill the research gap with the sample of the service industries with the introduction of the BSC in an attempt to proposing a complete framework for performance evaluation.

The sample data used in this paper cover the firms in the tourism industry for the period from 2004 to 2008, collected from both the Taiwan Economic Journal (TEJ) and the Taiwan Stock Exchange (TWSE). In addition, some data are also collected and then computed from public information such as prospectuses and annual reports. There are seven publicly listed firms in the tourism industry (by the end of 2008). To protect the privacy of the sample firms, we name these firms A through G. The basic information of each firm is presented in Table 3.

Table 3 The Basic Information of the Sample Firms (Based on the data in 2008)

Firm	The Year Founded	The Year of Publicly Listed	Equity (in NT$ billions)	Major Business
A	1958	1965	3.231	Building Leasing, Cinemas
B	1959	1965	0.734	Restaurants, Hotels
C	1962	1982	3.669	Restaurants, Hotels
D	1968	1988	2.902	Restaurants, Hotels, Theme Parks
E	1968	1991	3.088	Building Leasing, Hotels
F	1976	1998	0.799	Restaurants, Hotels
G	1993	2003	0.665	Restaurants

4 Research Result

This section is comprised of three sub-sections, including descriptive statistics, the analysis of correlation and multicollinearity, and the efficiency analysis.

4.1 Descriptive Statistics

As discussed in the preceding section, the study sampled from the publicly listed companies of the tourism industry for the period between 2004 and 2008. Table 4 presents the descriptive statistics of the original data. As shown in Table 4, the variables indicate dramatic discrepancies. Take the debt ratio, its mean, minimum, maximum, and standard deviation are 0.3443, 0.0187, 0.7790, and 0.1443, respectively. In addition, the mean, minimum, maximum, and standard deviation of the current ratio are 2.5088, 0.1445, 32.6932, and 2.0197, respectively, which are also quite dispersed. The spread data also exist in the other three dimensions. The dispersed characteristic of the data would prevent our analysis from systematic bias.

Table 4 Descriptive Statistics – Original Data

Dimension	Measure	Var. Name	Median	Mean	Min	Max	Std. Dev.
Financial (FIN)	Debt Ratio	*DA*	0.3453	0.3443	0.0187	0.7790	0.1443
	Current Ratio	*CR*	1.9291	2.5088	0.1455	32.6932	2.0197
	Quick Ratio	*QR*	1.4818	1.9905	0.1441	26.6142	1.8126
	Net Worth/Assets Ratio	*EA*	0.6547	0.6557	0.2210	0.9813	0.1443
	Operation Leverage	*OL*	1.9800	17.5800	-142.3500	2256.00	142.8871
	Financial Leverage	*FL*	1.0300	1.7316	-11.0300	247.5800	10.7644
	Total Assets Turnover	*AT*	0.9000	1.1220	0.0400	6.8500	0.7795
	Net Profit Margin	*NPM*	0.0928	0.1397	-0.1500	5.0080	0.2423
Customer (CUS)	Market Share (*1000)	*MS*	0.1090	0.6296	0.0026	34.5967	2.1371
	Sales Growth Ratio	*SG*	0.1019	0.1633	-0.8299	13.9094	0.5829
Internal Business Processes (INT)	R & D Expense Ratio	*RD*	2.3600	3.6311	0.0000	27.0000	3.9889
	Accounts Receivable Turnover	*ART*	4.7300	6.4532	0.4900	387.3600	16.2551
	Fixed Assets Turnover	*FAT*	7.0900	77.3966	0.3900	13218.81	670.84
	Equity Turnover	*ET*	1.3500	2.0073	0.0400	15.6000	1.9605
	Productivity Indicators	*SPE*	9.1528	9.3341	6.6464	13.2436	1.0420
Learning and Growth (LEA)	Ratio of Average Income of Employees in Sales (*10000)	*SSR*	0.0090	0.0317	0.0000	4.4921	0.1369
	Average Income of Employees	*NIPE*	843.00	1417.83	-2457.00	43556.00	2289.26
	Average Income Growth Ratio of Employees	*NPG*	-0.0405	-0.2194	-289.0000	90.5000	11.8793
	Employee Retention Ratio	*ETR*	0.1100	0.1352	0.0000	0.9200	0.1220
Dependent Variable	Return on Assets	*ROA*	11.0400	12.6813	0.5100	49.5400	7.8937
	Return on Equity	*ROE*	14.6700	16.0262	-7.1300	77.0200	10.7298
	q Ratio	*Tq*	-0.0835	-0.0793	-0.7122	0.7165	0.2016
	Earnings Per Share	*EPS*	2.5000	3.4694	-0.3900	57.8500	4.0672
	Stock Return	*Ri*	-0.9906	7.1621	-85.0051	462.4834	57.9265
Control Variable	Corporate Size	*SIZE*	15.4348	15.7371	13.3956	20.2904	1.3152
	Price Earnings Ratio	*PER*	0.1821	5.4530	0.0191	435.0400	22.6096
	Market Return	*Rm*	0.0664	-0.0131	-0.4614	0.1949	0.2302

For the application of the BSC and the DEA, the original data must be transformed into the scoring data. The descriptive statistics of the scoring data is exhibited in Table 5. As shown in Table 5, the data appear to be a uniform distribution with a mean of 5 between 0 and 10. For example, the mean, median, minimum, maximum, and standard deviation of BSC are 4.8407, 4.8953, 2.9100, 6.725, and 2.0372, respectively. However, this is not surprising after the scoring of the data. For the other dimensional data, please refer to Table 5.

Table 5 Descriptive Statistics – Scoring Data

Dimension	Measure	Var. Name	Median	Mean	Min	Max	Std. Dev.
Financial (FIN)	Debt Ratio	*DA*	5.0000	4.9941	0.0000	10.0000	2.8904
	Current Ratio	*CR*	5.0000	4.9949	0.0000	10.0000	2.8904
	Quick Ratio	*QR*	5.0000	4.9949	0.0000	10.0000	2.8904
	Equity/Assets Ratio	*EA*	5.0000	4.9941	0.0000	10.0000	2.8902
	Operation Leverage	*OL*	5.0000	4.9801	0.0000	10.0000	2.9004
	Financial Leverage	*FL*	4.8600	4.5049	0.0000	10.0000	3.2783
	Total Assets Turnover	*AT*	4.9700	4.9666	0.0000	10.0000	2.9001
	Net Profit Margin	*NPM*	5.0000	4.9933	0.0000	10.0000	2.8912
Customer (CUS)	Market Share (*1000)	*MS*	5.0000	4.9951	0.0000	10.0000	2.8903
	Sales Growth Ratio	*SG*	5.0000	4.9951	0.0000	10.0000	2.8903
Internal Operating Processes (INT)	R & D Expenditure Ratio	*RD*	5.0000	4.9626	0.0000	10.0000	2.9361
	Accounts Receivable Turnover	*ART*	5.0000	4.9873	0.0000	10.0000	2.8934
	Fixed Assets Turnover	*FAT*	5.0000	4.9928	0.0000	10.0000	2.8923
	Equity Turnover	*ET*	4.9800	4.9781	0.0000	10.0000	2.8976
	Productivity Indicators	*SPE*	5.0000	4.9948	0.0000	10.0000	2.8905
Learning and Growth (LEA)	Ratio of Average Income of Employees in Sales (*10000)	*SSR*	5.0000	4.9951	0.0000	10.0000	2.8903
	Average Income of Employees	*NIPE*	5.0000	4.9932	0.0000	10.0000	2.8912
	Average Income Growth Ratio of Employees	*NPG*	5.0000	4.9950	0.0000	10.0000	2.8903
	Employee Retention Ratio	*ETR*	4.7700	4.8065	0.0000	10.0000	2.9852
BSC Dimensions	Financial	*FIN*	5.0000	4.9989	0.0000	10.0000	2.8725
	Customer	*CUS*	5.0000	4.9781	0.0000	10.0000	2.8976
	Internal Business Processes	*INT*	5.0000	4.9666	0.0000	10.0000	2.9501
	Learning and Growth	*LEA*	4.9900	4.9849	0.0000	10.0000	2.8964
	BSC Composite	*BSC*	4.8407	4.8953	2.9100	6.7525	2.0372

4.2 Analysis of Correlation and Multicollinearity

After scoring the variables of the BSC, we calculate the average score of the four dimensions and the composite BSC indicator. For checking the multicollinearity problem, the analysis of correlation and the analysis of variance inflation factor (VIF) are conducted to measure whether there was a high level of correlation between the variables.

Since the original data are transformed into the scoring data, it is more appropriate to compute the coefficients of Spearman correlation, rather than Pearson correlation. Table 6 shows the analysis of Spearman correlation. As shown in Table 6, all the coefficients are less than 0.8, appearing a low correlation and no sign of multicollinearity in the four dimensions.

To confirm whether there is multicollinearity, the VIF analysis is further conducted. The result of the VIF analysis is exhibited in Table 7. As shown in the table, all the VIFs are significantly less than 10, revealing no multicollinearity in the four dimension variables and control variables.

Table 6 The Spearman Correlation Analysis

Variable	*ROA*	*ROE*	*Tq*	*EPS*	*Ri*	*SIZE*	*PER*	*Rm*	*FIN*	*CUS*	*INT*	*LEA*	**BSC**
ROA	1												
ROE	0.860**	1											
Tq	-0.093**	-0.036	1										
EPS	0.807**	0.924**	-0.033	1									
Ri	0.301**	0.368**	-0.128**	0.275**	1								
SIZE	0.099**	0.085**	-0.304**	0.228**	0.021	1							
PER	-0.070*	-0.084**	0.029	-0.064*	0.106**	-0.170**	1						
Rm	-0.003	-0.009	-0.016	-0.011	0.084**	0.002	0.029	1					
FIN	0.487**	0.377**	0.483**	0.392**	0.087**	-0.213**	0.057*	-0.019	1				
CUS	0.183**	0.281**	-0.078**	0.310**	0.201**	0.458**	-0.107**	0.012	-0.167**	1			
INT	-0.034	0.205**	0.122**	0.235**	0.021	0.258**	-0.058*	-0.010	-0.060*	0.448**	1		
LEA	0.329**	0.349**	0.057**	0.264**	0.252**	-0.263**	-0.011	0.014	-0.281**	-0.047	-0.129**	1	
BSC	0.451**	0.567**	0.275**	0.572**	0.243**	0.151**	-0.064*	0.000	0.473**	0.593**	0.612**	0.422**	1

Note: * denotes $p < 0.10$ and ** denotes $p < 0.05$.

Table 7 The VIF Multicollinearity Test

Variables	VIF	VIF
Financial Dimension (FIN)	-	1.155
Customer Dimension (CUS)	-	1.690
Internal Operating Processes Dimension (INT)	-	1.319
Learning and Growth Dimension (LEA)	-	1.227
BSC Composite (BSC)	1.051	-
Corporate Size (SIZE)	1.070	1.503
Price to Earnings Ratio (PER)	1.082	1.091
Market Return (Rm)	1.037	1.038

4.3 Regression Analysis

H1 proposes that the BSC has a positive impact on firm performance. Five regression models therefore are established to test this hypothesis by changing different measures of the dependent variables. The empirical results are presented in Table 8. As shown from the table, five models are fitted well as the F statistics from Model 1-1 to Model 1-5 was 55.269 ($p < 0.01$), 106.066 ($p < 0.01$), 52.427 ($p < 0.01$), 111.754 ($p < 0.01$), and 208.693 ($p < 0.01$), respectively. In addition, the five regression models have a moderate explaining power as the coefficients of adjusted R2 are 0.211, 0.341, 0.228, 0.353 and 0.577, respectively.

According to Table 8, the composite BSC indicator has a significantly positive impact on firm performance as the coefficients for five models are 0.348 ($p < 0.01$), 0.440 ($p < 0.01$), 0.292 ($p < 0.01$), 0.437 ($p < 0.01$) and 0.138 ($p < 0.01$), respectively. Regarding the control variables, the variable of firm size, SIZE, shows a significance impact only in Models 1-3 and 1-4. In addition, most of the annual dummy variables show no significant impact on the dependent variables except in 2008 due to financial tsunami. Summarized from the results of Models 1-1 through 1-5, the composite BSC indicator has a significantly positive impact on the measures of firm performance, thus accepting the H1 hypothesis.

H2 proposes that the four dimensions of the BSC have a positive impact on firm performance. To test the hypothesis, five regression models are also set up by varying the dependent variables. The empirical results are presented in Table 9. As shown in the table, five models are fitted well as their F statistics in Models 2-1 through 2-5 are 93.301 ($p < 0.01$), 84.351 ($p < 0.01$), 68.527 ($p < 0.01$), 93.903 ($p < 0.01$), and 163.580 ($p < 0.01$), respectively. In addition, the five regression models have a moderate explaining power as the coefficients of adjusted R2 are 0.405, 0.381, 0.356, 0.407 and 0.594, respectively. It is apparent that the four dimensions of the BSC have a better explaining power than the composite BSC indicator since the coefficients of adjusted R2 are in general larger than those in Models 1-1 through 1-5.

Table 8 The Regression Result of H1
(BSC to Firm Performance Measures)

Model / Variable	H1				
	Model 1-1	Model 1-2	Model 1-3	Model 1-4	Model 1-5
	ROA	*ROE*	*Tq*	*EPS*	*Ri*
Constant	-2.219**	-3.597**	2.061**	-5.064**	1.385**
	(-4.632)	(-8.215)	(4.228)	(-11.662)	(3.401)
BSC	0.348**	0.440**	0.292**	0.437**	0.138**
	(16.473)	(22.802)	(13.980)	(22.835)	(8.940)
SIZE	0.046	0.010	-0.517**	0.205**	-0.018
	(1.269)	(0.305)	(-14.444)	(6.251)	(-0.654)
PER					-0.035
					(-1.314)
Rm			0.001		0.010
			(0.037)		(0.578)
2005	0.098	0.072	0.126	0.235	3.408**
	(0.405)	(0.324)	(0.524)	(1.066)	(19.076)
2006	0.180	-0.070	0.078	0.145	2.812**
	(0.753)	(-0.324)	(0.329)	(0.671)	(15.860)
2007	0.373	0.077	0.019	0.495**	1.699**
	(1.586)	(0.360)	(0.081)	(2.324)	(9.739)
2008	-0.554**	-1.097**	-1.221**	-0.303	-2.416**
	(-2.289)	(-4.957)	(-5.100)	(-1.380)	(-13.599)
R^2	0.215	0.344	0.232	0.356	0.579
$\overline{R}^2$	0.211	0.341	0.228	0.353	0.577
F	55.269	106.066	52.427	111.754	208.693
P	0.000**	0.000**	0.000**	0.000**	0.000**

Note: * denotes $p < 0.1$; **denotes $p < 0.05$.

As balanced scorecard is broken down into four dimensions, the results show that FIN and CUS are significant in Models 2-1 through 2-5, whereas INT is shown to be significantly positive in Models 2-2 through 2-4 and LEA is significantly positive in most models except in Model 2-3. In regard to the control variables, SIZE is significant in Models 2-1, 2-2, and 2-4. Also, similar to the results in Models 1-1 through 1-5, the annual dummy variables in the five models of H2 show mostly insignificance except in 2008 due to financial tsunami. Summarized from Tables 8 and 9, Table 10 provides a summary table for accepting the two hypotheses. In general, management should view the balanced scorecard as well as its four dimensions as critical corporate input resources to drive up its firm performance. This finding is consistent with those in Kaplan and Norton (1996) and Fletcher and Smith (2004).

Table 9 The Regression Result of H2
(Four Dimensions to Firm Performance Measures)

Model / Variable	H2				
	Model 2-1	Model 2-2	Model 2-3	Model 2-4	Model 2-5
	ROA	*ROE*	*Tq*	*EPS*	*Ri*
Constant	-3.740**	-4.611**	3.047**	-5.979**	0.820*
	(-8.289)	(-10.016)	(6.337)	(-13.258)	(0.055)
FIN	0.835**	0.635**	0.793**	0.717**	0.107**
	(21.674)	(16.153)	(19.768)	(18.619)	(3.346)
CUS	0.400**	0.382**	0.120**	0.347**	0.294**
	(8.449)	(7.914)	(2.428)	(7.332)	(7.507)
INT	-0.235	0.220**	0.313**	0.212**	-0.065*
	(-0.406)	(4.974)	(6.928)	(4.880)	(-1.811)
LEA	0.470**	0.582**	-0.266	0.504**	0.295**
	(9.059)	(10.996)	(-0.928)	(9.707)	(6.867)
SIZE	0.269**	0.146**	-0.453**	0.359**	-0.013
	(7.196)	(3.838)	(-11.652)	(9.602)	(-0.418)
PER					-0.022
					(-0.829)
Rm			0.010		0.009
			(0.479)		(0.520)
2005	0.000	0.019	-0.176	0.133	3.493**
	(0.000)	(0.088)	(-0.798)	(0.628)	(19.891)
2006	-0.161	-0.245	-0.244	-0.085	2.848**
	(-0.772)	(-1.148)	(-1.112)	(-0.407)	(16.288)
2007	-0.022	-0.094	-0.477**	0.242	1.760**
	(-0.108)	(-0.447)	(-2.198)	(1.171)	(10.192)
2008	-0.698**	-1.181**	-0.538**	-0.496**	-2.178**
	(-3.236)	(-5.366)	(-2.396)	(-2.302)	(-12.187)
R^2	0.409	0.385	0.362	0.411	0.598
$\overline{R}^2$	0.405	0.381	0.356	0.407	0.594
F	93.301	84.351	68.527	93.903	163.580
p	0.000**	0.000**	0.000**	0.000**	0.000**

Note: * denotes $p < 0.1$; **denotes $p < 0.05$.

Table 10 A Summary for Hypothesis Testing

	H1	H2			
	BSC	*FIN*	*CUS*	*INT*	*LEA*
ROA	+	+	+		+
ROE	+	+	+	+	+
Tq	+	+	+	+	
EPS	+	+	+	+	+
Ri	+	+	+	−	+
Hypotheses	Accept	Mostly Accept			

Note: + denotes a significantly positive impact; − denotes a significantly negative impact.

4.4 DEA Analysis

On the ground of accepting H2, we take the next step to analyze operating efficiency of the sample firms by conducting the DEA. The Malmquist productivity index was further utilized to analyze the changes in inter-temporal efficiency. Eventually, the BCG matrix model is applied to examine the competitive status of each firm in the industry.

4.4.1 Technology Efficiency and Scale Efficiency

According to the CCR and BCC models, operating efficiency is defined by overall efficiency (OE), which could be decomposed into technical efficiency (TE) and scale efficiency (SE). By treating the four dimensions of the BSC as inputs and the measures of firm performance as outputs, the results of the DEA are presented in Table 11. In addition, based on the average efficiency, Figure 3 was drawn to help compare the efficiency values.

Table 11 The Efficiency Analysis of Sample Companies

Measure / Firm	Overall Efficiency (OE)		Technology Efficiency (TE)		Scale Efficiency (SE)		Return to Scale (in five years)		
	Mean	S. D.	Mean	S. D.	Mean	S. D.	IRS	CRS	DRS
A	0.684	0.105	1.000	0	0.684	0.125	4	1	0
B	0.782	0.114	0.899	0.096	0.870	0.104	4	1	1
C	1.000	0	1.000	0	1.000	0	0	5	0
D	0.405	0.138	0.701	0.097	0.578	0.115	3	1	1
E	0.904	0.079	1.000	0	0.904	0.095	3	2	0
F	1.000	0	1.000	0	1.000	0	0	5	0
G	0.223	0.131	0.676	0.090	0.330	0.124	4	1	0
Mean	0.714	0.081	0.879	0.040	0.767	0.080	2.571	2.286	0.286

Note: 1. IRS denotes increasing scale returns; CRS constant scale returns; DRS decreasing scale returns.
2. OE = TE × SE.

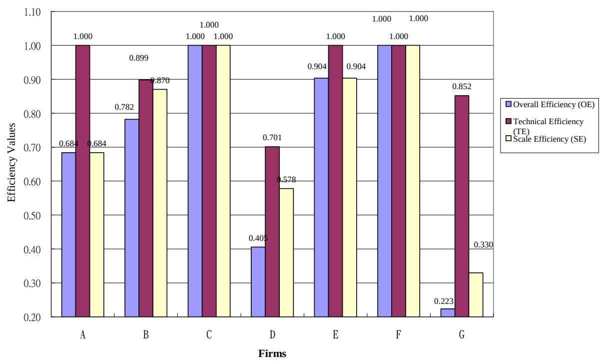

Figure 3 The Efficiency Measures of Sample Companies

As shown in Table 11 and Figure 3, the most efficient companies during the research period are Firms C and F, for both of their OEs are equal to 1. Since Firms C and F perform exceptionally well in all the efficiency measures, and have a constant return to scale throughout consequently five years, they are definitely the most efficient firms. By contrast, the relatively inefficient firms are Firms A, D, and G, since their OEs are 0.684, 0.405 and 0.223, respectively, all of which are lower than the industry mean, 0.714. Obviously, these three firms need to improve in order to catch up with their competitors.

From the measures of TE, Firms A, C, E, and F perform relatively well, indicating that these firms have achieved optimal technical efficiency and should make efforts to stay on the top.

On the contrary, the TEs of Firms D and G are 0.701 and 0.676, respectively, both of which are lower than the industry average, 0.879. This means that if these two firms could improve their technical efficiency, their overall efficiency would be greatly boosted. In terms of return to scale, Firms A, B, and G have shown increasing returns to scale for four out of five years, thus implying that they could expand their scale to improve their overall efficiency.

The OE, TE, and SE of the industry average are 0.714, 0.879, and 0.767, respectively. Since technical efficiency is higher than scale efficiency, an implication for policy-makers is that the governments should make policies to encourage firms to expand in order to improve the industrial efficiency.

4.4.2 MPI Analysis

As for MPI analysis, the results for the whole industry during the research period are presented in Table 12. As shown from the table, in the years of 2004–2005, except for CTE, all the other efficiency measures increased; in the years of 2005–2006, except for the decreasing CPTE and ST, all the others were on the rise; in the years of 2006–2007, except for CPTE, all the others were increasing; in the years of 2007–2008, all the efficiency measures dropped. It can be seen that there was a drastic decline in the year of 2008, which was possibly due to the impact of the global financial tsunami.

Table 12 The MPI Analysis (the Industry Level) for the Period of 2004-2008

Year / Efficiency	2004–05	2005–06	2006–07	2007–08	2004–08
Change in Pure Technical Efficiency (CPTE)	1.121	0.933	0.991	0.836	0.870
Change in Scale Efficiency (CSE)	1.443	1.649	1.048	0.636	1.194
Change in Technical Efficiency (CTE)	0.998	1	1	0.763	0.941
Shift in Technology (ST)	1.121	0.933	1.298	0.836	1.047
Change in Total Factor Productivity (CTFP)	1.617	1.539	1.038	0.532	1.182

Note: For each DMU (firm), CTFP = CTE × ST = CPTE × CSE × ST.

Generally speaking, the industry average of CTFP over the period of 2004-2008 was 1.182, showing a continuing growth of the overall efficiency of the industry. However, both of the CPTE and CTE were 0.870 and 0.941, respectively, indicating that the tourism industry in Taiwan could further improve the industrial operations and services by increasing the investments in the four BSC dimensions. On the other hand, the CSE for the industry is 1.194, suggesting a continuing growth of scale efficiency.

In addition to the industry-level analysis, the MPI analysis for the firm-level is also conducted and the results are exhibited in Table 13. As shown from the table, the CFTPs of most firms except for Firm D are on the rise. In particular, Firms E and F outperform their competitors in the changes in total factor productivity, reaching prominent CTFPs of 1.344 and 1.378, respectively. It is also apparent to observe that the high CTFPs in both firms result from the good performance of both CTE and ST. By contrast, Firm D suffers from a drastic drop in CTFP due to low CPTE and CTE. It is noticeable that the changes in pre technology efficiency (CPTE) of most the firms, except for Firm A, are lower than 1, suggesting the entire industry needs to further improve pure technology efficiency.

Table 13 The MPI Analysis (the Firm Level)

Efficiency Change / Firm	**Change in Pure Technology Efficiency (CPTE)**	**Change in Scale Efficiency (CSE)**	**Change in Technology Efficiency (CTE)**	**Shift in Technology (ST)**	**Change in Total Factor Productivity (CTFP)**
A	1.164	1.046	1.217	0.889	1.082
B	0.949	1.157	1.098	1.095	1.202
C	0.916	1.183	1.083	1.198	1.298
D	0.678	1.256	0.851	1.097	0.934
E	0.987	1.233	1.217	1.104	1.344
F	0.925	1.329	1.229	1.121	1.378
G	0.672	1.154	0.775	0.825	0.640

Note: CTFP = CTE × ST = CPTE × CSE × ST.

4.4.3 The BCG Matrix Analysis

The BCG matrix model is composed of two dimensions, i.e., market share and market growth, in which market share represents current competitive status of a firm (or industry) and market growth describes growth power of a firm. In the study, a similar a similar analysis of the BCG matrix model is conducted by treating OE as current competitive status and CTFP as the growth of a firm in productivity. A higher OE indicates better operating efficiency and better competitiveness, and vice versa; in addition, a higher CTFP demonstrates a greater potential in productivity growth, and vice versa. The application of the BCG matrix model to the efficiency analysis is graphed in Figure 4.

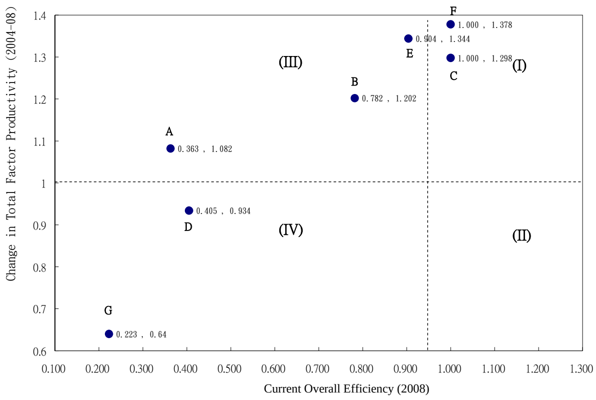

Figure 4 The Analysis of BCG Matrix

Figure 4 shows that the sample firms are divided into four types of firms according to their OE and CTFP. Type I firms, also called stars, have high values of both OE and CTFP, indicating strong competitiveness and high efficiency growth. Type II firms, also called cash cows, have a high OE but a low CTFP, suggesting strong competitiveness but a sluggish growth in efficiency. Type III firms, also called question marks, have a low OE but a high CTFP, showing relatively weak competitiveness but high efficiency growth. Finally, Type IV firms have low values of both OE and CFTP, indicating weak competitiveness and sluggish growth.

Type I firms, both of whose OEs and CTFPs are all greater than or equal to 1, should be ranked as the most competitive firms for their higher competitiveness and greater progress in efficiency. Among the sample companies, Firms C and F have good performance at present, and have made speedy progress in operating efficiency in the recent five years. Therefore, the two firms have good operating efficiency, competitive and technique advantages. However, if they want to keep their leading position, they should work harder on their market positioning and technical innovation.

Type II firms, whose OEs are greater than or equal to 1, but their CTFPs are less than 1, represented the ones with high competitiveness but lower operational efficiency. Among the sample firms, no firm falls into this zone. If any, they should be defined as firms with a good performance at the present time but lower progress in efficiency in recent years. Therefore, management should try to improve their efficiency by introducing new technology or managerial technique to ensure continuing progress in operational efficiency to maintain competitive advantages.

Type III firms, whose OEs are less than 1, but their CTFPs are more than or equal to 1, are the ones with advantages in efficiency growth but poor operating performance at present. Among the sample companies, Firms B and E remained as such a type. This means that these firms have made progress in the operating efficiency in recent years, but their current performance obviously is lagged behind that of competitors. Thus, they should manage to boost their operating performance to overcome this plight.

Type IV firms, whose OEs and CTFPs are both less than 1, are the ones who need to improve both operating performance and efficiency growth. Among the sample firms, companies A, D and G fall into this zone due to low competitiveness and slow efficiency growth. Accordingly, these firms should strive to improve their current operating efficiency and to advance their efficiency growth.
Summarized from the analysis of the BCG matrix model, Firms C and F are the leaders in the industry in terms of current competitiveness and efficiency growth. If these two firms would like to maintain their leading position, they should constantly make investments in customer satisfaction, employee productivity, internal operation, and financial health, i.e., the four dimensions of the BSC. In addition, Firms B and F have made a good progress in improving their operating efficiency, though they have not yet reached a optimal operating efficiency. Among the sample firms, Firms A, D, and G are the worst performers that fall far behind their competitors in both current operating efficiency and efficiency improvement.

Table 14 A Comparison of the BSC Inputs of IV Firms to Industry Average

Type IV Firms				
	FIN	**CUS**	**INT**	**LEA**
A	7.16	3.14*	3.94*	6.42
D	3.39*	3.54*	5.15	4.03*
G	3.46*	5.00	5.40	4.14*
Industry Average	5.05	4.99	4.86	5.00

Notes: * denotes the efficiency measure is less than industry average.

To pointing out the direction for the worst performers to improve their operating efficiency, a comparison study of the four input resources of Type IV firms to the industry is conducted and the results are presented in Table 14. As shown in Table 14, both the customer dimension (CUS) and the internal operating process dimension (INT) are scored 3.14 and 3.94, respectively, both of which are less than the industry average, indicating that Firm A needs to make investments in these two dimensions to improve their operating efficiency. For Firm D, the laggers are the financial dimension

(FIN) and the customer dimension (CUS), scored 3.39 and 3.54, respectively, showing that they should make efforts to improve their financial performance and customer satisfaction. Finally, Firm G should strive to improve their financial performance and employee growth since both scores fall below the industry average.

5 Conclusion

Since the theory of the BSC was proposed in 1992, relevant research on the BSC has been directed mostly at qualitative studies such as case or questionnaire-based studies. This study, however, integrates the BSC theory, the DEA method, and the BCG matrix model to propose a complete framework for evaluating firm performance, based on the sample of the publicly listed firm in the Taiwan tourism industry. The conclusions are given as follows:

First, the BSC is not only a conceptual theory, but is applicable to the real life management of corporate resources and performance evaluation. Based on the public information of the sample firms, this study successfully sets up the general BSC indicator and dimension indicators for monitoring firm performance that firms can abide by. With these measures, a firm could acknowledge whether it has invested sufficient resources in corporate inputs in terms of the four dimensions, i.e., financial, customer, internal operating process, and learning and growth dimensions. When it has not invested enough, the framework shows the way for management to make improvements.

Second, this study finds that the BSC has a significant, positive impact on firm performance. Thus, it is obvious that the utilization of the BSC could meet the expectations of potential investors in the capital market as well as the shareholders. More importantly, the application of the BSC could take the full development of a firm into consideration to ensure a comprehensive growth for the firm since the BSC considers not only the financial aspect but also the other aspects of stakeholders, such as customers, employees, and creditors. Therefore, the application of the BSC could not only take the interests of stakeholders into account, but also improve firm performance. As a result, the BSC is considered as a comprehensively "balanced" theory.

Third, based on the causation between BSC and firm performance, this study employs the DEA method to evaluate operational efficiency of the sample firms, which demonstrates a successful combination of two different managerial techniques. As the DEA method particularly emphasizes operating efficiencies of corporate resources, this study views the four dimensions of the BSC as the inputs and the measures of firm performance as the outputs, thus leading to a more objective analytical result for evaluating firm performance.

Fourth, this study successfully integrates the BCG's matrix model into the DEA to analyze competitive status of a firm. With the efficiency measures of the DEA, the firms could be classified into different groups, which could show a way for management to make improvements. For example, two out of the sample firms are classified into the "dog" firms, meaning that both the efficiency improvement and current operating currency are far behind their competitors. Therefore, by analyzing their corporate input resources in terms of the four dimensions of the balanced scorecard, this framework could shed light on the direction for management to improve operating efficiency.

To sum up, the major contributions of this study is that a complete framework for evaluating firm performance is proposed by integrating several managerial techniques, i.e., the BSC, the DEA, and the BCG's matrix model. The managerial implications are three-fold. First, the utilization of the BSC could not only make the evaluation of firm performance more objective, but also avoid the harms caused by adopting a single performance measure, thus allowing a firm to pay equal attention to the interests of all the stakeholders. Second, the four dimensions of the BSC should be seen as corporate input resources as wells as strategic investments for a firm as it has a significant impact on firm performance. Third, by expanding our framework to industry analysis, government decision-makers could understand how to make public policies and to allocate budget resources. Future research could be directed to include more quantitative measures for constructing a more efficient BSC indicator.

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