An Empirical Study of Credit Risk Efficiency of Banking Industry in Taiwan

Kuan-Chung Chen  Chung-Yu Pan

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Abstract

The operating efficiency of Taiwanese commercial banks is a key factor on Taiwan's economic development. However, the credit risk parameters of the banks have serious impact on productivity. In this paper, we use financial ratios to assess credit risk of 34 Taiwanese commercial banks over the period 2005-08, and investigate the performance based on the credit risk parameters with data envelopment analysis (DEA) approach. Then we employ the individual mean of credit risk technical efficiency (CR-TE) at each bank over the period 2005-08 for measurement of the competitiveness and apply the individual mean of earnings per share (EPS) at each bank over the period 2005-08 to measure the profitability of each bank. Our results indicate that only one bank is efficient in all types of efficiencies over the evaluated periods. And most of the banks suffered from the global financial crisis in 2008 held many bad debts, overdue loans or loss profitability. Therefore, CR-TE, credit risk allocative efficiency (CR-AE) and credit risk cost efficiency (CR-CE) are inefficient over our observational periods. And the banks should have different strategies of credit risk management to survive in this changing environment.

Keywords: Credit Risk, Financial Ratios, Earnings Per Share, Data Envelopment Analysis.

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Introduction

Most of the studies on bank performance in the literature employ objective functions focusing on the economics of cost minimization, profit maximization or managerial utility maximization, where the performance equation denotes a cost function, a profit function or a managerial utility function (Sherman & Zhu, 2006; Lin et al., 2009; Liu, 2010). In recent years, there has been a dramatic proliferation of research concerned with risk assessment on bank performance. The notion of risk which matters is central to all industries. It is not just a question of what kinds of products will be produced, or how much it will cost. Because of its practical importance, topic on bank risk assessment has become a matter of great concern. More recently, the study of the risk preferences on the efficiencies of banks have developed rapidly and its achievements have become a center of attraction (Ozyildirim & Ozdincer, 2008).

The forces of globalization, financial deregulation and innovation have not diminished the importance of credit risk even if market and off-balance risk did capture a lot more attention during recent episodes of turmoil in international financial markets (Paradi et al., 2004). Yet credit risk is still the most significant risk for financial institutions as the devastating effects from the current credit crisis will affirm. The New Basel Capital Accord places explicitly the onus on banks to adopt sound internal credit risk management practices to assess their capital adequacy requirements. Through effective management of credit risk exposure banks not only support the viability and profitability of their own business but also contribute to systemic stability and to an efficient allocation of capital in the economy (Psillaki et al., 2010).

Credit risk is one of the oldest and most important forms of risk faced by banks as financial intermediaries. It is defined as the degree of value fluctuations in debt instruments and derivatives due to changes in the underlying credit quality of borrowers and counterparties. And, it is also measured as the uncertainty of future credit losses around their expected levels. In the literature, early research of credit risk can be traced back to Black and Scholes (1973). They put forward a basic model for corporate default risks, which was called a structural model of credit risk (Black & Scholes, 1973). While the study of Merton (1974) on the pricing of risky debt was published, interest in pricing models for credit risk has been
discussed extensively. About this setting, default of a firm occurs when the total market value of its assets falls below the value of its debts or a certain given threshold level. In order to manage this kind of risk, bank regulators select and monitor borrowers and create a diversified loan portfolio.

The literature on credit risk assessment is extensive and growing. A variety of analytical techniques have been used for credit risk assessment. They include statistical methods, models based on contingent claims and asset value coverage of debt obligations, neural networks, and operational research (OR) methods such as linear or quadratic programming and data envelopment analysis (DEA). The bulk of this literature has concentrated on the use of financial factors such as liquidity, profitability and capital structure in risk evaluation (Psillaki et al., 2010).

Formal or mathematical modeling of finance theory began in the late 1950s. The work of Markowitz (1959) proposed a framework for finance theory that has withstood the test of time. Markowitz (1959) advocated that “risk” and “return” are inextricably linked. For an individual (or an organization) to achieve a certain level of reward (both financial and non-financial), they have to accept a certain amount of risk. In the last several decades, numerous studies were carried out on the effectiveness of mergers and acquisitions (M&As) (Ismail et al., 2009), using investment portfolios to manage risk (Rossi et al., 2009), and optimization of a firm’s financing mix (Franck & Krausz, 2007).

One of the fields in which formal or mathematical modeling of finance theory has found widespread application is performance evaluation. A firm’s financial information plays a vital role in decision making of investment activities by different parties in the economy. Traditionally, the application of financial ratios helps the evaluation of bank performance. Accounting ratios may be used in order to interpret financial accounts or management accounting data. Two main reasons for using ratios as a tool of analysis are to allow comparison among different sized bank and to control for sector characteristics permitting the comparison of individual bank’s ratios with some benchmark for the sector (Halkos & Salamouris, 2004). Furthermore, the working method of financial ratios is also a widely applied approach for measuring risk. In the past, risk is usually evaluated by a function of expected profit and its standard deviation. The method is
considered that the probability distribution depends on the parameter (Flannery, 1981; Gizycki, 2001; Ennis & Malek, 2005). Recently, extensive literatures dedicated to the prediction of business failure as well as credit crisis have emerged (Mingo, 2000; Brown & Wang, 2002; Carling et al., 2007). Financial ratios are among the most popular and widely used tools of financial analysis. They provide bank regulators with clues and symptoms of underlying conditions and have been found useful in predicting business failure.

While considerable attention has been paid in the past to research issues related to bank performance evaluation, a literature on issues of bank credit risk efficiency has emerged only very slowly and in a more scattered way. Moreover, common sense seems to indicate the importance of bank credit risk efficiency, but we lack empirical support. This paper extends the efficient method of evaluating bank credit risk efficiency. We combine financial ratios with DEA model to evaluate the efficiency. Our main goal is to discuss the effect of credit risk preferences on bank performance and the techniques as applied to the advances in performance measurement. In so doing it seeks to contribute to our growing understanding of how and to what extent effect on credit risk management measures bank performance. Empirical results are of great interest both for application and scientific research.

The remainder of the paper is organized as follows. Section II presents the data and methodology used in the study. Section III discusses the research findings. Section IV presents the conclusions from the results obtained.

Data and Methodology

The Data

Financial institutions bridge the needs of lenders (savers) and those of borrowers. They provide the flow of resources from one party to the other. Among financial institutions, commercial banks play a major role. They have the largest share of intermediation and are at the very core of a financial system. This study used financial ratio and DEA to assess the 2005–08 relative financial performance of 34 Taiwanese commercial banks. We obtain the data from Taiwan Economic Journal (TEJ) database and annual report of our sample. This set should be as
homogeneous as possible to be meaningful within the DEA relative efficiency measurement characteristic. The ratio of weighted outputs to weighted inputs constitutes the DEA performance index.

Furthermore, selection of proper variables to define and to measure financial performance is always an extremely important decision. Most of the studies in the literature apply DEA for measuring the comparative efficiency of banks. Several literatures evaluate technical efficiency (TE), allocative efficiency (AE), and cost efficiency (CE) on bank operating performances, and that provide bank regulators with important information for decision-making. There are a few studies that measure bank performance by observing the change in earnings-based financial ratios including the value of return on equity (ROE), return on assets (ROA), return on tier 1 capital, average profit per employee and earnings per share (EPS). The five variables are used to determine if financial structure differences affect the relationship between the cash conversion cycle (CCC) and operating performance. Therefore, we specify five outputs that represent profitability of our sample:

Return on equity \( (Y_1) \)

\[
Y_1 = \frac{\text{Income after tax}}{\text{Average shareholders' equity}} \quad (1)
\]

Return on assets \( (Y_2) \)

\[
Y_2 = \frac{\text{Income after tax}}{\text{Average assets}} \quad (2)
\]

Return on tier 1 capital \( (Y_3) \)

\[
Y_3 = \frac{\text{Income before tax}}{\text{Average tier 1 capital}} \quad (3)
\]

Average profit per employee \( (Y_4) \)

\[
Y_4 = \frac{\text{Income after tax}}{\text{Total employees}} \quad (4)
\]

Earnings per share \( (Y_5) \)

\[
Y_5 = \frac{(\text{Income after tax} - \text{Dividends of preferred shares})}{\text{Weighted average outstanding shares}} \quad (5)
\]

In addition, we select three financial ratios in evaluating credit risk; the input set
consisted of three main items:

\[
\text{Ratio of total loans to total assets}(X_1) = \frac{\text{Total loans}}{\text{Total assets}} \tag{6}
\]

\[
\text{Ratio of deposit reserve to total deposits}(X_2) = \frac{\text{Deposit reserve}}{\text{Total deposits}} \tag{7}
\]

\[
\text{Ratio of overdue loans}(X_3) = \frac{\text{Overdue loans}}{\text{Total loans}} \tag{8}
\]

**Methodology**

DEA is a widely applied approach for measuring the relative efficiencies of a set of decision making units (DMUs), which use multiple inputs to produce multiple outputs. It has been proven to be an effective tool for performance evaluation and benchmarking since it was first introduced by Charnes et al. (1978). Charnes et al. (1978) based on the seminal paper by Farrell (1957), and is a non-parametric method of efficiency analysis. It is used to evaluate the relative efficiency of a set of comparable entities with making simultaneous use of multiple inputs and outputs. And the method does not require assumptions regarding the shape of the production frontier. After Charnes, Cooper, and Rhodes’ model (CCR), a number of different DEA models have been proposed (Banker et al., 1984; Seiford, 1996; Wu et al., 2006; Lin et al., 2009), and these models have wide applications in various performance evaluation problems. The DEA formulation is given as follows:

To estimate efficiency scores for each DMU we use DEA estimator. We assume that there are n DMUs (DMU$_j$; j = 1, 2, ..., n) within a sample having access to the same technology for transforming a vector of m inputs ($x_{ij}$; i = 1, 2, ..., m) into a vector of s outputs ($y_{rj}$; r = 1, 2, ..., s). Then the relative efficiency of DMU$_j$ can be expressed as $e_j = \frac{\sum_{i=1}^{m} v_i x_{ij}}{\sum_{r=1}^{s} u_r y_{rj}}$, where $u_r$ and $v_i$ represent output and input multipliers, respectively. And the associated output-oriented CCR-DEA model is
\[
\begin{align*}
\text{max} & \quad e'_{jk} = \phi_{jk} \\
\text{s.t.} & \quad \sum_{j=1}^{n} \delta_j x_{ij} \leq x_{ijk}, \quad i = 1, 2, \ldots, m \\
& \quad \phi_{jk} y_{rjk} \leq \sum_{j=1}^{n} \delta_j y_{rj}, \quad r = 1, 2, \ldots, s \\
\delta_j & \geq 0
\end{align*}
\]

where \( j_k \) represents one of the DMUs. And \( \phi_{jk} \) is a real variable and \( \delta_j \) is a non-negative vector. Model (9) is built on the assumption of constant returns to scale (CRS) of activities and that it evaluates TE.

Following the approach developed in Model (9), one may at the following Model (10) that accounts for cost vector, \( c = (c_1, c_2, \ldots, c_m) \). It is built on the assumption of CRS of activities and that it evaluates CE.

\[
\begin{align*}
\min_{\delta, x_{ij}} & \quad e'_{jk} = \sum_{i=1}^{m} c_i x_{ijk} \\
\text{s.t.} & \quad \sum_{j=1}^{n} \delta_j x_{ij} \leq x_{ijk}, \quad i = 1, 2, \ldots, m \\
& \quad \phi_{jk} y_{rjk} \leq \sum_{j=1}^{n} \delta_j y_{rj}, \quad r = 1, 2, \ldots, s \\
\delta_j & \geq 0
\end{align*}
\]

In fact, since the very beginning of DEA studies, various extensions of the CCR model have been proposed. The BCC (Banker-Charnes-Cooper) model is a common representative of those extensions. The BCC model has its production frontiers spanned by the convex hull of the existing DMUs. The frontiers have piecewise linear and concave characteristics which leads to variable returns to scale (VRS) characterizations with (a) increasing returns-to-scale occurring in the first solid line segment followed by (b) decreasing returns-to-scale in the second
segment and (c) constant returns to scale occurring at the point where the transition from the first to the second segment is made (Cooper et al., 2007).

BCC model is used to evaluate the pure technical efficiency (PTE) and the scale efficiency (SE). The associated output-oriented BCC-DEA model is

\[
\text{max} \quad e'_{jk} = \phi_{jk}
\]

s.t. \[
\sum_{j=1}^{n} \delta_j x_{ij} \leq x_{ijk}, \quad i = 1,2, \ldots, m
\]

\[
\phi_{jk} y_{rk} \leq \sum_{j=1}^{n} \delta_j y_{rj}, \quad r = 1,2, \ldots, s
\]

\[
\sum_{j=1}^{n} \delta_j = 1, \quad j = 1,2, \ldots, n
\]

\[\delta_j \geq 0\] \quad (11)

Similarly, taking into accounts for cost vector, \( c = (c_1, c_2, \ldots, c_m) \), one may reach at the following linear programming formula:

\[
\text{min} \quad ce'_{ij_k} = \sum_{i=1}^{m} c_i x_{ij_k}
\]

s.t. \[
\sum_{j=1}^{n} \delta_j x_{ij} \leq x_{ijk}, \quad i = 1,2, \ldots, m
\]

\[
\phi_{jk} y_{rk} \leq \sum_{j=1}^{n} \delta_j y_{rj}, \quad r = 1,2, \ldots, s
\]

\[
\sum_{j=1}^{n} \delta_j = 1, \quad j = 1,2, \ldots, n
\]

\[\delta_i \geq 0\] \quad (12)
Model (12) is used to evaluate CE on the assumption of VRS.

Regarding AC, it is given input prices and production technology, and a DMU has the ability to engage in production using the optimal proportion of investment portfolio. It is calculated by the following formula:

\[ AE = \frac{CE}{TE} \]  \hspace{1cm} (13)

**Empirical Analysis**

**Descriptive Statistical Analysis**

Table 1 gives the descriptive statistics of the variables used in the empirical analysis. It includes mean and standard deviation. In inputs, the standard deviation tells us that there are considerable differences in ratio of deposit reserve to total deposits \((X_2)\) intensity among the banks in 2005, 2006, 2007 and 2008 with year in 2006 being the most \(X_2\) intensive. In 2008, there are the lower means of the inputs \(X_2\) and \(X_3\). And in outputs, it shows that there are considerable differences in average profit per employee \((Y_4)\) intensity among the banks in 2005, 2006, 2007, and 2008 with year in 2006 being the most \(Y_4\) intensive. There are the lower means of the outputs \(Y_2\), \(Y_3\), \(Y_4\), and \(Y_5\) in 2008. We consider that banks had a lower profitability in 2008. In this analysis, we obtain a result that there are considerable differences in all inputs and outputs intensity among the banks in 2006. However, they do not indicate the effects of credit risk on the profitability over the study period.

<table>
<thead>
<tr>
<th>Var</th>
<th>2005 Mean</th>
<th>2006 Mean</th>
<th>2007 Mean</th>
<th>2008 Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>(X_1)</td>
<td>62.535</td>
<td>62.958</td>
<td>64.509</td>
<td>63.619</td>
</tr>
<tr>
<td>(X_2)</td>
<td>22.326</td>
<td>27.209</td>
<td>20.912</td>
<td>20.609</td>
</tr>
<tr>
<td>(X_3)</td>
<td>2.137</td>
<td>2.206</td>
<td>2.007</td>
<td>1.856</td>
</tr>
<tr>
<td>(Y_1)</td>
<td>122.904</td>
<td>109.720</td>
<td>117.001</td>
<td>115.701</td>
</tr>
<tr>
<td>(Y_2)</td>
<td>6.281</td>
<td>5.676</td>
<td>5.975</td>
<td>5.623</td>
</tr>
<tr>
<td>(Y_3)</td>
<td>160.323</td>
<td>165.676</td>
<td>155.878</td>
<td>154.504</td>
</tr>
<tr>
<td>(Y_4)</td>
<td>12069.510</td>
<td>11433.760</td>
<td>11671.384</td>
<td>10421.327</td>
</tr>
<tr>
<td>(Y_5)</td>
<td>9.588</td>
<td>8.269</td>
<td>8.156</td>
<td>7.850</td>
</tr>
</tbody>
</table>

We consider that banks had a lower profitability in 2008. In this analysis, we obtain a result that there are considerable differences in all inputs and outputs intensity among the banks in 2006. However, they do not indicate the effects of credit risk on the profitability over the study period.
Credit Risk Efficiency Analysis

Table 2 presents the results of DEA. We apply financial ratios to evaluate credit risk and employ the output-oriented DEA model to estimate contemporaneous credit risk technical efficiency (CR-TE), credit risk allocative efficiency (CR-AE), and credit risk cost efficiency (CR-CE) for the banks in our sample. In table 2, we can find that Bank 7 is efficient in all types of efficiencies over the study period, because all efficiency scores are equal to “1”. The result shows that Bank 7 may have good credit risk management and its performance is stable. It also represents that the bank has better performance than others, and there are no adverse effects in credit risk changes due to the global financial crisis in 2008 in Bank 7. Bank 9 and 12 are efficient in CR-TE over the study period, but they are inefficient in CR-AE and CR-CE in 2008. Clearly, the findings indicate that the global financial crisis in 2008 has negative effect on CR-AE and CR-CE of Bank 9 and 12. Nevertheless, there are thirteen banks never attaining the perfect efficiency score 1.0 during the four years, namely, Bank 3, 14, 17, 19, 20, 21, 22, 23, 25, 26, 27, 31, and 33. The result indicates that these banks have poorer performance than others over the study period. According to our investigation, the global financial crisis, brewing for a while, really started to show its effects in the middle of 2007 and into 2008. And most of the banks suffered from the global financial crisis held many bad debts, overdue loans or loss profitability. Therefore, CR-TE, CR-AE and CR-CE of the thirteen banks are inefficient over our observational periods. Furthermore, the average CR-TE, CR-AE, and CR-CE of 2008 are smaller than that of 2005, 2006, and 2007. In the analysis of the results, it points out that the global financial crisis really hurts the performance for some banks.

Table 2 Credit Risk Technical Efficiency, Credit Risk Allocative Efficiency, and Credit Risk Cost Efficiency

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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.948</td>
<td>0.911</td>
<td>1.000</td>
<td>0.953</td>
<td>0.866</td>
<td>0.911</td>
<td>0.791</td>
<td>0.744</td>
<td>0.821</td>
<td>0.830</td>
<td>0.791</td>
<td>0.709</td>
</tr>
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<td>0.829</td>
</tr>
<tr>
<td>3</td>
<td>0.783</td>
<td>0.776</td>
<td>0.731</td>
<td>0.701</td>
<td>0.877</td>
<td>0.984</td>
<td>0.950</td>
<td>0.956</td>
<td>0.687</td>
<td>0.763</td>
<td>0.694</td>
<td>0.670</td>
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<tr>
<td>4</td>
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<td>1.000</td>
<td>1.000</td>
<td>0.830</td>
<td>1.000</td>
<td>0.978</td>
<td>0.905</td>
<td>0.986</td>
<td>1.000</td>
<td>0.978</td>
<td>0.905</td>
<td>0.818</td>
</tr>
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<td>5</td>
<td>1.000</td>
<td>1.000</td>
<td>0.952</td>
<td>1.000</td>
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<td>0.948</td>
<td>0.915</td>
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<td>1.000</td>
<td>0.948</td>
<td>0.871</td>
<td>1.000</td>
</tr>
<tr>
<td>6</td>
<td>0.889</td>
<td>1.000</td>
<td>0.876</td>
<td>0.810</td>
<td>0.963</td>
<td>1.000</td>
<td>0.924</td>
<td>0.976</td>
<td>0.856</td>
<td>1.000</td>
<td>0.810</td>
<td>0.790</td>
</tr>
<tr>
<td>7</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
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<td>1.000</td>
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</tr>
<tr>
<td>8</td>
<td>0.937</td>
<td>0.868</td>
<td>0.875</td>
<td>1.000</td>
<td>0.894</td>
<td>0.878</td>
<td>0.875</td>
<td>0.723</td>
<td>0.838</td>
<td>0.762</td>
<td>0.766</td>
<td>0.723</td>
</tr>
</tbody>
</table>
of each DMU, we depict the CR-TE and EPS of the Taiwanese commercial banks over the period 2005-08 in Figure 1. In Figure 1, we employ the horizontal axis to represent the individual mean of CR-TE at each DMU over the period 2005-08 for measurement of the competitiveness and the vertical axis to display the individual mean of EPS at each DMU over the period 2005-08 for measuring the profitability of each bank. We utilize the total average values of CR-TE and EPS to determine the threshold values. From table 3, we have the total average value of CR-TE 0.883 for the four years. And we obtain the total average value of EPS

| Ave. | 0.908 0.899 0.882 0.851 0.958 0.941 0.934 0.914 0.871 0.835 0.821 0.775 |

Note: CR-TE = credit risk technical efficiency; CR-AE = credit risk allocative efficiency; CR-CE = credit risk cost efficiency

CR-TE and EPS Analysis

Table 3 shows the mean of CR-TE and the mean of EPS over the study period. In order to understand the relevance between credit risk efficiency and profitability of the DMUs, we depict the CR-TE and EPS of the Taiwanese commercial banks over the period 2005-08 in Figure 1.
Overall, there are fourteen DMUs which have an average CR-TE above 0.883 and an average EPS above -0.03. They are Bank 1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 18, 28, and 34. The result shows that these banks should hold and gain the competition advantage and improve their profitability over the evaluated periods. And this might indicate that these banks are right in their credit risk management. They should maintain and gain the greater competitive advantage and seek to find further improvements. On the other hand, Bank 6, 15, 24 and 29 have an average CR-TE above 0.883, but an EPS below -0.03. At present, these four DMUs should hold the competition advantage, but their EPS represent their profitability deterioration. We consider that these banks maintain the competitive advantage, but do not explore the opportunities to improve their profitability. Especially, there are three DMUs, namely, Bank 3, 17, and 27, which have an average CR-TE below 0.883, but an EPS above -0.03. Compared to other banks, although these three banks do not have the competition advantage, they have their substantial profitability for the four years. In the case of Bank 14, 16, 19, 20, 21, 22, 23, 25, 26, 30, 31, 32, and 33, these DMUs have an average CR-TE below 0.883 and an EPS below -0.03. The result clearly implies that these banks have less competitiveness and profitability deterioration than other banks. We regard that these banks should reexamine their actions and activities in their credit risk management.

<table>
<thead>
<tr>
<th>Bank (DMU)</th>
<th>CR-TE</th>
<th>EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.948</td>
<td>0.911</td>
</tr>
<tr>
<td>2</td>
<td>0.840</td>
<td>0.939</td>
</tr>
<tr>
<td>3</td>
<td>0.783</td>
<td>0.776</td>
</tr>
<tr>
<td>4</td>
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<td>1.000</td>
</tr>
<tr>
<td>5</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>6</td>
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<td>1.000</td>
</tr>
<tr>
<td>7</td>
<td>1.000</td>
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<tr>
<td>8</td>
<td>0.937</td>
<td>0.868</td>
</tr>
<tr>
<td>9</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>10</td>
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<td>11</td>
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<tr>
<td>13</td>
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### Table 1: CR-TE and EPS

<table>
<thead>
<tr>
<th></th>
<th>CR-TE</th>
<th>EPS</th>
</tr>
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<tbody>
<tr>
<td>14</td>
<td>0.828</td>
<td>0.859</td>
</tr>
<tr>
<td>15</td>
<td>0.777</td>
<td>1.000</td>
</tr>
<tr>
<td>16</td>
<td>0.746</td>
<td>0.714</td>
</tr>
<tr>
<td>17</td>
<td>0.754</td>
<td>0.761</td>
</tr>
<tr>
<td>18</td>
<td>0.884</td>
<td>0.833</td>
</tr>
<tr>
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**Ave.**

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*Note: CR-TE = credit risk technical efficiency; EPS = earnings per share*

**Figure 1: CR-TE and EPS**
Conclusion

This study examines credit risk efficiency of the 34 Taiwanese commercial banks over the period 2005-08. This paper uses output-oriented DEA model with financial ratios to measure CR-TE, CR-AE and CR-CE.

The DEA results show relatively low average efficiency levels in CR-TE, CR-AE and CR-CE in 2008. It is possible to have the adverse effects in the average efficiency scores due to the global financial crisis over the period of analysis for the banking systems in our sample. However, in order to analyze the relevance between credit risk efficiency and profitability of the DMUs over the four years, we utilize the individual mean of CR-TE as the measurement of the competitiveness and employ the individual mean of EPS to measure the profitability of each bank over the years from 2005 to 2008.

According to the values of the individual mean of CR-TE and the individual mean of EPS of our sample, we classify the 34 banks into four groups, namely, high competitiveness and high profitability, high competitiveness but low profitability, low competitiveness but high profitability, and low competitiveness and low profitability. Different groups of banks should have different strategies of credit risk management to survive in this changing environment. For example, the banks have low competitiveness and low profitability should consider to be merged with other banks or reexamine their actions and activities in their credit risk management.

References


