DOES SIZE MATTER? FINDING THE PROFITABILITY AND MARKETABILITY BENCHMARK OF FINANCIAL HOLDING COMPANIES

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The aim of this paper is to explore the efficiency and the benchmarks of financial holding companies (FHCs) for a small open economy, Taiwan. We employ a two-stage production process including profitability and marketability performance using a non-parametric frontier method — data envelopment analysis (DEA). Furthermore, the factor-specific measure and BCC (Banker-Charnes-Cooper) model are combined together not only to identify the inputs/outputs that are most important but also to distinguish those FHCs which can be treated as benchmarks. Our empirical result shows that (1) big-sized FHCs are generally more efficient than small-sized ones; (2) FHCs with the main body of insurance averagely perform better than the other two types (banks and securities); (3) while small efficient FHCs are easily to become benchmarks, big efficient FHCs are deemed as competitive niche players; (4) further mergers and acquisitions among FHCs should be considered so as to achieve economies of scale. The profitability/marketability matrix of FHCs is also presented.

Keywords: DEA; performance; reference-share measure; FHCs.

1. Introduction

The financial services industry is undergoing global restructuring. Over the past several years, the advent of financial holding companies has opened up cross-industry operations and this type of financial service institution has already become popular in the United States and Japan. The government of the United States passed the

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Financial Services Modernization Act in 1999, known as the Gramm–Leach–Bliley Act, abolishing the Banking Law and the Glass–Steagall bill, which had demanded the separation of the activities of commercial banks, investment banks, and insurance companies for over 60 years. In 1997, Japan reformed the Anti-Monopoly Law and passed the Financial System Reform Law and the Bank Holding Company Act. The laws were implemented in 1998. While the US and Japan banks had been prohibited from expanding into many service activities, the financial landscape in Europe, however, has been quite different and there is a long history of 'universal banking' where financial institutions offer a broad range of financial services, including lending, deposit-taking, underwriting, brokerage, trading, and portfolio management. Referring to American and Japanese experiences of financial reform, Taiwan's government passed a package of legislation to reform its financial sector. The most important part of this legislation was the Financial Holding Company (FHC) Act in 2001, which created a regulatory framework for local financial institutions to merge or acquire cross-financial industry operations.

Fourteen holding companies in Taiwan have begun operating since the government implemented the Financial Holding Company Act. The law enables the establishment of a holding company, which acts as a management umbrella, to invest in subsidiary institutions engaging in different kinds of financial services such as banking, insurance, securities, bills financing, and venture capital. Since it allows for cross-selling and sales of various financial products, company synergy should therefore be achieved. Consumers, on the other hand, can enjoy the convenience of one-stop shopping. It is generally believed that the establishment of FHCs will promote economies of scale and help the banking sector to compete more efficiently. The FHC framework in Taiwan is designed as no bidders and targets. A FHC is constructed as a pure financial holding company with more than two other financial subsidies. These 14 FHCs are divided into: (i) banks as the main body: Hua Nan, China Development, E.SUN, Mega, Taishin, Sinopac, Chinatrust, and First; (ii) insurance as the main body: Cathay, Fubon, and Shin Kong; (iii) securities as the main body: Fuhwa, Waterland, and Jihsun.

Even though the mushrooming of holding companies virtually guarantees an expansion in scope, the FHCs in Taiwan are still "too many, too small" compared to other Asian countries. For instance, the three largest banks in both Hong Kong and Singapore have a total market share of more than 88% and 80%, respectively. However, none of these 14 FHCs in Taiwan have a market share of more than 10%. It is suggested that about no more than five holding companies should be established for the sake of market scale in Taiwan’s small economy. Taiwan’s financial holding companies therefore urgently need to merge in order to get benefits from multi-business synergy and to raise stockholders’ value in this highly competitive market place.

Operating efficiently is the major task of survival for FHCs especially in a small market which has been highly saturated and competitive. Although the history of FHCs in Taiwan is quite short compared with other industrialized countries, this issue cannot be ignored since this small economy is vulnerable to the existence of
big inefficient financial institutions. Furthermore, we would like to test the general belief whether a FHC’s size matters to its performance or if it should be referenced frequently. The aim of this paper is therefore to measure the efficiency and to find the benchmarks of FHCs in Taiwan. We employ a two-stage production process including profitability and marketability performance using a non-parametric frontier method — data envelopment analysis (DEA).

Since efficiency is an important topic in banking, numerous studies on this related topic have been published. DEA is one of the common techniques used to measure bank efficiency. There are several journals that have published special issues on banking efficiency using the DEA technique, such as the *European Journal of Operations Research* (1997), the *Journal of Economics and Business* (1998), and *Management Science* (1999). An international survey of 130 studies of efficiency performance of financial institutions is given by Berger and Humphery (1997). However, there are several important banking issues less considered in the previous literature.

First, empirical studies rarely treat a financial service institution as a whole entity with an integrated perspective. Verweire (1999) proposes some reasons: Financial conglomeration has been prohibited in many countries for decades. The financial consolidation trend is relatively new. The main financial conglomerates were formed at the end of the 1980s and the early 1990s. Another reason is that the banking industry, the insurance industry, and the security industry for a long time have been separately studied, because each of them has its own characteristics, valuation techniques, and accounting systems. This makes comparisons more difficult. Since FHCs are gradually becoming a new and dominant form in the global financial services industry, the implementation and evolution of FHCs in various countries are worthy of our efforts to study.

Second, while focusing on bank efficiency, the previous literature usually ignores the market reaction or investors’ valuation for the financial service industry. It is generally agreed that the infrastructure and information-sharing nature of holding companies will save costs. This then yields diversified earnings and higher returns. However, while profit efficiency is important for a bank, marketability is also crucial, because the existence of any corporation is for the maximization of its stockholders’ wealth. The capital market or investors usually pay attention to a FHC’s earnings per share (EPS), stock price level, and market value. In other words, the value of a FHC is ultimately assessed by the stock market. Seiford and Zhu (1999) initially employ the DEA technique to propose a two-stage production process examining both the profitability and marketability efficiency of the top 55 US commercial banks. Following their model, Luo (2003) takes a sample of 245 US large banks in his research. Zhu (2000) employs this model in an application to Fortune 500 companies. From this, it would be very interesting to apply this two-stage process model to FHCs.

Third, using the DEA model will produce plural FHCs having a full efficient status denoted by unity. A number of the FHCs might be possible to lead on the frontier. To discriminate between these efficient FHCs, the reference-share measure
(Zhu, 2000) defines a ranking measure by combining the factor-specific measure and VRS (variable returns-to-scale)/BCC (Banker–Charnes–Cooper) model. We can then identify the input/output that are most important or distinguish those FHCs which can be treated as benchmarks.

There are three more sections aside from this introductory section. Section 2 introduces the research design and data selection. Section 3 presents the empirical results and analysis. Finally, conclusion remarks are given in the last section.

2. Research Design

2.1. Defining performance models

Since a company’s performance is a complex phenomenon requiring more than a single criterion to characterize it, a number of studies have argued that a multi-factor performance measurement model may be used (Bagozzi et al., 1982; Chakravarthy, 1986). Seiford et al. (1999), Zhu (2000), and Luo (2003) develop a multi-factor performance measure model for US companies. This study adopts Seiford’s (1999) two-stage transformation process (Fig. 1) to design two performance models, namely, profitability performance and marketability performance.

From Fig. 1, the profitability performance model (stage-1) measuring a FHC’s ability to generate revenue and profit consists of three inputs (assets, stockholders’ equity, and employees) and two outputs (revenues and profits). The marketability performance model (stage-2) measuring a FHC’s attractiveness in the stock market consists of two inputs (revenues and profits) and three outputs (market value, stock price, and earnings per share (EPS)). The output and input factors (eight financial measures) used in this study are defined as follows:

- Employees are composed of all staff members in a FHC to keep operating normally.
- Revenues include consolidated subsidiaries and exclude excise taxes.

![FHC Production Process](image)

Fig. 1. Profitability and marketability efficiency models for FHC (Adapted from Seiford et al., 1999).
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- Profits are after taxes, after extraordinary credits or charges, and after cumulative effects of accounting charges.
- Assets are the company's year-end total.
- Equity is the sum of all capital stock, paid-in capital, and retained earnings at the company's year-end.
- Market value is obtained by multiplying the number of common shares outstanding by the price per common share as of December 31, 2003.
- EPS for each company is the primary earnings per share that appear on the income statement.
- Stock price is the price per common share as of December 31, 2003.

2.2. Sample and data

This paper uses a sample of 14 FHCs in Taiwan. Each of these FHCs is treated as a decision making unit (DMU) in DEA analysis. At the end of 2003, there are 14 FHCs operating, and we therefore include these FHCs into our investigation. Since 14 financial holding company licenses have been issued through 2003 in Taiwan, we use the data based on 2003. The inputs and outputs data were extracted from the Taiwan Economic Journal (TEJ) data bank. The TEJ data bank is commonly deemed valid, reliable, and available to the public. Table 1 presents the descriptive statistics for our data set.

The DEA technique presumes the existence of a relationship among inputs and outputs data, and a correlation analysis is therefore performed in Table 2. The correlation coefficients between the selected three input factors and two output factors are positive in the profitability model. These input and output factors hold an isotonical relationship, and therefore they can be included within one model. According to Golany et al. (1989), the number of FHCs should be at least twice of the total number of input and output factors considered when using the DEA model. In this study the number of FHCs is 14, at least twice the selected five factors for the profitability performance model. We hence conclude that the developed DEA model of the profitability performance model holds high construct validity. Following the above rules, the marketability performance model also achieves high construct validity.

Table 1. Descriptive statistics for the 14 FHCs in Taiwan.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std. Dev.</th>
</tr>
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<tbody>
<tr>
<td>Assets (NT$100 million)</td>
<td>9007.31</td>
<td>416.56</td>
<td>23416.96</td>
<td>6875.79</td>
</tr>
<tr>
<td>Equity (NT$100 million)</td>
<td>742.39</td>
<td>238.00</td>
<td>1565.33</td>
<td>482.54</td>
</tr>
<tr>
<td>Employees</td>
<td>8308.50</td>
<td>1318.00</td>
<td>33660.00</td>
<td>8087.78</td>
</tr>
<tr>
<td>Revenues (NT$100 million)</td>
<td>911.13</td>
<td>79.38</td>
<td>5257.47</td>
<td>1371.14</td>
</tr>
<tr>
<td>Profits (NT$100 million)</td>
<td>50.67</td>
<td>-130.41</td>
<td>205.89</td>
<td>96.80</td>
</tr>
<tr>
<td>EPS (NT$)</td>
<td>1.07</td>
<td>-2.30</td>
<td>2.48</td>
<td>1.38</td>
</tr>
<tr>
<td>Market value (NT$100 million)</td>
<td>1343.66</td>
<td>187.02</td>
<td>4236.82</td>
<td>1157.06</td>
</tr>
<tr>
<td>Stock price (NT$)</td>
<td>22.64</td>
<td>8.30</td>
<td>51.00</td>
<td>11.19</td>
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Table 2. Correlation coefficients among inputs and outputs.

<table>
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<tr>
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<th>Equity</th>
<th>Employees</th>
<th>Revenues</th>
<th>Profits</th>
<th>EPS</th>
<th>Market Value</th>
<th>Stock Price</th>
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<tr>
<td>Assets</td>
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<td>Employees</td>
<td>0.7641</td>
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<tr>
<td>Revenues</td>
<td>0.7037</td>
<td>0.4573</td>
<td>0.9784</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Profits</td>
<td>0.5600</td>
<td>0.4339</td>
<td>0.5413</td>
<td>0.5432</td>
<td>1.0000</td>
<td></td>
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<tr>
<td>EPS</td>
<td>0.2163</td>
<td>0.0700</td>
<td>0.3684</td>
<td>0.3913</td>
<td>0.8645</td>
<td>1.0000</td>
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<tr>
<td>Market value</td>
<td>0.8230</td>
<td>0.9079</td>
<td>0.7475</td>
<td>0.7500</td>
<td>0.4999</td>
<td>0.1813</td>
<td>1.0000</td>
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<tr>
<td>Stock price</td>
<td>0.8141</td>
<td>0.6269</td>
<td>0.8469</td>
<td>0.8110</td>
<td>0.5535</td>
<td>0.3870</td>
<td>0.8546</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

2.3. DEA models

DEA was originally introduced by Charnes et al. (1978) and conventionally is a non-parametric linear programming approach, capable of handling multiple control inputs and outputs. DEA was initially designed to investigate the relative efficiency of non-profit organizations and is now widely applied to profit-making organization. It has been successfully applied in diverse settings such as hospitals, schools, courts, the US Air Force, rate departments, banks, etc (Seiford 1996; Gattoufi et al., 2004; Sueyoshi et al., 2004a, 2004b). Charens et al. (1997) compile an extensive discussion of efficiency models across a variety of industries.

We assume that the objective of each FHC is to minimize its inputs, keeping the output level constant in the CRS (constant returns-to-scale)/CCR (Charnes-Copper-Rhodes) model. The technical efficiency of the FHC\(_{jo}\) (\(jo = 1,2,\ldots,n\)) can be computed as a solution to the following linear programming (LP) problem:

\[
\text{Min } \theta_{jo} - \varepsilon \left( \sum_{i=1}^{m} s_{i}^{-} + \sum_{r=1}^{s} s_{r}^{+} \right) \\
\text{s.t. } \sum_{j=1}^{n} \lambda_{j} x_{ij} + s_{i}^{-} = \theta_{jo} x_{ijo}, \quad i = 1,\ldots,m, \\
\sum_{j=1}^{n} \lambda_{j} y_{rj} - s_{r}^{+} = y_{rjo}, \quad r = 1,\ldots,s, \\
\theta_{jo}, \lambda_{j}, s_{i}^{-}, s_{r}^{+} \geq 0; \quad \forall i \text{ and } r, \\
\varepsilon \text{ is non-Archimedean infinitesimal},
\]

where \(x_{ij}\) and \(y_{rj}\) are the amount of the \(i\)th input consumed and amount of the \(r\)th output produced by the \(j\)th FHC, respectively. The technical efficiency (TE) of FHC\(_{jo}\) equals TE = \(\theta_{jo}\). By varying the index \('jo'\) over all FHCs, we will get the technical efficiency in each FHC. If TE = 1 and all input and output slacks, \(s^{-}\) and \(s^{+}\), are equal to zero, then FHC\(_{jo}\) is technically efficient. If TE is smaller than 1, then FHC\(_{jo}\) is technically inefficient.
The solution value of $\lambda_j$ indicates whether FHC$_j$ serves as a role model or peer for FHC$_{jo}$. If $\lambda_j = 0$, then FHC$_j$ is not a peer. However, if $\lambda_j > 0$, say $\lambda_j = 0.4$, then FHC$_j$ is a peer FHC with a 40% weight placed on deriving the target efficient output and input levels for FHC$_{jo}$. For an inefficient FHC$_{jo}$, we have the expression in Eq. (2):

$$\theta_{jo}x_{ijo} = \sum_{j=1}^{n} x_{ij}\lambda_j^* + s_i^{-*}, \quad i = 1, \ldots, m,$$

$$y_{rjo} = \sum_{j=1}^{n} y_{rj}\lambda_j^* - s_r^{+*}, \quad r = 1, \ldots, s,$$

where $\theta_{jo}, s_i^{-*}, s_r^{+*}$ and $\lambda_j^*$ are optimal slacks and weights obtained from Eq. (1). The FHC$_{jo} (x_{io}, y_{ro})$ can be improved and become efficient by deleting its excess input and augmenting the shortfall output as follow:

$$\hat{x}_{ijo} = \theta_{jo}x_{ijo} - s_i^{-*} = \sum_{j=1}^{n} x_{ij}\lambda_j^*, \quad i = 1, \ldots, m,$$

$$\hat{y}_{rjo} = y_{rj} + s_r^{+*} = \sum_{j=1}^{n} y_{rj}\lambda_j^*, \quad r = 1, \ldots, s,$$

This operation is called CCR-projection.

The BCC (Banker et al., 1984) model evaluates the performance in the context of variable returns to scale (VRS) by imposing an additional constraint of $\sum_{j=1}^{n} \lambda_j = 1$ into Eq. (1). That is,

$$\min \quad \rho_{jo} - \varepsilon \left( \sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right)$$

s.t.

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \rho_{jo}x_{ijo}, \quad i = 1, \ldots, m,$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{rjo}, \quad r = 1, \ldots, s,$$

$$\sum_{j=1}^{n} \lambda_j = 1,$$

$$\rho_{jo}, \lambda_j, s_i^-, s_r^+ \geq 0; \quad \forall i \text{ and } r,$$

$\varepsilon$ is non-Archimedean infinitesimal.

The pure technical efficiency (PTE) of FHC$_{jo}$ equals $\text{PTE} = \rho_{jo}$. If $\text{PTE} = 1$ and all input and output slacks, $s^-$ and $s^+$, are equal to 0, then FHC$_{jo}$ is pure technically efficient. A scale efficiency (SE) is defined by the ratio of the $\text{SE} = \text{TE}/\text{PTE}$. If the ratio is equal to one, then FHC$_{jo}$ is scale efficient; otherwise, if the ratio is less than one, then FHC$_{jo}$ is scale inefficient.
To determine the current operating region for scale inefficient FHCs, following the recent result of Zhu and Shen (1995), one can easily estimate the returns to scale (RTS) by the TE and PTE scores and $\sum_{j=1}^{n} \lambda_j$ in any optimal solution to the CCR model. That is, if the TE = PTE, then CRS (constant returns-to-scale) prevails; otherwise, if the TE $\neq$ PTE, then $\sum_{j=1}^{n} \lambda_j < 1$ indicates IRS (increasing returns-to-scale) and $\sum_{j=1}^{n} \lambda_j > 1$ indicates DRS (decreasing returns-to-scale).

To identify the inputs/outputs that are most important or to distinguish those efficient FHCs which can be treated as benchmarks, the reference-share measure (Zhu, 2000) is defined as a ranking measure by combining the factor-specific measure and BCC model. Lewin et al. (1982) and Torgersen et al. (1996) report the application for output-specific efficiency measures which are derived from radial component and non-zero slacks. Here, for a particular inefficient FHC the factor-specific ($k$th input-specific and $q$th output-specific) measure is via the following two linear programming problems and the existing BCC model's best practice frontier.

The $k$th input-specific DEA model can be written as follows:

$$\theta_{d}^{k*} = \min \theta_{d}^{k}, \quad d \in N,$$

s.t.

$$\sum_{j \in E} \lambda_{d}^{k} x_{ij} = \theta_{d}^{k} x_{kd}, \quad k \in \{1, \ldots, m\},$$

$$\sum_{j \in E} \lambda_{d}^{k} x_{ij} \leq x_{id}, \quad i \neq k,$$

$$\sum_{j \in E} \lambda_{d}^{k} y_{rj} \geq y_{rd}, \quad r = 1, \ldots, s,$$

$$\sum_{j \in E} \lambda_{d}^{k} = 1,$$

$$\lambda_{d}^{k} \geq 0, \quad j \in E.$$  \hfill (5)

The $q$th output-specific DEA model can be written as follows:

$$\phi_{d}^{q*} = \max \phi_{d}^{q}, \quad d \in N,$$

s.t.

$$\sum_{j \in E} \lambda_{d}^{q} y_{qj} = \phi_{d}^{q} y_{qd}, \quad q \in \{1, \ldots, s\},$$

$$\sum_{j \in E} \lambda_{d}^{q} y_{rj} \geq y_{rd}, \quad r \neq q,$$

$$\sum_{j \in E} \lambda_{d}^{q} x_{ij} \leq x_{id}, \quad i = 1, \ldots, m,$$

$$\sum_{j \in E} \lambda_{d}^{q} = 1,$$

$$\lambda_{d}^{q} \geq 0, \quad j \in E.$$  \hfill (6)
Here, $E$ and $N$ respectively represent the index sets for the efficient and inefficient FHCs identified by Eq. (4). The factor-specific measures in Eqs. (5) and (6) determine the maximum potential decrease of an input and increase of an output while keeping other inputs and outputs at current levels. These factor-specific measures are still multi-factor performance measures, since all related factors are considered in a single model.

On the basis of Eq. (5), the $k$th input-specific reference-share measure for each efficient FHC$_{j_0}$, $j \in E$, is

$$\Delta_{j_0}^k = \sum_{d \in N} \lambda_{j_0}^{d*} (1 - \theta_d^{k*}) \, x_{kd} / \sum_{d \in N} (1 - \theta_d^{k*}) \, x_{kd},$$

(7)

where $\lambda_{j_0}^{d*}$ and $\theta_d^{k*}$ are optimal values in Eq. (5). On the basis of Eq. (6), the $q$th output-specific reference-share measure for each efficient FHC$_{j_0}$, $j \in E$, is

$$\Pi_{j_0}^q = \sum_{d \in N} \lambda_{j_0}^{d*} [1 - (1/\phi_d^{q*})] \, y_{qd} / \sum_{d \in N} [1 - (1/\phi_d^{q*})] \, y_{qd},$$

(8)

where $\lambda_{j_0}^{d*}$ and $\phi_d^{q*}$ are optimal values in Eq. (6).

The reference-share $\Delta_{j_0}^k$ (or $\Pi_{j_0}^q$) depends on the values of $\lambda_{j_0}^{d*}$ and $\theta_d^{k*}$ (or $\lambda_{j_0}^{d*}$ and $\phi_d^{q*}$). Note that $(1 - \theta_d^{k*}) \, x_{kd}$ and $[1 - (1/\phi_d^{q*})] \, y_{qd}$ characterize the potential decrease on the $k$th input and increase on the $q$th output, respectively. Therefore, the reference-share here measures the contribution an efficient FHC makes to the potential input (output) improvement in inefficient FHCs.

Terms $\Delta_{j_0}^k$ and $\Pi_{j_0}^q$ are weighted optimal lambda values across all inefficient FHCs. The weights,

$$\left[ (1 - \theta_d^{k*}) \, x_{kd} / \sum_{d \in N} (1 - \theta_d^{k*}) \, x_{kd} \right]$$

and

$$\left\{ [1 - (1/\phi_d^{q*})] \, y_{qd} / \sum_{d \in N} [1 - (1/\phi_d^{q*})] \, y_{qd} \right\},$$

are normalized, and therefore we have $\sum_{j \in E} \Delta_{j_0}^k = 1$ and $\sum_{j \in E} \Pi_{j_0}^q = 1$. It is very clear from Eqs. (7) and (8) that an efficient FHC which does not act as a referent FHC for any inefficient FHC will have zero reference-share measure. The bigger the reference share measure is, the more important an efficient FHC is in benchmarking.

3. Results and Analysis

3.1. Measuring profitability and marketability performances

Based on the controllable aspect from a manager’s point of view, all performance models in this study are run under the assumption of input minimization (also known as input orientation). The technical efficiency (TE) is decomposed into pure technical efficiency (PTE) and scale efficiency (SE), and the nature of returns to
scale is reproduced in Table 3. The order (No.) of the FHCs is coded by the size of the total assets. First, we consider the pure technical efficiency (PTE). The mean scores of profitability and marketability models are 0.866 and 0.952, respectively. About half of the FHCs are not efficient in the profitability performance model. In the marketability performance model, 3 out of the 14 FHCs are not efficient. From the result of the mean efficiency score and numbers on the frontier, we can conclude that marketability performance is better than profitability performance for these 14 FHCs. This result can be interpreted that even though some FHCs do not perform that well in generating revenue, the stock market still acts positively to their earnings news.

No matter in the profitability model or marketability model, big-sized FHCs are more efficient than small-sized ones (Table 4). In the profitability model this result shows that big-sized FHCs are more likely to generate profit with its large-scaled assets, etc. In the marketability model, this phenomenon can be explained by representative bias in that big-sized FHCs can more easily catch the attention of the investors. Using a Mann–Whitney test, we cannot reject the null hypothesis that there is no significant difference in the pure technical efficiency for big and small FHCs at the 5% level of significance for both models. This is because of the small sample size (see Brockett et al.'s research, 1996). We further investigate the relationship between efficient score and main body of a FHC. There are three types of main body for Taiwan’s FHCs: bank, insurance, and securities. Table 4 reveals that those FHCs with the main body of insurance, on average, perform better than the other two types both in profitability and marketability models. The reason for this result is that demand for insurance services has grown rapidly in Taiwan’s market recently, and revenue from insurance activities plays a major role in these insurance-based FHCs. For example, the revenue from insurance subsidies is about 90% of the total annual revenue for Cathay (01). Due to the small sample size, using a Kruskal–Wallis test shows no significant difference in pure technical efficiency at the 5% level for the type of main body.

A scale efficiency is defined by the ratio of a CRS score to a VRS score, i.e., TE/PTE. If the ratio is equal to 1, i.e., TE/PTE = 1, then a FHC is scale efficient; otherwise, if the ratio is less than 1, i.e., TE/PTE < 1, then a FHC is scale inefficient. This t-test indicates that the scale efficiency ratios are significantly less than 1, which means that serious scale inefficiencies occur in these 14 FHCs both in profitability (p-value = 0.0125) and marketability performance models (p-value = 0.0000). This is evidence showing that a scale problem really does exist in Taiwan’s FHCs, which can be treated as support for future mergers and acquisitions between FHCs.

We further investigate the status of returns to scale for FHCs. From Table 3, there are only two (in the profitability model) and three (in the marketability model) FHCs that operate at the appropriate scale (constant returns to scale). Approximately 80% of the FHCs in Taiwan are experiencing decreasing returns to scale in profitability and marketability performance models, especially for the big FHCs.
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<table>
<thead>
<tr>
<th>No.</th>
<th>FHC</th>
<th>Profitability</th>
<th>Marketability</th>
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<tbody>
<tr>
<td>01</td>
<td>Cathay</td>
<td>0.987</td>
<td>1.000</td>
<td>DRS</td>
</tr>
<tr>
<td>02</td>
<td>Mega</td>
<td>0.954</td>
<td>0.954</td>
<td>DRS</td>
</tr>
<tr>
<td>03</td>
<td>First</td>
<td>0.937</td>
<td>0.981</td>
<td>DRS</td>
</tr>
<tr>
<td>04</td>
<td>Hang Seng</td>
<td>0.984</td>
<td>0.984</td>
<td>DRS</td>
</tr>
<tr>
<td>05</td>
<td>Fujian</td>
<td>0.677</td>
<td>1.000</td>
<td>DRS</td>
</tr>
<tr>
<td>06</td>
<td>China Trust</td>
<td>1.000</td>
<td>1.000</td>
<td>DRS</td>
</tr>
<tr>
<td>07</td>
<td>Shin Kong</td>
<td>0.810</td>
<td>0.810</td>
<td>DRS</td>
</tr>
<tr>
<td>08</td>
<td>Sun SinoBank</td>
<td>0.678</td>
<td>0.678</td>
<td>DRS</td>
</tr>
<tr>
<td>09</td>
<td>SunPac</td>
<td>0.477</td>
<td>0.477</td>
<td>DRS</td>
</tr>
<tr>
<td>10</td>
<td>Hua</td>
<td>0.640</td>
<td>0.640</td>
<td>DRS</td>
</tr>
<tr>
<td>11</td>
<td>Chian Development</td>
<td>0.477</td>
<td>0.477</td>
<td>DRS</td>
</tr>
<tr>
<td>12</td>
<td>Waterland</td>
<td>1.000</td>
<td>1.000</td>
<td>DRS</td>
</tr>
<tr>
<td>13</td>
<td>Chian</td>
<td>0.865</td>
<td>0.865</td>
<td>DRS</td>
</tr>
<tr>
<td>14</td>
<td>Salt</td>
<td>0.736</td>
<td>0.736</td>
<td>DRS</td>
</tr>
</tbody>
</table>

Table 3. Efficiency scores of FHCs' performance models.

Notes: Technical efficiency (TE) = pure technical efficiency (PTE) × scale efficiency (SE). RTS denotes returns to scale. CRS denotes constant returns to scale. DRS denotes decreasing returns to scale. IRS denotes increasing returns to scale. Small denotes assets < NT$1 trillion. Big denotes assets > NT$1 trillion.
Table 4. Summary statistics: PTE of size and main body for fourteen FHCs.

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of FHCs</th>
<th>Profitability Performance</th>
<th>Marketability Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Test (p-value)</td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big</td>
<td>7</td>
<td>0.890</td>
<td>0.337</td>
</tr>
<tr>
<td>Small</td>
<td>7</td>
<td>0.842</td>
<td></td>
</tr>
<tr>
<td>Main body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>3</td>
<td>1.000</td>
<td>0.147</td>
</tr>
<tr>
<td>Security</td>
<td>3</td>
<td>0.832</td>
<td></td>
</tr>
<tr>
<td>Bank</td>
<td>8</td>
<td>0.828</td>
<td></td>
</tr>
</tbody>
</table>

This result also reveals that FHCs are facing a highly competitive environment in Taiwan. On the other hand, four FHCs and one FHC are experiencing an increase in returns to scale, especially for small FHCs, in profitability and marketability performance models, respectively.

The big-sized FHCs are relatively pure technically efficient, but in the stage of decreasing returns to scale, suggesting that big FHCs have caught managerial know-how to operate a FHC efficiently, however, they have not yet achieved their optimal scale or still lack scale efficiency. Small-sized FHCs are relatively pure technically inefficient, but in the stage of increasing returns to scale, suggesting that small FHCs do not perform efficiently and they need to become bigger to attain scale efficiency. To summarize the above results, further mergers and acquisition among FHCs should be considered so as to achieve economies of scale for Taiwan’s financial service industry.

3.2. Analysis of best-practice-frontier FHCs

For an efficient decision making unit (DMU/FHC in our case), the role it plays to be benchmarked by other inefficient DMUs is also important. One may want to know the importance of each efficient DMU by measuring the extent of inefficiencies of other inefficient DMUs. One way to accomplish such a task is to count the number of times a particular efficient DMU acts as a referent DMU. Andersen and Petersen (1993) rank efficient DMUs by measuring the radial distance from a specific efficient DMU to a frontier, as constructed by the remaining DMUs. The most efficient (or important) DMU is the one that has the largest radial distance. However, it is possible that the most efficient DMU detected by Andersen et al.'s method may never appear in the reference set for inefficient DMUs. Li and Reeves (1999) present the Multiple Criteria Data Envelopment Analysis (MCDEA) which focuses on solving two key problems: lack of discrimination and inappropriate weighting schemes. Tone (2002) proposes a super-efficiency model by using slacks-based measure (SBM). In Li and Reeves’s and Tone’s methods, the contribution an efficient DMU makes to the potential input (output) improvement in inefficient DMUs cannot be measured.
In the current study the reference-share measure (Zhu, 2000) defines a ranking measure by using the factor-specific measure and BCC model. We can now identify the input/output that are most important or distinguish those FHCs which can be treated as benchmarks. In this section, rank lists of the profitability and marketability models for all those efficient FHCs will be given. In Tables 5 and 6, the reference-share measures are reported for the profitability and marketability performance models, with the ranking in parenthesis and ordered by the average rank of the efficient FHCs. There are seven pure technical efficient FHCs in the profitability performance model in Table 5. Of the total 35 reference-share measures, 15 are greater than 10%. Waterland, which is a particular technically efficient FHC, has the biggest reference-share in assets, equity, employees, and revenues.

Table 5. Reference-share measure in profitability performance model.

<table>
<thead>
<tr>
<th>No.</th>
<th>FHC</th>
<th>Input Factors</th>
<th>Output Factors</th>
<th>Average Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Assets (%)</td>
<td>Equity (%)</td>
<td>Employees (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Waterland</td>
<td>75.57 (1)</td>
<td>65.34 (1)</td>
<td>69.82 (1)</td>
</tr>
<tr>
<td>07</td>
<td>Shin Kong</td>
<td>13.19 (2)</td>
<td>10.04 (3)</td>
<td>12.24 (2)</td>
</tr>
<tr>
<td>02</td>
<td>Mega</td>
<td>0.25 (5)</td>
<td>0.04 (6)</td>
<td>10.60 (3)</td>
</tr>
<tr>
<td>10</td>
<td>E.SUN</td>
<td>0.00 (6.5)</td>
<td>16.36 (2)</td>
<td>7.34 (4)</td>
</tr>
<tr>
<td>01</td>
<td>Cathay</td>
<td>0.44 (4)</td>
<td>2.41 (5)</td>
<td>0.00 (6)</td>
</tr>
<tr>
<td>04</td>
<td>Hua Nan</td>
<td>0.00 (6.5)</td>
<td>5.81 (4)</td>
<td>0.00 (6)</td>
</tr>
<tr>
<td>05</td>
<td>Fubon</td>
<td>10.55 (3)</td>
<td>0.00 (7)</td>
<td>0.00 (6)</td>
</tr>
</tbody>
</table>

Note: Ranks are given in parenthesis, and ties are assigned mid-rank.

Table 6. Reference-share measure in marketability performance model.

<table>
<thead>
<tr>
<th>No.</th>
<th>FHC</th>
<th>Input Factors</th>
<th>Output Factors</th>
<th>Average Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Revenues (%)</td>
<td>Profits (%)</td>
<td>EPS (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>E.SUN</td>
<td>35.18 (2)</td>
<td>46.74 (1)</td>
<td>69.74 (1)</td>
</tr>
<tr>
<td>13</td>
<td>China</td>
<td>13.83 (3)</td>
<td>45.99 (2)</td>
<td>16.22 (2)</td>
</tr>
<tr>
<td>14</td>
<td>Waterland</td>
<td>50.99 (1)</td>
<td>5.72 (3)</td>
<td>8.59 (3)</td>
</tr>
<tr>
<td>07</td>
<td>Shin Kong</td>
<td>0.00 (7.5)</td>
<td>1.56 (4)</td>
<td>0.91 (5)</td>
</tr>
<tr>
<td>08</td>
<td>Taishin</td>
<td>0.00 (7.5)</td>
<td>0.00 (8)</td>
<td>4.54 (4)</td>
</tr>
<tr>
<td>06</td>
<td>Chinatrust</td>
<td>0.00 (7.5)</td>
<td>0.00 (8)</td>
<td>0.00 (8.5)</td>
</tr>
<tr>
<td>02</td>
<td>Mega</td>
<td>0.00 (7.5)</td>
<td>0.00 (8)</td>
<td>0.00 (8.5)</td>
</tr>
<tr>
<td>03</td>
<td>First</td>
<td>0.00 (7.5)</td>
<td>0.00 (8)</td>
<td>0.00 (8.5)</td>
</tr>
<tr>
<td>04</td>
<td>Hua Nan</td>
<td>0.00 (7.5)</td>
<td>0.00 (8)</td>
<td>0.00 (8.5)</td>
</tr>
<tr>
<td>05</td>
<td>Fubon</td>
<td>0.00 (7.5)</td>
<td>0.00 (8)</td>
<td>0.00 (8.5)</td>
</tr>
<tr>
<td>01</td>
<td>Cathay</td>
<td>0.00 (7.5)</td>
<td>0.00 (8)</td>
<td>0.00 (8.5)</td>
</tr>
</tbody>
</table>

Note: Ranks are given in parenthesis, and ties are assigned mid-rank.
Waterland is therefore an important FHC in assets, equity, employees, and revenues benchmarking, except in profits. The percentage number is the extent to be referred for a particular input/output while other input/output are controlled. For example, Waterland plays a leading role in terms of employees given the current levels of assets and equity. E.SUN, which is a technically efficient FHC, has the biggest reference-share in profits. The reference-share for the 11 technically efficient FHCs in the marketability performance model is reported in Table 6. E.SUN is an important FHC in profits, EPS, market value, and stock price benchmarking. Waterland is an important FHC in revenue benchmarking.

Those FHCs which have reference shares of zero are self-evaluators in Tables 5 and 6. Even if these FHCs are efficient, they are revealed as too different in the input/output space either to be a reference to other units, or to be referenced. In summary, while small efficient FHCs are frequently referenced, big efficient FHCs can hardly become benchmarks. This result is quite reasonable since the scale of various inputs, e.g., assets and employees, is more easily attained for small-sized FHCs. It is relatively difficult to imitate the scale of a big efficient FHC. In terms of managerial implication, this phenomenon can be explained by it being hard for big FHCs to be imitated for their large scale, and this attribute can make big FHCs competitive niche players. This corresponds to the reason that the bigger the size of FHCs is, the more possible they are able to survive the trend of mergers and acquisitions.

Although the reference-share measures give a different ranking list according to the input/output factor which they are measured by, the result of this analysis is robust. The ranking lists are very similar with rank correlation coefficients ranging from 0.77 to 0.91 in both the profitability and marketability models. Therefore, these ranking lists give a clear and stable indication of the FHCs that should be pointed out as benchmarks for others.

### 3.3. Analysis of performance on profitability and marketability

In the previous section the FHCs' benchmarks are identified either by their profitability or marketability performance. An overview analysis including these two performance models have not yet been discussed. In this section a cross-tabulation is presented in Fig. 2 to further illustrate the difference between profitability and marketability. In Fig. 2 the profitability and marketability PTE give a two-by-two matrix to classify the FHCs. FHCs fall into four quadrants: star, cow, sleepers, and dogs, which are similar to the classification done by the Boston Consulting Group. A good performer shows a high profitability efficiency and marketability efficiencies (they get the PTE score of one in both two dimensions). FHCs have been split subjectively into four groups plotted respectively in the zones of stars, sleepers, dogs, and cows. The FHCs in each group are summarized as follows.

**The zone of stars:** Those FHCs enjoy high efficiency in both profitability and marketability efficiency dimensions. Seven FHCs are included here: Cathay (01),
Fig. 2. Profitability/marketability efficiency cross-tabulation.

Mega (02), Hua Nan (04), Fubon (05), Shin Kong (07), E.SUN (10), and Waterland (14). These FHCs appear to be good role model, which can be treated as benchmarks to others.

The zone of sleepers: Those FHCs experience a higher level of marketability performance, but a lower profitability performance. Four FHCs are included: First (03), Chinatrust (06), Taishin (08), and China Development (13). It is suggested that FHCs in this zone should place more emphasis on activities of generating profits.

The zone of dogs: Those FHCs which perform inferior both in profit efficiency and marketability efficiency. Three FHCs, SinoPac (09), Fuhwa (11), and Jisun (12), are classified here. These FHCs should place more emphasis on activities of generating profit as well as market attractiveness.

The zone of cows: Those FHCs which have high profitability efficiency, but low marketability efficiency. There are no FHCs in this zone.

Those FHCs falling into the zone of sleepers and dogs are almost small-sized ones. However, those FHCs which are classified into the zone of stars are almost big-sized FHCs. This shows that the big-sized FHCs have better competitive power than small ones.

4. Concluding Remarks

Under the global trend of bank conglomerations, the issue of financial holding companies' (FHCs) efficiency is especially important for small economies, like Taiwan,
because this small island is vulnerable to large inefficient banking service institutions. Although bank efficiency has been widely discussed in the previous literature and the DEA technique is frequently used to explore this topic, there are still some important points not touched. From the perspective of a research topic, the financial conglomerations are rarely taken as the main research target and capital market reaction to a FHCs' performances is even less considered. From the perspective of research methods, the problem that many units are easily calculated as being efficient in non-parametric methods, especially in a small sample data set, is usually ignored. This paper therefore aims to measure the profitability and marketability efficiency of FHCs in Taiwan. We include two models, profitability and marketability, using DEA techniques for FHCs' efficiency.

Our findings can briefly be concluded as the following: First, big-sized FHCs are generally more efficient than small-sized ones in both the profitability model and marketability model. Second, while big-sized FHCs are relatively pure technically efficient, but in the stage of decreasing returns to scale, small-sized FHCs are relative pure technically inefficient, but in the stage of increasing returns to scale. This suggests that further mergers and acquisitions among FHCs should be considered so as to achieve economies of scale. Third, among those efficient FHCs, small efficient FHCs can more easily be referred through the models. While small efficient FHCs are more easily to become benchmarks which means that they are more easily to be imitated, big efficient FHCs are hardly become benchmarks which makes them competitive niche players. Fourth, most big-sized FHCs are classified into a zone of stars. This means that big-sized FHCs have better competitive power than small ones. To conclude this paper, we find that size does matter to a FHCs' performance.

Our findings can serve as a guide in the financial service industry for coping with issues related to financial holding companies. A further investigation would be the examination of performance over time (panel data) by using the Malmquist productivity change index techniques. Such an approach would allow a dynamic view of the multidimensional performance of FHCs. It is also hoped that the models and methods used in this study can bring about other related research in other industries.

Acknowledgement

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References


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