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Full Length Research Paper

Evaluating branch efficiency of a Taiwanese bank using data envelopment analysis with an undesirable factor

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This study applies a novel evaluation model to identify resource utility rate in the banking sector for enhancing branch operations. The Data Envelopment Analysis (DEA) model including undesirable-factor developed by Seiford and Zhu (2002) is used to determine the operational efficiency of each studied bank branch. This study identifies non-performing loan ratio as an undesirable output. Results indicate that the efficiency score differs between traditional DEA and the undesirable-factor DEA model considered here. Insufficient branches generally exhibit wasted personnel expenses and low profits. The study results can offer feasible strategies for adoption by bank branch managers to enhance performance.

Key words: Undesirable-factor, data envelopment analysis, performance evaluation.

INTRODUCTION

Facing increasing competition, financial institutions should promote their competitiveness by implementing performance evaluation, and analyzing the operating efficiency of individual branches. Banks improve their performance by reducing expenditure and increasing revenue. For banks, interest gain through loan to private consumption and corporate investment is the main source of profit growth (Hu et al., 2004). However, the more lending accompanied higher probability of non-performing loans. The non-performing loans are an unavoidable risk when lending. Furthermore, non-performing loans negatively impact performance because of increasing the costs of debts on which the debtor has defaulted (Berger and De Young, 1997; Chang, 1999; Rahman et al., 2004). Therefore, consideration should be given to include non-performing loan ratio (the ratio of non-performing loans to total loans) in performance evaluation methods. Performance evaluation methods contain ratio approach, regression analysis and Data Envelopment Analysis (DEA). However, the ratio approach can only conduct single input analysis. Regression analysis must incorporate the assumption of linear relationships among variables. DEA has been comprehensively accepted for implementing performance evaluations in banking, primarily because it permits multiple inputs and multiple outputs (MIMO) and suits for nonlinear relationship examination. Moreover, Chang (1999) incorporated undesirable outputs in performance evaluation for DEA to increase the accuracy of the analysis of operating efficiency. Therefore, it is necessary to include undesirable outputs in evaluations of bank performance. Traditional DEA approaches have mostly been used to evaluate bank performance without considering the influence of undesirable outputs. The results do not offer a comprehensive picture of performance evaluation. Instead, this study analyzes operating efficiency of individual branch with a domestic brand in Taiwan via the DEA model including undesirable-factor. Importantly, this study identifies non-performing loan ratio as an undesirable output. The contribution of the research extends our understanding of undesirable output.

LITERATURE REVIEW

Performance measurement

Regarding the method of efficiency evaluation, the ratio

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approach can merely implement single inputs and outputs. Some researchers attempt to utilize the weighted approach to combine multiple inputs and outputs. This approach selects weights subjectively and can only partially solve problems. Regression analysis was been applied to identify the relationship between independent and dependent variables. However, regression should meet the assumption of linear relationships among variables and the adequacy of the study sample. Additionally, the residual for each variable should fit in with the assumption of normal distribution. Moreover, the results presented here are only estimates. On the other hand, data envelopment analysis permits analysis of MIMO. Additionally, the efficient frontier was represented by the most beneficial condition for each decision-making units (DMUs). The study results thus were fitted with comparative function and higher acceptance for DMUs.

DEA was first proposed by Charnes et al. (1978, 1981) as a method of assessing efficiency based on mathematical programming. DEA has been widely applied in evaluating bank performance and operational efficiency (Aly et al., 1990; Athanassopoulos and Giokas, 2000; Bhattacharyya et al., 1997; Elyasiani and Mehdian, 1995; Grabowski et al., 1994; Miller and Noulas, 1996; Sherman and Gold, 1985; Soteriou and Zenios, 1999; Sufian and Habibullah, 2009). DEA has been applied in numerous areas, such as academic departments (Charnes et al., 1981; Johnes, 1990), health care organizations (Grosskopf and Valdmanis, 1987; Kooreman, 1994), transportation (Chang and Kao, 1992), department of defense (Bowlin, 1987), judicial institutions (Lewin et al., 1982), mineral extracting (Byrnes et al., 1984) and Shipping industry (Lin et al., 2010), agriculture industry (Kareem et al., 2008; Kilic et al., 2009) and so on.

Criteria for bank branch performance evaluation

Numerous studies have applied DEA to analyze efficiency in bank branches in Europe and Canada providing the primary data source. Shermand and Gold (1985) applied the DEA model to evaluate the performance of 14 branches of a particular savings bank using number of employees, office space, and operating expenses as the inputs. Four categories of outputs have been identified based on 17 financial ratios. Vassiloglou and Giokas (1990) measured the relative efficiency of different branches of a Greek commercial bank. Vassiloglou and Giokas implemented four inputs, including person-hours, supplies (for example stationery), installation (floor-area), and numbers of terminal output which is the number of transactions. Athanassopoulos (1997) studied production efficiency for 68 branches of a particular Greek bank. The input variables included number of employees, online services, number of automated teller machines (ATM) and number of computers. Furthermore, the output variables included number of deposit accounts, credit transactions, debit transactions, loan applications and transactions involving commissions. Soteriou and Stavrinides (1997) utilized DEA to evaluating performance of internal costumer service quality for bank branches in Mediterranean countries.

The input variables include clerical personnel (person hours), managerial personnel (person hours), computer terminals (terminal hours), working space (m^2), number of personal accounts, business accounts and credit application accounts. The output variable is service quality. Camanho and Dyson (1999) utilized DEA to evaluate the performance of 168 branches of a Portuguese bank in 1996. Camanho and Dyson used number of employees, floor space (m^2), operating costs and number of external ATMs as the input variables. Meanwhile, the output variables included number of general transactions, number of transactions in external ATMs, number of all types of accounts, value of saving (in thousand escudos) and value of loans (in thousand escudos). Zenios et al. (1999) applied the DEA model to analyze operating performance for a sample of banks on Cyprus. Zenios et al. (1999) divided the 145 samples into urban, rural and tourist branches. The input variables were manipulated to resource type such as managerial personnel, clerical personnel, computer terminals, and working space (m^2), as well as microeconomic type, including number of current personal accounts, savings accounts, foreign currency, and credit applications. The output variable is the branch total working hours.

Paradi and Schaffnit (2004) evaluated performance during 1993 to 1996 for 90 branches of a Canadian commercial bank. Paradi and Schaffnit implemented a production and strategic model. For the strategic model, the input variables included number of managers, accountant managers, assistants, cash managers, and expenses for information and technology, rent and non-accrual loans. The output variables included deposits, loans, fee income, deposit spread and loan spread. Wu et al. (2006) focused on 142 branches of a single Canadian bank from October to December in 2001. The input variables include personnel and other general expenses. Meanwhile, the output variables include deposits, loans and revenues. Synthesizing the aforementioned, this study considers the available for data and refer to numerous of researches to provide useful variables for bank branch performance evaluation. This study notes the importance of undesirable output for performance evaluation. Taking the paper industry as an example, outcomes included not only paper but also suspended particulates and tainted outputs. Reduced undesirable outputs were associated with enhanced performance during the production process. This study considers adding the undesirable output to performance evaluations and using different methods of interpreting desirable and undesirable outputs.

Lending is a crucial activity for banks. Once a loan becomes defaulting, banks must expend considerable resources on enforcement and debt collection (Berger et al., 1997; Chang, 1999; Rangan et al., 1988). Moreover, the undesirable output to performance evaluations could avoid incorrect analyzing operating efficiency (Chang, 1999). This study identifies non-performing loan ratio as an undesirable output. This study uses the government definition of overdue loans, namely loans that have been defaulting for six months or longer.

METHODOLOGY AND MEASUREMENT

Data envelopment analysis approach

Farrell (1957) provided the first perspective on non-parameter efficiency evaluation and proposed the concept of production frontiers. To evaluate technical and price efficiency using production frontier and isoquant curve, Farrell (1957) established the theory of whole evaluation efficiency based on mathematical programming. Charnes et al. (1978) based on the model of Ferrell (1957) who develop his model by using the constant returns to scale to evaluate production efficiency in terms of multiple inputs and outputs. It was named the data envelopment analysis (DEA), or CCR model. It is not necessary to assume production function or estimate parameter of function using nonparametric methods for the CCR model. The basic concept is to conduct linear combination for each evaluated DMUs of input and output. The results exhibit efficiency via the linear combination ratio. Regarding the determination of model weight, the final weight setting was confirmed based on the optimum combination of input and output. However, one restriction of this model is that the user must control the ratio of inputs to outputs to be below 1.

Banker et al. (1984) revised the CCR model to develop BCC model. Furthermore, Banker et al. (1984) converted the original assumption regarding restriction of constant scale return into variation scale return. Additionally, DEA could separate into two dimensions, namely input-oriented and output-oriented (Kao, 1994).

DEA with undesirable factor

Most of the literature views ignore the influence of undesirable outputs. However, the production of undesirable outputs is unavoidable in certain industries. Certain by-products such as pollution from factories, high default ratio for banking, etc. are examples of undesirable outputs (undesirable factors). On the other hand, desirable inputs are operationally beneficial. It is necessary to improve performance by reducing output or increasing input when facing inefficient contingencies for the undesirable factors. Generally, the DEA model does not allow output deduction or input progression. The DEA model thus exhibits significant limitations in dealing with negative input and output values. Pittman (1983) evaluated the production efficiency of the paper industry, and considered adding pollutants such as suspended solids, particulates and sulfur oxides as undesirable factors. Furthermore, Banker et al. (1984) established a standard linear BCC model for the DEA model. Specifically, Banker et al. (1984) designed a linear and convexity model capable of simultaneously implementing desirable and undesirable problems. Additionally, Färe et al. (1989) applied the concept of distance function proposed by Farrell (1957), develop a nonlinear DEA model for manipulating the undesirable factors. Subsequently, Seiford and Zhu (2002) revised the standard DEA model to deal with the undesirable output into the output-oriented BCC model.

Seiford and Zhu (2002) supposed the DEA data domain was shown in Equation 1:

$$\begin{bmatrix} Y \\ -X \end{bmatrix} = \begin{bmatrix} Y^g \\ Y^b \\ -X \end{bmatrix} \quad (1)$$

Where, Y^g and Y^b represent desirable and undesirable outputs, respectively.

First, each undesirable output is multiplied by "-1" and then a proper translation vector w is identified that lets all negative undesirable outputs be positive. ($\bar{Y}_j^b = -Y_j^b + w > 0$, where, $w = \max_j Y_j^b + 0.01$). The equation was shown as Equation 2:

$$\begin{bmatrix} Y \\ -X \end{bmatrix} = \begin{bmatrix} Y^g \\ \bar{Y}^b \\ -X \end{bmatrix} \quad (2)$$

The DEA model was equipped with the desirable output presented as Equation 3:

$$\begin{aligned} & Max\ h \\ & s.t. \sum_{j=1}^{n} z_j y_j^g \geq h y_o^g \\ & \sum_{j=1}^{n} z_j x_j \geq x_o \\ & \sum_{j=1}^{n} z_j = 1 \\ & z_j \geq 0,\ j = 1, \cdots, n \end{aligned} \quad (3)$$

Where, $\sum_{j=1}^{n} z_j = 1$ denotes the convexity set of efficient points of DMU. h represents relative efficiency score and z_j represents weighted input and output value.

To date, the undesirable factor model of DEA cannot be applied in the CCR mode, and can only be implemented in the output-oriented BCC mode. Consequently, this study utilizes the output-oriented BCC mode with the undesirable output (Seiford and Zhu, 2002) to evaluate bank branch performance.

Measuring inputs and outputs

The financial industry exhibits different operating process when compared to the manufacturing industry. The biggest difference is that manufacturing has explicit input and output items, while the banking industry has unclear input and output items. Favero and Papi (1995) described five methods of determining input and output variables, including production approach, intermediation approach, asset approach, user cost approach and valued-added approach. Because banks act as financial intermediaries, providing services such as deposit and loan via spending lots human and capital resource during operating process, this study refer to intermediation approach associated with Aly et al. (1990), Noulas et al. (1990), Elyasiani and Mehdian (1995) and Favero and Papi (1995). In this study, the input variables for DEA model include personnel expenses, interest fees, and incidental expenses. Moreover, the output variables are net profit, operating profit, interest gain, total loans, total deposit and non-performing loans ratio.

The study sample comprised 151 branches of a single commercial bank during 2005. Each variable is defined in detail as follows:

Input variables

Personnel expenses describe salary and employee expenses for each branch. Interest fees represent expenditure for deposit interest fees for each branch. Incidental expenses include routine expenses, taxes and rental expense.

Output variables

Net profit denotes total profit after deducting expenses. Operating profit includes fees, investment gains, exchange rate profit, other profit, and so on. Interest gains are interest gains on loans at individual branches. Furthermore, loans describe total loans for each branch. Moreover, deposit denotes total deposits for each branch. Finally, the non-performing loans ratio denotes the ratio of non-performing loans to total loans for each branch.

Factor for impacting on bank's operating performance

To further interpret the factors for impacting on bank's operating performance, this study refer to the relative literatures' method from Bender (1986), Aly et al. (1990), Favero and Papi (1995), Miller and Noulas (1996), Yildirim (2002) and Luo (2003). Therefore, this study uses efficiency scores calculated from DEA as the dependent variable and uses branch size, branch market share and branch geographical location as the explanatory variables. To discuss the non-financial factors influences on bank operating performance via the Tobit regression. Estimates of bank size could consider total assets (Ataullah et al., 2004; Forster and Shaffer, 2005; Miller and Noulas, 1996; Yildirim, 2002), total deposits (Aly et al., 1990; Favero and Papi, 1995), total sales (Gomes and Ramaswamy, 1999), number of branches (Aly et al., 1990) and employee number (Bender, 1986), etc. However, the high probability of utilizing total assets and total deposits as be input and output variables in the DEA model. Therefore, this study uses employee number as a proxy for branch size. This study measures the influence of market share on branch operating performance.

Miller and Noulas (1996) and Yildirim (2002) applied the ratio of bank eposits to total deposits as the proxy for market share. Yildirim (2002) and Papadopoulos (2004) used the ratio of bank's assets to total assets as the proxy for market share. Accordingly, this study used ratio of branch deposits to deposits of the total branches as the proxy for market share in analyzing the influence of branch market share on operating. Numerous studies pointed out that geographic location influences operating performance (Aly et al., 1990; Favero and Papi, 1995; Luo, 2003; Miller and Noulas, 1996). This study categorizes 151 branches according to their geographical location. To determine the geographical location in urban is denoted as 1, while other locations are 0, the goal is to analyze whether geographical location impacts branch operating performance (According to No. 4 of Local Government Act, the population of urban should up 150 thousands and under 500 thousands). The equation for Tobit is as follows:

$$TE_i = \beta_0 + \beta_1 Size_i + \beta_2 Market\ Share_i + \beta_3 Location_i + \varepsilon_i \qquad i = 1, 2, \cdots, 151 \tag{4}$$

Where, TE denotes the efficiency scores of the output-oriented BCC model with undesirable factors; Size represents branch size; Market Share is branch market share and Location denotes branch geographical location.

EMPIRICAL RESULTS

Descriptive statistics

The input variables for the output-oriented BCC model with undesirable factors included personnel expense, interest fees, and incidental expense. Additionally, the output variables included net profit, operating profit, interest gain, total loan, total deposit and non-performing loans ratio. Table 1 lists the descriptive statistics.

Correlation analysis

The basic requirements for DEA are that input and output scores should exceed 0 and be isotonicity. This study checks the suitability of input and output variables via the Pearson correlation test. Furthermore, this study converts the non-performing loans ratio via DEA using the undesirable factor model. Specifically, this study performs a correlation test following converting the non-performing loans ratio into undesirable non-performing loans ratio. Table 2 lists the results. The Table 2 reveals that all variables exhibit significant correlation between pairwise factors. Although the table exhibits negative relations among personnel expenses, interest fees, incidental expenses, operating profit, total deposit and undesirable non-performing loans ratio, the coefficient is not significant, fitting the principle of isotonicity.

Efficiency scores of analysis

This section implements frequency statistics analysis for 151 branches based on the results of DEA with undesirable factor. From Table 3, there are 26 efficiency branches comprising 17.2% of the sample. Additionally, there are 125 inefficient branches comprising 82.8% of the sample. The percentage of 104 braches with 90 to 99.99% efficiency scores is 68.9%. Furthermore, the percentage of 19 braches with 80 to 89.99% efficiency scores is 12.6%. Finally, the efficiency scores 1.3% of the sample, have efficiency scores below 79.99%. The mean efficiency is 95.25%. Table 4 compares the efficiency scores of the standard output-oriented BCC model, the BCC model, and the output-oriented BCC model with undesirable factors. All three models exhibit significance, whether for the Wilcoxon test or the t-test. The efficiency scores of the BCC model with undesirable factors are

Table 1. Descriptive statistics (NT$1,000).

Input/Output	Variable	N	Mean	S. D.
Input variable	Personnel expenses	151	28,166.48	9,932.45
	Interest fees	151	58,730.67	25,938.52
	Incidental expense	151	19,635.30	9,308.63
Output variables	Net profit	151	75,682.74	65,591.58
	Operating profit	151	62,008.48	34,832.62
	Interest gains	151	120,593.14	87,051.90
	Loans	151	4,046,241.27	347,263.74
	Deposits	151	6,071,942.63	2,904,836.37
	Non-performing loans ratio (%)	151	1.84	2.69

Table 2. Correlation coefficients between variables.

Coefficient	1	2	3	4	5	6	7	8	9
1. Personnel expenses	1.000								
2. Interest fees	0.745**	1.000							
3. Incidental expenses	0.799**	0.556**	1.000						
4. Net profit	0.806**	0.568**	0.825**	1.000					
5. Operating profit	0.759**	0.848**	0.556**	0.558**	1.000				
6. Interest gains	0.760**	0.530**	0.814**	0.974**	0.432**	1.000			
7. Loans	0.780**	0.545**	0.831**	0.970**	0.471**	0.984**	1.000		
8. Deposits	0.840**	0.940**	0.735**	0.742**	0.864**	0.688**	0.713**	1.000	
9. Non-performing loans ratio	-0.045	-0.013	-0.067	0.059	-0.045	0.057	0.010	-0.012	1.000

**: p<0.01.

Table 3. The different efficiency range for number distribution of branches.

Efficiency score (%)	No.	Percentage	Cumulating percentage
100	26	17.2	17.2
90.00 - 99.99	104	68.9	86.1
80.00 - 89.99	19	12.6	98.7
<79.99	2	1.3	100
Total	151	100	-

superior to those of the standard output-oriented BCC model. When non-performing loan ratio is included in performance evaluation, the more debt collects from loaner, the better positive contribution to operating efficiency. Therefore, the lower non-performing loans ratio reveals relatively high operating performance. Testing of the efficiency scores reveals a difference between the standard output-oriented BCC model BCC and output-oriented BCC model with undesirable factors. The latter can objectively express efficiency performance.

Target improving analysis

The purposes of target improvement analysis are to obtain the needed quantity of each input/output variables and potentials improvement for relatively inefficient branches trying to become relatively efficient. There were 125 branches (82.78%) requiring increases in net profit, operating profit, interest gain, total deposit and non-performing loans ratio. Moreover, there were 122 branches (80.79%) requiring increases in total loans. Furthermore, 103 branches (68.21%) needed to reduce personnel expenses. Moreover, 54 branches (35.76%) needed to decrease interest fees, and 16 (10.60%) needed to decrease incident expenses. Net profit had the highest adjustment rate which need increasing 63.12% average. Taking personnel expenses, 68.21% of branches are inefficient. It is necessary to improve performance by checking the efficiency of human resource

Table 4. The compare efficiency scores of two models.

Model	Mean	S.D.	Wilcoxon test		t-test	
			Z	P-value	t	P-value
Standard output-oriented BCC model	86.44	8.9468	-9.145	0.000**	-13.870	0.000**
Output-oriented BCC model with undesirable factors	95.25	5.0015				

***p<0.01.

Table 5. The descriptive analysis for improve of input variables.

Adjustment item	No. of branch	% of branch	Adjustment rate
Personnel expenses	103	68.21	19.95
Interest fees	54	35.76	8.84
Incidental expenses	16	10.6	9.25
Net profit	125	82.78	63.12
Operating profit	125	82.78	35.65
Interest gains	125	82.78	28.19
Loans	122	80.79	59.84
Deposits	125	82.78	7.64
Non-performing loans ratio	125	82.78	39.05

allocation and salary structure. In terms of interest fees, for economic adversity, the investors turn the investment behaviour to be conservative, so that they make the capital to be time-deposits, which results in increasing interest fees for banks. As shown in Table 5, higher incidental expenses may result from higher routine expense and rental expense.

Regarding net profit, Table 5 reveals that inefficient branches could increase revenue by improving operating profit, interest gain and increasing sales. On the part of total loan, a total of 122 branches exhibit very poor loan performance. Branches should aggressively search lending targets, and use capital flexibly. In terms of total deposit, banks improve performance by exert superior leverage strategy to absorb deposit. Several reasons exist for reducing the efficiency of non-performing loan ratio, including lack of controls over the loan approval process, economic adversity and lack of a good tracking mechanism.

Tobit regression analysis

This section discusses whether size (branch employee number), market share (ratio of branch deposits to deposits of the total branches) and geographical location influence branch performance. The dependent variable is efficiency scores which use undesirable factors to calculate DEA. This study performs Tobit regression analysis. The results are shown as follows:

The results of Tobit regression reveals a negative influence between branch size and operating efficiency (Table 6). Hiring too many employees not only increases the likelihood of human resources not being fully utilized but also influences competitiveness. Furthermore, the increased probability of human resources being underutilized decreases per employee profitability and increases salary costs, eventually negatively impacting revenues. Branch managers thus should hire an optimal number of employees. Market share positively influences branch operating efficiency. This result demonstrates that high market share represents great loyalty to branches to increasing high deposit. Additionally, high market share implies that the branch has a stable source of customers. Consequently, if the bank utilizes an improved leverage strategy to absorb deposits, it receives more distributable resource for investment and loan; furthermore, profits are improved by increasing customer numbers. Additionally, higher branch market share of deposits shows branch steady expands the enterprise domain and facilitates diversification to provide diverse services for increasing customer base.

Market share of branch deposits can be used to forecast branch operating efficiency. Based on the aforementioned results, branch number of employees and market share for deposits impact branch operating efficiency.

DISCUSSION AND CONCLUSIONS

The numbers of branches of financial institutions in Taiwan recently has grown considerably, and competition

Table 6. The results for Tobit regression.

Variable	Coefficient	S. D.	t-value	p-value
Intercept	0.9635	0.0181	53.1876	0.0000**
Size	-0.0019	0.0010	-1.8506	0.0642^{+}
Market share	8.8497	3.4477	2.5669	0.0103*
Geographical location	-0.0047	0.0139	-0.3356	0.7372
Scale	0.0567	0.0037	15.3137	0.0000**

Note: **p<0.01, *p<0.05, $^{+}$p<0.1.

has become intensely. Competition in the banking sector intensified. Therefore, the importance for performance evaluation is obvious and incontrovertible. This study stresses the utilization of output-oriented DEA with undesirable factors, a procedure developed by Seiford and Zhu (2002). This procedure is designed to examine the performance of individual branches for one of Taiwan's commercial banks. The input variables include personnel expenses, interest charges, and incidental expenses. The output variables contain net profit, operating profit, interest gain, total loan, total deposit and non-performing loans ratio. Finally, three variables are used to analyze whether non-financial factors influence branch operating performance via Tobit regression. Those three variables include branch employee number as a proxy of size, and ratio of branch deposits to deposits of the total branches as a proxy for market share, as well as geographical location.

The standard DEA model does not consider the influence of undesirable factors. Therefore, the negative impacts from the non-performing loans ratio to banking are frequently ignored, making it impossible to evaluate the performance of individual branches. However, this study utilizes DEA with undesirable factors (Seiford and Zhu, 2002) offering a solution to evaluate the performance of individual branches. When non-performing loan ratio is included in performance evaluation, the more debt collects from loaner, the better positive contribution to operating efficiency. Therefore, the lower non-performing loans ratio reveals relatively high operating performance. Additionally, this study finds that the efficiency scores generated by DEA with undesirable factors are higher than for the BCC model. Since DEA with undesirable concerned the more debt collects from loaner, the better positive contribution to operating efficiency. Therefore, the DEA with undesirable factors exhibits better capability to describe individual branch performance.

Inefficient branches are characterized by excessive inputs and inadequate outputs. To improve branch operating performance, it is necessary to reduce inputs and increase outputs. Regarding analysis of target improvement, this study finds input inefficiency to be lower than output inefficiency, but the adjust mean of personnel expense is the highest among three input variables. Notably, it is critical to avoid underutilization and waste of human resource branch and salary structure of branch. Additionally, regarding outputs, the study finds that the highest adjust mean of relative inefficiency for the branch is net profit. Consequently, individual branch should prioritize the quality of net profit to mirror the real value of operating performance. Regarding the result of Tobit regression, the market share of branch deposits is significantly and positively related with operating efficiency, meaning branch operating performance improves with deposit market share. However, the number of employees is significantly and negatively related with operating efficiency. Furthermore, the geographical location is insignificantly negatively related to operating efficiency. Banks thus exert superior leverage strategy to absorb deposit, in which creating increased deposits to conduct efficient investment and loan, and increase revenues.

Profits simultaneously increase with increasing number of customers. However, in light of branch size, optimizing employee number could reduce waste and retrench relative cost of personnel. By following the above steps the branch can increase revenue and maintain advantage. Because the efficiency scores of the DEA model are relatively absolute and data for the single year of 2005 are evaluated only, relatively efficient branches should continuously enhance their operating performance to remain competitive. Relatively inefficient branches should be cautious with regard to human resource and salary structure. Branch managers should adjust employee work content and salary in order to benefit branch operation. With respect to avoiding resource waste, banker should reduce the operation cost and expenses of debt collecting. Most deposits are transferred into loans by banks to earn much interest. Consequently, balancing deposits and loans is important, it is important to take care in approving loans to avoid future defaults.

This study finds branch market share in deposits is positively related with efficiency. Additionally, employs number is negatively related with efficiency. Consequently, with regard to suggestions for enhancing community relationship, strong relationships exist among customers and branch geographical location. The interest gain can be improved by localizing and expanding customer sources to increase loans because of rapid growth in branch numbers in Taiwan. Consequently, competition in the banking sector intensified. Most of bank customers in

Taiwan have accounts at multiple banks. Based on the service perspective, real profit and revenue of banks thus can be improved by providing high quality customer service which is important to stimulate the willingness of customer for conducting each transaction in the bank. To check human resources, banks suffering sub optimal human resources should analyze employee work content to compress human resources and allocate reallocate working scale to reduce personal expenses and increase banks operating efficiency.

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