A Study on Technical Efficiency and Productivity Changes of Taiwan’s Life Insurance Industry

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ABSTRACT

With the 2005-2009 data of Taiwan’s life insurance companies as the subject, this study adopted DEA to discuss the business efficiency of Taiwan’s life insurance industry. The research results showed that the average technical efficiency of Taiwan’s life insurance industry was relatively low and most life insurance companies should further enhance and improve efficiency; in the respect of productivity, most life insurance companies continuously grow in productivity, while a small number of companies slightly decline. The average productivity of various life insurance companies grew in 2008-2009 by 4.1%, with technical advancement as the major source of productivity changes; according to technical efficiency and productivity changes, life insurance companies can be classified by development into high growth and high efficiency type, high growth and low efficiency type, low growth and high efficiency type, and the low growth and low efficiency type.

Keywords: productivity changes, technical efficiency, data envelopment analysis, life insurance

INTRODUCTION

Since Taiwan’s entry into WTO, Taiwan’s life insurance market has become more open, thus, the life insurance industry faces strong international competition. In response to the impact of accession to WTO, life insurance companies are actively developing characteristics of individual enterprises in order to enhance their competitiveness. Improving technical efficiency and productivity is one of the methods to enhance competitiveness, as it is involved with the use and configuration of the resources of the life insurance industry.

In recent years, DEA (Data Envelopment Analysis) is widely used in the analysis and study relating to productivity or efficiency of educational and academic research units, the financial industry, the transportation business, mobile phones, and other science and technology industries. However, applications of DEA in studies relating to the business efficiency of the life insurance industry are not commonly seen. In foreign literature, Fecher, Kessler, Perelman, and Pestieay(1993)studied the relative production efficiency of 84 life insurance companies and 243 non-life insurance companies in France using nonparametric DEA and parametric maximum likelihood comparison. The study findings suggested that the two types of assessment results were highly correlated with many inefficient companies in scattered distribution.

The purpose of this study was to discuss technical efficiency, assess the productivity changes of various life insurance companies in Taiwan, and explore the reasons for such productivity changes. This can help understand the productivity changes and technical efficiency of Taiwan’s various life insurance companies, as well as to classify Taiwan’s life insurance industry according to development, in order to provide a reference for relevant units in terms of the development strategy of Taiwan’s life insurance industry.

LITERATURE REVIEW

Business Performance and Productivity

Performance is one of the key goals of the business operations of all companies. Performance includes the
different meanings of efficiency and effectiveness. Efficiency measures the level of achieving goals. The greater calculable quantity and value from production and service are, the better the efficiency is, without considering the consumption of resources. However, efficiency is measured by the concept of relative investment and production. As a concept originating from physics or engineering, efficiency refers to the minimization of resource costs to achieve specific business operational goals, with the maximization of output using optimal resource allocation.

Productivity analysis can be used to assess profit and nonprofit business performances. The application of the concept in the life insurance industry business can assess the life insurance industry’s productivity. The measurement and analysis of the productivity of the life insurance industry lie in measuring resource use efficiency, assessing the developmental plan implementation efficiency of the life insurance industry, confirming the growth sources of the life insurance industry, as well as using productivity analysis to create production plans for the life insurance industry.

Lee & Fan (2010) discussed the business performance of Taiwan’s banking industry from 2004 to 2008 using the technical efficiency and productivity indicators proposed by Luenberger. The empirical results suggested that the inefficiency value of Taiwan’s banking industry tended to gradually decline over the years, along with the fading dual-card banking crisis, however, the changes in productivity were mainly deterioration.

As the population conditions for Taiwan’s life insurance businesses are poorer than other countries, the government has invested a lot of money in studies on life insurance industry technical and business management. Many scholars have studied how to effectively assess the productivity of the life insurance industry.

**Business performance assessment factors**

Liu & Li (1995) measured the 1993 business efficiency of 15 life insurance companies in Taiwan using DEA methodology, with number of outdoor staff, number of indoor staff, and business cost as inputs, and the first year personal life insurance premiums and other premiums as outputs. The empirical results suggested that one third of the 15 sample companies had complete efficiency under the assumption of fixed scale returns, while only 7 companies had complete efficiency under the assumption of variable scale returns.

Chen, Chang, You, & Shiu (2009) used multi-sectoral data, including analysis models, to assess the business performance of Taiwan’s agricultural industry. The directional distance function was used to incorporate the non-desirable output variables in order to establish a complete model able to measure the differences in efficiency of different departments. The results suggested that the efficiency of the credit and supply departments were higher than the promotion and insurance departments. The performances of the four departments had apparent complementary effects from the perspective of the correlation of the efficiency of the various departments.

Chen & Huang (2008) introduced the LeChatelier principle into the DEA model to verify how the incorporation of the quasi-fixed input of the DEA model affects technology, allocation, and business efficiency. Huang, Kao, Chiang, & Liang (2010) used DEA to assess the 1994-2003 business performance of Taiwan’s life insurance industry to calculate the Malmquist productivity index, in addition to the estimation of the technical efficiency, scale efficiency, and pure technical efficiency. The results suggested that defining input and output variables using the intermediation approach was reasonable and the business efficiency of Taiwan’s life insurance market gradually improved over the years. After incorporating the quasi-fixed factors, it was found that various efficiency estimated values declined significantly, which was consistent with theoretical expectations, and can relatively better reflect the actual efficiency of Taiwan’s life insurance companies.

This study summarized salary-related items, including the salaries of the outdoor staff and the indoor staff, as the salesperson allowances, and used business management costs and capital investment as the inputs of this study, and the first year premium income, the follow-up years’ premiums, and investment income as the output items of this study.

**Business performance assessment methodology**

Hao & Chou (2002) used the translog cost function, with costs of labor, capital costs, and costs for claims as inputs; and individual life insurance premium income, personal accident and health insurance premiums, group insurance premiums, and investment income as outputs, in order to assess the impact of the opening market from 1977 to 1999 on the business efficiency of Taiwan’s life insurance companies. The empirical results suggested that the impact
of the opening of market in assisting to improve business efficiency, increase product diversity, expand business scale, and increase market share was not significant. Wang, Peng, & Chang (2006) used the DEA method to discuss the business efficiency of Taiwan’s life insurance companies from 1998 to 2002, and found that the participation of life insurance companies in the banking business can improve company business efficiency. The higher the level of life insurance companies’ involvement in banking business was, the more apparent the positive effect on company scale efficiency, technical efficiency, and overall production efficiency was. However, whether the company was a shareholding company or not had no significant impact on business efficiency.

RESULTS AND DISCUSSION

Variable selection

This study mainly focused on Taiwan’s life insurance companies during the 5 year research period from 2005 to 2009. Due to the withdrawal of foreign life insurance companies, such as ING, Atena, and British Prudential, as well as the establishment of local life insurance companies, such as the Firstholding, this study selected only 24 life insurance companies as study subjects. The sources of the secondary data used in this study were the “Life Insurance Business Statistics Yearbook”, the “Insurance Yearbook”, and other secondary data.

This study adopted business management costs to replace the number of office staffs and related logistics support as the input variables. As external consignment institutions compensated labor and material costs of sales by commission, this study adopted sales allowance (including commissions and grants to banks and agents selling insurance products) to replace the number of outdoor staff.

DEA (Data Envelopment Analysis)

DEA is commonly used in the assessment of productivity and efficiency, which uses historical data to objectively measure input/output efficiency, in order to solve the input/output inconsistency and weight selection problem for decision-makers to determine the most efficient and most inefficient measurement benchmarks (Wang, Chien, & Chen, 1997). Wang, Chang, & Chen (2006) also used the 1997-2006 data of local-level courts in Taiwan to assess the management efficiency of local courts by using the output-oriented DEA methodology.

This study used three input and three output models for empirical analysis, namely, the three input variables include investment capital, business management costs, and business allowance representing capital, outdoor and indoor staff management costs, and cost factor inputs, respectively; and three output variables, including the first year premium income, the follow-up years’ premiums, and financial income, in order to suggest that the resource allocation of the life insurance industry can generate different outputs. Then, this study used the 2007-2009 data of life insurance companies in Taiwan to assess their productivity changes and relative technical efficiency values using the Deap suite software.

Malmquist productivity index

The above CCR model and BCC model used sectional data to conduct single period comparisons of various DMUs. To assess the trans-periodical efficiency and productivity changes of various DMUs, the Malmquist productivity index can be used for discussion. The Malmquist productivity index measures the changes in productivity from Period t to Period t+1 in a given scale reward. To avoid the errors of estimation caused by the benchmark period selection, Fare, Grosskopf, Norries, and Zhang (1993) used the Period t and Period t+1 productivity indices to calculate the geometric average number in order to measure changes in total factor (TFP). The Malmquist productivity index obtained from the production perspective can be represented as below:

\[ M(x', y', x, y) = \left[ \frac{D^{CRS}_0(x', y', x, y)D^{CRS}_0(x', y', x, y)}{D^{CRS}_0(x', y', x, y)} \right]^{1/2} \]

In Eq. (3), \( M(x', y', x, y) \) denotes the total productivity change index, which contains two current period output distance functions \( D^{CRS}_0(x', y') \) and \( D^{CRS}_0(x', y') \), and two mixed period production distance functions \( D^{CRS}_0(x', y') \) and \( D^{CRS}_0(x', y') \).
and $D_0(x^{i+1}, y^{i+1})$. Regarding the definitions of production distance functions, assume $S^i$ is the possible production set of all input and output $(x', y')$ of Period $t$, then, the current period production distance function $D_0'(x', y') = \inf\{\theta : (x', y'/\theta) \in S^i\}$, $\theta$ represents the proportion of output $y'$ expansion to production frontier in given input $x'$. Generally speaking, if it is not the production frontier, $D_0'(x', y') \leq 1$; however, if it is at the production frontier, then $D_0'(x', y') = 1$. It applies similarly to the Period $t+1$ production distance function $D_0''(x^{n+1}, y^{n+1})$.

The mixed period production distance function $D_0''(x^{n+1}, y^{n+1})$ denotes the maximum proportion of $(x^{n+1}, y^{n+1})$ output expansion under the production technical conditions of the Period. This is also applicable to $D_0''(x^{n+1}, y^{n+1})$. Eq. (3) is the weighted average of the productivity indices of Period $t+1$ and Period $t$. When $TFP > 1$, it means the productivity of the DMU under assessment improves; on the contrary, if $TFP < 1$, it means a decline in productivity of the DMU under assessment.

The Malmquist productivity index of Eq. (3) can be represented by the multiplication of the efficiency changes (EFFCH) and technical changes (TECH). Eq. (3) can be rewritten as:

$$M_0(y^{i+1}, x^{i+1}, y', x) = D_0''(y^{i+1}, y^{i+1})CRS \cdot \left[ D_0''(y^{i+1}, y^{i+1})CRS / D_0''(y^{i+1}, y^{i+1})VRS \right]^\frac{1}{2}$$

Eq. (4)

$$EFFCH = \frac{D_0''(x^{i+1}, y^{i+1})CRS}{D_0''(x, y)CRS}$$

$$= \frac{D_0''(x^{i+1}, y^{i+1})VRS / D_0''(x', y'VRS)}{D_0''(x, y)VRS / D_0''(x', y'VRS)}$$

$$TECH= \frac{D_0''(x^{i+1}, y^{i+1})CRS \cdot D_0''(x, y)CRS}{D_0''(x^{i+1}, y^{i+1})VRS \cdot D_0''(x, y)VRS}$$

When $EFFCH > 1$, it means efficiency is improved, while $EFFCH < 1$ represents a decline in efficiency. $TECH > 1$ represents technical progress and $TECH < 1$ represents technical decline.

If the change scale reward is taken into account, the efficiency changes can be further represented by the multiplication of the scale efficiency changes (SECH) and pure technical efficiency changes (PTECH), namely $EFFCH = PTECH \times SECH$, where

$$PTECH= \frac{D_0''(x^{i+1}, y^{i+1})VRS}{D_0''(x, y)VRS}$$

$$SECH= \frac{D_0''(x^{i+1}, y^{i+1})CRS / D_0''(x', y'VRS)}{D_0''(x, y)CRS / D_0''(x', y'VRS)}$$

When $PTECH > 1$, it means an improvement of the pure technical efficiency, namely, it is getting closer to the change scale reward production frontier; on the contrary, it means a decline in pure technical efficiency. When $SECH > 1$, it means the production scale is getting closer to the long term most appropriate production scale; while $SECH < 1$ represents that the production scale is deviated from the most appropriate production scale.

**RESULTS AND ANALYSIS**

The average technical efficiency values of various life insurance companies in Taiwan from 2005 to 2009 were as illustrated in Table 1. According to the research findings, the average technical efficiency value of the life insurance industry was 0.65, indicating resources were not fully used or the inefficiency rate was 35%, and greater outputs can be obtained from the same resources environment. Technical efficiency can be further classified into pure technical efficiency and scale efficiency, with efficiency values at 0.774, and 0.847. It thus can be learnt that, the major source of the inefficiency of the life insurance industry was pure technical inefficiency, followed by the scale inefficiency.

Among various life insurance companies, the average technical efficiency value of the Bank of Taiwan Life Insurance, Nanshan Life Insurance, Allianz Life Insurance, Taiwan Postal Service, and Fubon Life Insurance was 1, and the pure technical efficiency value and scale efficiency value was 1. Namely, the five life insurance companies were at the production frontier, their technology was relatively good, and production scales were at relative appropriate scales.
for the reference of the development of various life insurance companies.

As the technical efficiency values of various life insurance companies were lower than 1, it can be learnt that resource applications can be improved. Furthermore, the technical efficiency values varied significantly in various life insurance companies. China Life Insurance’s technical efficiency value was above 0.9, suggesting its relative efficiency was high; there are 12 life insurance companies of lower average efficiency values. The technical efficiency value of Manulife Life Insurance was lowest at 0.149, followed by Prudential Life Insurance at 0.222.

The major source of inefficiency of the 9 life insurance companies lacking in technical efficiency may be pure technical inefficiency or scale inefficiency. It can be learnt from Table 1 that there were 7 life insurance companies of relatively pure technical inefficiency. Some companies had production scales close to the most appropriate, but with high pure technical inefficiency. For example, the scale efficiency of Transglobe Life Insurance was 0.949, and its pure technical efficiency value was 0.492; some companies had scale and high scale inefficiency, for example, the pure technical efficiency and scale efficiency of Kuo Hua Life Insurance were 0.754 and 0.646; some companies had pure technical efficiency and scale efficiency values close to 1 (for example, China Life Insurance). Companies with relative scale inefficiency include Taiwan Life Insurance. However, some companies of high scale efficiency, for example, China Life Insurance’s pure technical efficiency value and scale efficiency value were 1 and 0.92, respectively. In summary, companies of pure technical inefficiency should strengthen and improve technical levels to obtain higher efficiency. Companies of scale inefficiency should expand the production scale to obtain higher efficiency, as suggested by the analysis of the 2009 data in this study, that life insurance companies lacking technical efficiency experienced gradually increasing scale returns.

### Table 1: 2005-2009 average technical efficiency of various life insurance companies

<table>
<thead>
<tr>
<th>Company</th>
<th>Technical efficiency</th>
<th>Pure technical efficiency</th>
<th>Scale efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank of Taiwan Life Insurance</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Taiwan Life Insurance</td>
<td>0.857</td>
<td>0.867</td>
<td>0.989</td>
</tr>
<tr>
<td>CPA Life Insurance</td>
<td>0.261</td>
<td>0.333</td>
<td>0.783</td>
</tr>
<tr>
<td>Cathay Life Insurance</td>
<td>0.863</td>
<td>1.000</td>
<td>0.863</td>
</tr>
<tr>
<td>China Life Insurance</td>
<td>0.920</td>
<td>1.000</td>
<td>0.920</td>
</tr>
<tr>
<td>Nanshan Life Insurance</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Kuo Hua Life Insurance</td>
<td>0.733</td>
<td>0.754</td>
<td>0.646</td>
</tr>
<tr>
<td>Shing Kong Life Insurance</td>
<td>0.646</td>
<td>1.000</td>
<td>0.646</td>
</tr>
<tr>
<td>Fubon Life Insurance</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Global Life Insurance</td>
<td>0.676</td>
<td>0.757</td>
<td>0.894</td>
</tr>
<tr>
<td>Mercuries Life Insurance</td>
<td>0.570</td>
<td>0.580</td>
<td>0.982</td>
</tr>
<tr>
<td>Sinon Life Insurance</td>
<td>0.641</td>
<td>1.000</td>
<td>0.641</td>
</tr>
<tr>
<td>Singfor Life Insurance</td>
<td>0.650</td>
<td>0.814</td>
<td>0.799</td>
</tr>
<tr>
<td>Far Glory Life Insurance</td>
<td>0.719</td>
<td>0.797</td>
<td>0.902</td>
</tr>
<tr>
<td>Hong Tai Life Insurance</td>
<td>0.523</td>
<td>0.533</td>
<td>0.981</td>
</tr>
<tr>
<td>Allianz Life Insurance</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Metlife Life Insurance</td>
<td>0.438</td>
<td>0.585</td>
<td>0.748</td>
</tr>
<tr>
<td>Prudential Life Insurance</td>
<td>0.222</td>
<td>0.263</td>
<td>0.841</td>
</tr>
<tr>
<td>Cigna Life Insurance</td>
<td>0.378</td>
<td>1.000</td>
<td>0.378</td>
</tr>
<tr>
<td>AIA Life Insurance</td>
<td>0.401</td>
<td>1.000</td>
<td>0.401</td>
</tr>
<tr>
<td>Manulife Life Insurance</td>
<td>0.149</td>
<td>0.178</td>
<td>0.839</td>
</tr>
<tr>
<td>New York Life Insurance</td>
<td>0.498</td>
<td>0.620</td>
<td>0.804</td>
</tr>
<tr>
<td>Transglobe Life Insurance</td>
<td>0.467</td>
<td>0.492</td>
<td>0.949</td>
</tr>
<tr>
<td>Taiwan Postal Service</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>average</td>
<td>0.650</td>
<td>0.774</td>
<td>0.847</td>
</tr>
</tbody>
</table>

Source: Compiled by this study*: indicating sample companies had efficiency

### The trend of changes in the productivity of the life insurance industry

Regarding the changes in productivity of various life insurance companies, according to the estimation of the
Malmquist productivity index, the average change trend was as shown in Table 2. The 2005-2009 average of total factor productivity (TFP) was 4.1%, indicating the average growth of various life insurance companies productivity was 4.1%. The major source of productivity changes are the technical efficiency changes with an average growth rate at 3.3% and the technological changes with an average growth rate at 1.7%. Regarding the growth of pure technical efficiency and scale efficiency changes, the average annual growth rates were 0.1% and 1.3%, respectively.

In terms of yearly differences, the changes in TFP were more apparent. TFP values between 2005-2006 and 2008-2009 were all above 1, indicating that productivity of the life insurance industry improved, with the growth rate between 2008-2009 the highest at 10.4%, and the growth rate between 2005-2006 the lowest at 4.8%; In addition, the SECH values between 2005-2006 and 2008-2009 were all above 1, indicating that the scale efficiency improved between these years.

Table 2 Trend of average changes in overall productivity of the life insurance industry

<table>
<thead>
<tr>
<th>Year of change</th>
<th>EFFCH</th>
<th>TECH</th>
<th>PTECH</th>
<th>SECH</th>
<th>TFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2006</td>
<td>1.118</td>
<td>0.937</td>
<td>1.100</td>
<td>1.016</td>
<td>1.048</td>
</tr>
<tr>
<td>2006-2007</td>
<td>0.978</td>
<td>1.096</td>
<td>0.969</td>
<td>1.009</td>
<td>1.072</td>
</tr>
<tr>
<td>2007-2008</td>
<td>0.834</td>
<td>1.128</td>
<td>0.911</td>
<td>0.916</td>
<td>0.941</td>
</tr>
<tr>
<td>2008-2009</td>
<td>1.137</td>
<td>0.971</td>
<td>1.025</td>
<td>1.109</td>
<td>1.104</td>
</tr>
<tr>
<td>Average</td>
<td>1.017</td>
<td>1.033</td>
<td>1.001</td>
<td>1.013</td>
<td>1.041</td>
</tr>
</tbody>
</table>

Source: Compiled by this study

Types of changes in the productivity of various life insurance companies

The types of changes in the productivity of various life insurance companies in the period of 2005-2009 were as shown in Table 3. The average TFP of Nanshan Life Insurance, Kuo Hua Life Insurance, Fubon Life Insurance, New York Life Insurance, and Taiwan Postal Service was lower than 1, indicating declining productivity; while the TFP values of other counties and cities were all above 1, indicating an improvement of productivity with the growth rate of Hong Tai Life Insurance at 13.5% as the highest. Meanwhile, according to efficiency changes and technical changes, the changes in the productivity of various life insurance companies can be categorized into four types.

Good efficiency and technical improvement refer to those with EFFCH values at 1 and TECH values above 1. The reason for average efficiency change value at 1 was that the DMU was at, or close to, the production frontier, namely, the efficiency of the DMU was relatively good. A technical change value above 1 indicated technical improvement.

Efficiency improvement and technical improvement refer to those with EFFCH and TECH values above 1, indicating that the efficiency was getting close to the production frontier, and there was technical improvement. Declining efficiency and technical performance refer to those with EFFCH and TECH value below 1, suggesting that efficiency deviated from the production frontier and technology fell behind.

Technical improvement and declining efficiency refer to those with TECH value above 1 and EFFCH value lower than 1, suggesting technical progress and efficiency deviation from the production frontier. With its efficiency change mainly coming from a decline of pure technical efficiency.

Table 3: Average productivity change of life insurance companies during the period of 2005-2009

<table>
<thead>
<tr>
<th>Company</th>
<th>EFFCH</th>
<th>TECH</th>
<th>PTECH</th>
<th>SECH</th>
<th>TFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank of Taiwan Life Insurance</td>
<td>1</td>
<td>1.105</td>
<td>1</td>
<td>1</td>
<td>1.105</td>
</tr>
<tr>
<td>Taiwan Life Insurance</td>
<td>1.039</td>
<td>1.034</td>
<td>1.036</td>
<td>1.003</td>
<td>1.074</td>
</tr>
<tr>
<td>CPA Life Insurance</td>
<td>0.967</td>
<td>1.045</td>
<td>0.922</td>
<td>1.049</td>
<td>1.011</td>
</tr>
<tr>
<td>Cathay Life Insurance</td>
<td>1.038</td>
<td>1.07</td>
<td>1</td>
<td>1.038</td>
<td>1.11</td>
</tr>
<tr>
<td>China Life Insurance</td>
<td>0.942</td>
<td>1.068</td>
<td>0.924</td>
<td>1.02</td>
<td>1.006</td>
</tr>
<tr>
<td>Nanshan Life Insurance</td>
<td>0.89</td>
<td>0.989</td>
<td>0.945</td>
<td>0.942</td>
<td>0.88</td>
</tr>
<tr>
<td>Kuo Hua Life Insurance</td>
<td>0.982</td>
<td>0.939</td>
<td>0.986</td>
<td>0.996</td>
<td>0.922</td>
</tr>
<tr>
<td>Shing Kong Life Insurance</td>
<td>1.015</td>
<td>0.995</td>
<td>1</td>
<td>1.015</td>
<td>1.01</td>
</tr>
<tr>
<td>Fubon Life Insurance</td>
<td>0.967</td>
<td>1.008</td>
<td>1</td>
<td>0.967</td>
<td>0.975</td>
</tr>
<tr>
<td>Global Life Insurance</td>
<td>0.971</td>
<td>1.059</td>
<td>1.072</td>
<td>0.906</td>
<td>1.029</td>
</tr>
</tbody>
</table>
### The development types of various life insurance companies

Although the Malmquist productivity index can determine changes in DMU productivity, large productivity growth did not necessarily mean good technical efficiency or vice versa. Hence, with the average value as the cut-off point, the development types of the life insurance companies can be categorized into the following types, as shown in Table 4:

1. **Low growth and low efficiency** refer to those with relatively smaller DMU productivity growth and technical efficiency, suggesting the DMU should focus on the improvement of productivity and technical efficiency to enhance competitiveness.
2. **High growth and low efficiency** refer to those with relatively greater DMU productivity growth and relatively lower technical efficiency, suggesting that the DMU productivity improved considerably, however, its technical efficiency had relatively more room for improvement.
3. **Low growth and high efficiency** refer to those with relatively higher DMU technical efficiency and relatively lower productivity growth, suggesting that the DMU productivity had relatively more room for improvement. Those with technical efficiency lower than 1 should continuously improve relative efficiency.
4. **High growth and high efficiency** refer to those with a DMU Malmquist productivity index and technical efficiency value higher than the average values, suggesting that the DMU had relative developmental advantages.

#### Table 4: Development types of life insurance companies

<table>
<thead>
<tr>
<th>Development type categorization</th>
<th>Insurance companies in the category</th>
</tr>
</thead>
<tbody>
<tr>
<td>High growth and high efficiency</td>
<td>Bank of Taiwan Life Insurance, Taiwan Life Insurance, Cathay Life Insurance, China Life Insurance, Global Life Insurance, Singfor Life Insurance, Far Glory Life Insurance</td>
</tr>
<tr>
<td>High growth and low efficiency</td>
<td>Shing Kong Life Insurance, Chao Yang Life Insurance, Cigna Life Insurance, AIA Life Insurance</td>
</tr>
<tr>
<td>Low growth and high efficiency</td>
<td>Nanshan Life Insurance, Fubon Life Insurance, Taiwan Postal Service</td>
</tr>
<tr>
<td>Low growth and low efficiency</td>
<td>New York Life Insurance, Kuo Hua Life Insurance</td>
</tr>
</tbody>
</table>

Source: Compiled by this study

### CONCLUSIONS AND SUGGESTIONS

With the 2005-2009 data of Taiwan’s life insurance companies as the subject, this study adopted DEA to discuss the business efficiency of Taiwan’s life insurance industry. The main purpose of this study was to analyze the business efficiency and productivity changes of Taiwan’s life insurance companies, and classify Taiwan’s life insurance companies by technical efficiency and productivity changes for the reference of the industry in terms of business
restructuring and decision-making. Average technical efficiency was relatively lower, and most life insurance companies should further enhance and improve efficiency. Most life insurance companies’ productivity has continuously grown, however, small number of life insurance companies, the productivity declined. By technical efficiency and productivity changes, the development of life insurance companies can be categorized into four types.

Various life insurance companies should develop business advantages of competitive models based on core competitive advantages to improve technical efficiency and productivity. Moreover, based on the regional economic development viewpoint, conduct strategic alliances with relevant financial units to produce and sell relevant products, in particular, life insurance companies of relatively lower technical efficiency or productivity should strengthen alliance with domestic and foreign financial industries, in addition to active business transformations, in order to expand domestic and international market to improve scale efficiency and productivity of resources. Hence, in the WTO environment of global competition, Taiwan’s life insurance industry can thus achieve sustainable development.

REFERENCES


