Title

A Study of Investment Performance and Overall Financial Performance for Life Insurers in Taiwan

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Abstract

For the purpose of managing market risk, insurers use various financial rating systems and methodologies to evaluate the financial performance. Many prior papers used data envelopment analysis (DEA) model to evaluate operational performance of firms. However, fewer papers explore the investment performance by DEA and Malmquist Productivity Index (MPI). Notably, the life insurers in Taiwan must maintain their relative investment efficiency and operational performance because declining profit could lead to serious interest spread loss or business failure. After the insurance market opened in 1987, the whole market structure changed. Facing more highly intensive competition, life insurers should set a goal of higher efficiency of investment performance and profitability. The main purpose of this study is to determine the capital investment efficiency and change based on the DEA results and MPI. Further, some hypotheses were created to test if there is a statistically significant difference among the DEA model and TFI of CAMEL-S model for life insurers. Finally, to identify efficient investment tools which are relative to investment return rate of life insurers by using regression model. One of results showed that more insurers should revise their investment strategies to improve company's overall financial performance.

Keywords: Performance Measurement, Data Envelopment Analysis (DEA), Malmquist Productivity Index (MPI), CAMEL-S model

Introduction

As the insurance market structure has been changed after the insurance market opened in 1987. More competitive environments were formed to impact financial profitability. In Taiwan, the main sources of a life insurer's profit, *financial receipts*, depend on the investment performance. Obviously, *premiums received* only cover commission and business expenses, although this amount is almost eighty percent of the total income (Yen, Sheu, & Cheng, 2001). Thus, the investment performance should be a key factor and affect the whole performance of business management. Companies may become insolvent when failure leads to declining profit, and even to serious interest spread loss. Facing more highly intensive competition, life insurers determined to achieve a higher efficiency of investment performance and profitability.

Literature Review

The DEA model

The DEA has been used frequently to make performance measures for banks (Asmild, Paradi, Aggarwall, & Schaffnit 2004; Krishnasamy, Ridzwa, & Perumal, 2004), insurers (ex Hewlitt, 1998), hospital (ex. Hu & Huang, 2004), and investment (ex. Chen & Zhu, 2004). However, fewer papers used the DEA to evaluate the investment performance measurement of life insurers. Lin (2002) applied the DEA to measure efficiency scores and to examine whether life insurers in Taiwan have faced the new market structure after deregulation. Results showed no change for overall efficiency change, no pure technical efficiency change, and no scale efficiency change after deregulation. The findings also suggested for incumbents that innovation is the most important factor leading to productivity improvement. Brockett, Cooper, Golden,

Rousseau, & Wang (2004) applied DEA to examine the effect of solvency on efficiency for insurance companies. Output variables of that study involved solvency, claims paying ability, and return on investment. Furthermore, Barr, Siems, & Thomas (1994) used DEA to predict bank failure. Hu & Huang (2004) use both the Mann-Whitney test and Tobit (censored) regression to find the effects of environmental variables on these efficiency scores.

Apart from DEA, the MPI can further provide the measurement of productivity changes. The main studies which focus on investment issues are: Chen & Zhu (2004), Sathye (2002), Ramanathan (2004), as well as Asmild, Paradi, Aggarwall, and Schaffnit (2004). Ramanathan (2004) applied MPI to provide a further investment improvement in the technical efficiency change. Asmild, Paradi, Aggarwall, & Schaffnit (2004) assessed the productivity changes of the banks by MPI and concluded that "the shift of the best practice frontier over time are typically due to changes in technology." Sathye (2002) analyzed the productivity change of Australian banks from1995 to 1999, and he found that the technical efficiency and the Total Factor Productivity (TFP) index have declined by 3.1% and 3.5% individually.

The TFI of CAMEL-S model

This CAMEL rating system, developed from the Uniform Financial Institutions Rating System (UFIRS) was adopted on November 13th, 1979 by the Federal Financial Institution (FFICE). Five different components including capital adequacy, asset quality, management, earnings, and liquidity were gathered into the CAMEL model. A sixth component was added in 1997 - sensitivity to market risk. A researcher may adopt many independent variables; however, fewer variables are selected, and these variables are

grouped into the CAMEL, CAMEL-S, or CAMELO models by using factor analysis. The factor pattern matrix takes forms as follows:

$X_i = a_{i1}F_1 + a_{i2}F_2 + \ldots + a_{ik}F_k + \varepsilon_i$ (i = 1, 2,…, n) where X is independent variables; F is the unobservable common factor; ε_i is the residual error term, and a_{ik} are loadings. The TFI of CAMEL-S is calculated by factor analysis and the following formulas:

$Y_i = (X_i - Xmin)*100/ (Xmax - Xmin)$. Here, " i " is an index of variable.

The CAMEL scores will be assigned for each company based on the total financial index (TFI) that follows the normal distribution. The calculation of the total financial index is shown as follows:

Total financial index (TFI_k) = $TFI = \Sigma\Sigma W_{ij} * Y_{ijk}$,

$W_{ij} = (H_{ij2} / \Sigma H_{ij2}) * ((G_j / \Sigma G_j) * 100)$

where, H is loading of j factors; and G is eignvalue.

In this study, the total financial index (TFI) of CAMEL-S was collected based on results of Hsiao (2005).

The Purpose of This Study and Hypotheses

The purpose of this study is to make a performance measurement of investment for life insurers by DEA and MPI first, in which DEA was developed by Charnes, Cooper, and Rhodes (1978) as well as the MPI was developed by Fare, Grosskopf, Lindgren, and Ross (1989). Further, MPI evaluate the efficiency change of companies from 1998 to 2002. These five components of MPI are technical efficiency change, technological change, pure technical efficiency change, scale efficiency change, and total factor productivity (TFP) change. Thirdly, to achieve optimal investment strategies, DEA results

may provide insurers to promote their competitive ability by revising investment strategies. Then hypotheses were created to test if there is a statistically significant difference among the DEA model and TFI of CAMEL-S model for life insurers. In addition, to identify efficient investment tools which are more relative to investment return rate of life insurers by using regression model.

Methodology

Data Sources and participants

The analysis period of this study will cover the years from 1998 to 2002. The participants of this study, based on an annual report of life insurers in Taiwan, were classified in the following groups: eight year original domestic companies, nine new entrant domestic, and foreign branch life insurers. The Kuo Hua Life Insurance Companies were eliminated because of missing data or incompleteness in their financial annual report. The annual report of life insurers was published by the Life Insurance Association of the Republic of China. This database contains records obtained from insurers' statutory annual statements.

Selection of Variables

The selections of variables in DEA model were assigned into input and output variables. Based on the insurance laws in Taiwan, investment targets of life insurers involve: deposits in bank, securities, real estates, loans to policyholders, mortgages, loans, foreign investments, as well as authorized projects or public investments. Securities include: government and treasury bonds, stock, corporation bonds, benefit certificates, and short-term investments. However, not every item was made for some insurers. Thus, input variables in this study were classified as deposits, securities, loans, and four other

items. The output variable is financial receipts, which involve three items: interest income, gain on investment-securities, and gain on investment-real estate. The economic variables, such as the gross domestic product (GDP) and the unemployment rate are not used in this model, since the primary purpose focused on key financial investment performance.

In this study, the DEA and MPI were adopted to evaluate the investment performance and technique efficiency change for each life insurer in Taiwan.

Data Envelopment Analysis (DEA)

DEA is a powerful analytical tool for managers, which can identify best performance and guide improvement of inefficient performance. Furthermore, "DEA is a tool that can combine many performance measures into a meaningful index of productivity and can assist insurance company management in accomplishing its goals" (DePree, Jude, & Turner, 1995). In addition to dealing with data in probability distribution-free, the advantage of DEA is the ability to handle multiple input and output scenarios (Hewlitt, 1998). More importantly, DEA also helps an investor to make a better decision (McMullen & Strong, 1998). Thus, DEA could also be used by the inefficient companies to improve the efficiency of conversion process and the scale of operation. Apart from characterizing the indirect impact of firm performance, DEA can also identify the efficient frontier and further analyze best practice benchmarking (Chen & Zhu, 2004).

Two models of CCR and BCC in DEA have different assumptions. CCR is constant returns to scale (CRS), whereby the model can measure and explain the overall technical efficiency (OTE). However, BCC is variable returns to scale (VRS), whereby the model decomposes CRS into pure technical efficiency (PTE) and scale efficiency (SE): OTE = PTE*SE (Hu & Huang, 2004). There are two types of information included

in DEA: relative efficiency scores and a detailed efficiency report for each company.

Malmquist Productivity Indices (MPI)

DEA was limited to the ability to analyze performance in one year, but MPI was extended to analyze the productivity change for a continuous different year. Based on Fare Grosskopf, Norris, and Zang (1994), MPI provide five indices: technical efficiency change (effch), technological change (techch), pure technical efficiency change (pech), scale efficiency change (sech), and total factor productivity change (tfpch). Moreover, features of MPI are first decomposed into a technical efficiency change index and a technical change index. Under the CCR model, its technical efficiency change index (techch) has been decomposed into a "pure" technical efficiency change index (pech), a scale efficiency change index (sech), and a congestion change index. Coelli's (1996) DEAP program was adopted to calculate MPI from DEA scores here.

Results of this study

An Investment Tendency of Companies

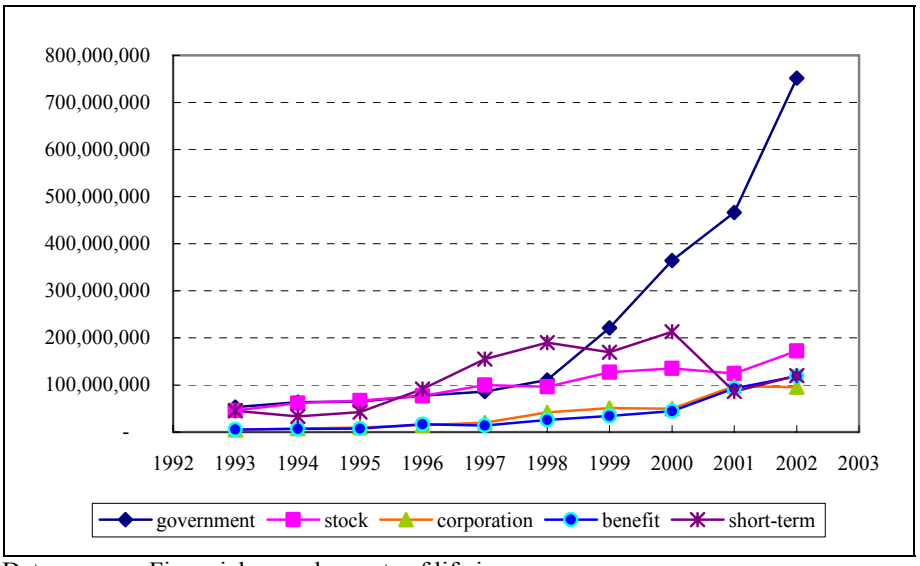
Refer to the investment tools, *securities* were the most important investment instrument for life insurers in Taiwan (Table 1). *Mortgage loans* were second. However, *authorized projects* or *public investment* generally keeps the minimum amount. It is reveal that the *deposit* was an important investment item before 1997, but the *securities* item increased sharply after 1997. *Foreign investment* also has increased very quickly since 2000. Notably, the possession rate of *government and treasury bonds* is the maximum within securities investment (Figure 1). Corporation bonds and benefit certificates appear to be not as important as government and treasury bonds. Finally, changes in short-term investments are relatively significant.

Table 1 Acquisitions of Investments of Life Insurers (Unit: NT$1,000)

Items	Deposit	Securities	Real states	Loan	Mortgage	Foreign I.	Public I.
1998	15,347,527	17,516,230	4,945,296	8,238,488	15,237,767	2,438,120	1,671,274
1999	15,846,198	22,532,522	5,968,185	10,101,202	16,470,323	3,203,781	2,541,326
2000	13,884,578	30,348,781	6,710,813	12,608,552	18,549,745	4,097,467	3,399,350
2001	13,339,679	34,611,977	7,101,547	14,579,611	19,014,452	13,166,546	3,747,623
2002	10,589,887	50,306,562	7,756,045	15,356,404	18,893,426	20,950,932	3,682,537
Mean	13,801,574	31,063,214	6,496,377	12,176,851	17,633,143	8,771,369	3,008,422
%	14.85%	33.42%	6.99%	13.10%	18.97%	9.44%	3.24%

Data sources: annual report of life insurers in Taiwan

Figure 1 Inclination of the Future of Securities for Life Insurers



Data sources: Financial annual reports of life insurers

Results of DEA

The DEA model of investment performance of life insurers in Taiwan can be expressed as following: Financial receipt = f (deposit in bank, securities, mortgage, other). Table 2 indicated the Pearson correlation coefficients between input and output variables for life insurers. It is adequate to use DEA to achieve the objective of this study because the correlation coefficients are all greater than 0.85. Further, the performance measurement for life insurers from 1998 to 2002 is shown in Table 3. Both Nan Shan and Hontai Life have an overall efficiency and scale efficiency of 100%. Only Shin Kong Life Insurer owns an increasing "return to scale." Table 4 listed the efficiency of

investment performance for life insurers.

Table 2 *Pearson Correlation Coefficients*

		Input Variables			
Output	Year	Deposit	Securities	Loan	Other
Financial Receipt	1998	0.9815	0.9458	0.9829	0.9984
	1999	0.9776	0.8996	0.9832	0.9952
	2000	0.9699	0.8770	0.9823	0.9897
	2001	0.8928	0.8028	0.9573	0.9929
	2002	0.8432	0.8842	0.9614	0.9540

Table 3 *Insurers with 100%* efficiency *in 1998~ 2002*

Items	Company Names
Overall efficiency (CCR)	Nan Shan, Hontai
Pure Technical efficiency (BCC)	Cathay, Nan Shan, Hontai, American, Manulife
Scale efficiency	Nan Shan, Hontai

Table 4 *Investment Performance of Life Insurers from 1998 to 2002*

Code	Company names	Overall efficiency (CCR)	Pure Technical efficiency (BCC)	Scale efficiency	Return to scale
1	Life Ins. Dept .of CTC	0.177	0.194	0.913	D
2	Taiwan	0.309	0.311	0.992	D
3	Prudential	0.783	0.831	0.942	D
4	Cathay	0.354	1.000	0.354	C
5	China	0.234	0.235	0.996	D
6	Nan Shan	1.000	1.000	1.000	C
7	Shin Kong	0.352	0.913	0.386	I
8	Fubon	0.247	0.254	0.973	D
9	Global	0.320	0.413	0.776	D
10	Mass Mutual Mercuries	0.244	0.255	0.958	D
11	Sinon	0.223	0.402	0.554	D
12	Singfor	0.374	0.454	0.825	D
13	Far Glory	0.300	0.327	0.916	D
14	Hontai	1.000	1.000	1.000	C
15	AZPL	0.169	0.203	0.831	D
16	Prudential of Taiwan	0.142	0.199	0.714	D
17	Aegon	0.197	0.587	0.335	D
18	New York	0.185	0.219	0.845	D
19	ING	0.269	0.269	0.998	D
20	Metropolitan	0.277	0.306	0.905	D
21	CIGNA	0.143	0.757	0.188	D
22	American	0.420	1.000	0.420	C
23	Manulife	0.099	1.000	0.099	C
24	Winterthur	0.352	0.494	0.713	D
25	Zurich	0.763	0.672	0.114	D

Note: “D” means decrease; “I” means increase; “C” means constant for return to scale.

To improve the overall efficiency and pure technical efficiency, some inefficient insurers are suggested to revise investment strategies, for example, the decision making of the least two inefficient insurers of overall efficiency and pure technical efficiency are shown in Table 5. Furthermore, Table 6 express that insurers 23 and 25 can maximize their overall efficiency up to 907% and 1210% after revising investment strategies.

Insurers 16 and 1 can maximize their pure technical efficiency up to 591% and 177%, respectively. Thus, it is important to select an optimal decision strategy.

Table 5 *The Optimal Input of the Least Two Inefficient Insurer during 1998-2002*

Items	Original efficiency	Code	Deposit	Security	Loan	Others
Overall efficiency	9.93%	23	49,437	59,604	11,061	94,923
	7.63%	25	51,358	35,996	8,142	71,054
Pure Technical efficiency	19.9%	16	453,402	961,970	110,750	1,129,345
	19.39%	1	2,171,036	1,911,772	360,919	3,296,806

Note: Under BCC & CCR

Table 6 *Maximum Improvement Output*

Items	Code	Improvement Output
Overall efficiency	23	907%
	25	1210%
Pure Technical efficiency	16	591%
	1	177%

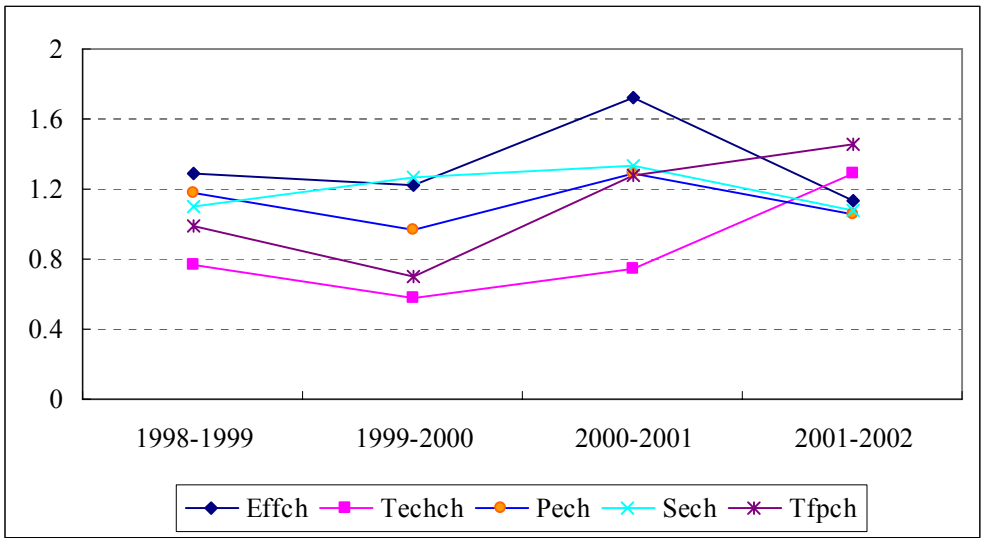
Results of MPI

Table 7 illustrated five means of MPI: effch, techch, pech, sech, and tfpch. Results of this study indicated that the effch decrease year by year. Figure 2 showed the results of MPI.

Table 7 *Means of Malmquist Productivity Indices (MPI)*

Year	effch	techch	pech	sech	tfpch
1998-1999	1.290	0.769	1.178	1.095	0.993
1999-2000	1.226	0.573	0.967	1.268	0.702
2000-2001	1.725	0.742	1.292	1.335	1.280
2001-2002	1.133	1.284	1.055	1.074	1.455
Mean	1.344	0.842	1.123	1.193	1.108

Figure 2 MPI for each two year



Research Question and Hypotheses

The main purpose of this study is to explore the investment performance and make an optimal strategy of life insurers in Taiwan. It is worth to know if the CCR and BCC were significant difference in rank within five years. In addition to using DEA to evaluate the performance efficiency, this study also adopted MPI to discuss the efficiency change. To explore the correlation of rating systems and investment performance, non-parameter methods are used to explore the difference in rank between the CCR/BCC and TFI of life insurers. Thus, some null hypotheses are created to approach purposes of the study:

Ho1: there is no significant difference in rank for life insurers between CCR and total financial index (TFI) for life insurers.

Ho2: there is no significant difference in rank for life insurers between BCC and total financial index (TFI) for life insurers.

Ho3: there is no significant difference in rank of CCR among five different years from 1998 to 2002.

Ho4: there is no significant difference in rank of BCC among five different years from 1998 to 2002.

Referred to in Table 9, outcomes of hypotheses one and two state that there is no significant difference in rank of overall efficiency or pure technical efficiency between the domestic and foreign life insurers. Furthermore, Table 10 shows that there are significant differences in rank of overall efficiency during the periods of 1998-1999, 2000-2001, and 2001-2002. However, there are no significant differences for BCC within the five-year period from 1998 to 2002. Finally, from regression outcome exhibit that deposits and loans are more contributive to *investment return rate* than securities since the worse investment environment after coming up the Financial Crisis in Southeast Asia (Table 11). The formula is expressed as follows:

Investment return rate = a0 + a1* Deposits +a2* Securities+a3* Loans+a4* other tools

Table 9 *Outcomes of Ho1 and Ho2*

	Mann-Whitney U	2002	2001	2000	1999	1998
CCR	Z	-1.520	-0.202	-1.251	-3.565	-3.78
	P-value	0.128	0.84	0.211	0.000	0.000
	Decision making	Don't reject Ho	Don't reject Ho	Don't reject Ho	reject Ho	reject Ho
BCC	Z	-2.704	-2.354	-2.085	-1.144	-2.029
	P-value	0.007	0.015	0.037	0.000	0.043
	Decision making	reject Ho	reject Ho	reject Ho	reject Ho	reject Ho

Note: the significant level is 0.05, and the test period cover 5 years.

Table 10 *Outcomes of Ho3 and Ho4*

	Wilcoxon sign rank	1998-1999	1999-2000	2000-2001	2001-2002
CCR	Z	-2.943	-0.886	-4.000	-2.190
	P-value	0.003	0.376	0.000	0.029
	Decision making	Reject	Don't reject	Reject	Reject
BCC	Z	-1.154	-0.885	-1.811	-1.54
	P-value	0.248	0.376	0.070	0.122
	Decision making	Don't reject Ho			

Note: the significant level is 0.05, and the test period is from 1998 to 2002.

Table 11 Results of regression

Items	Coefficients	t	P-value
Intercept	-206455.53	-1.31149	0.192196
Deposit	0.136655	9.581055	1.71E-16
Securities	0.0588373	12.46212	2.21E-23
Loan	0.0864726	6.026106	1.9E-08
other	0.0143146	2.662833	0.008812

Conclusion and Suggestion

The financial solvency of life insurers has been worsening since 1997 in Taiwan. "Profits dropped sharply in 1999, and yearly profit or loss before tax decreased 43.17 percent in 2000" (The Department of Insurance in Ministry of Finance, 2001). In addition to the Guo Guang Life Insurance Company's bankruptcy for its improper investment in April 1970, Hong Fu Life Insurance Company (Hong Fu Life Ins. Co.) in Taiwan recently experienced a financial crisis in 1997 due to a worse investment environment, resulting in interest spread loss and poor performance of capital investment after the Financial Crisis in Southeast Asia. Unfortunately, a more competitive climate has formed because of the four financial impacts: the declining interest rate, liberalization and internationalization, natural or man-made catastrophes, and the "fuzzy boundary" of industry. Given those impacts, life insurers must maintain their profitability and financial solvency.

In Taiwan, the total income of life insurers is generally classified into two parts: *financial received* and *premium received*. *Financial received* investment is the main profit source of life insurers. The *premium received* has possession of about eighty percent of total income, but *premium received* only covers commission and business expenses (Yen, Sheu, & Cheng, 2001). Thus, the investment performance and efficiency are very important since they are the determinants to a business's performance. In other words, a

domino effect may occur if the insurers adopt improper investment strategies. The strategies may further affect business performance with a result of business failure.

It is important to evaluate the overall efficiency, pure technical efficiency, scale efficiency, return to scale by using the DEA, and further express the productivity changes by using MPI. “The ultimate investment objective is maximizing utility, and utility comes from many sources, including some that are qualitative” (McMullen & Strong, 1998). DEA results express most life insurer should revise company’s inputs and outputs to promote the investment performance.

In Taiwan, the capital structure of investments of life insurers from 1998 to 2002 showed that securities had the largest proportion of 33.42%. The mortgage, deposit, and loan during the period possessed 14.85%, 13.1%, and 18.97% respectfully. The rest were all less than 10%. However, from regression outcome exhibit those securities didn’t seem as a good investment tools from 1998 to 2002 years. *Investment return rate* was not so ideal after the Financial Crisis in Southeast Asia occurring. Thus, security risk assessment and management are extremely important, because higher benefit should bear higher risk. In fact, life insurers could maximize their output efficiency if proper strategies could be adopted.

Finally, results of Table 10 expressed the BCC change in rank for each year. However, in CCR model, in addition to 1998 and 1999, other years seem no change in rank.

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