

Relative Efficiency Analysis Industry of Life and General Insurance in Malaysia Using Stochastic Frontier Analysis (SFA)

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Abstract

Insurance is a form of risk management in which the insured transfers the cost of potential loss to another entity in exchange for monetary compensation known as the premium. The purpose of the current study is to measure the relative efficiency of life and general insurances in Malaysia by using SFA referring to Battese and Coelli model for the year 2007 until 2009, consist of 13 life and 26 general insurance companies. All data were analyzed using the software FRONTIER to obtain the maximum likelihood (ML) and to get the relative efficiency of the life and general insurance company. The finding for life insurance showed that Mayban Life is at rank 1 for the three years and this insurance company has a relative efficiency score higher than most other companies. Overall results shown that every year there are an increasing from 1% to 17% for each year in life insurance industry and it shows that the performance of life insurance industry are in a good condition. For general insurance, *Oriental Capital Assurance Bhd (OCA)* is at rank 1 for the three years and this insurance company has a relative efficiency score higher than most other companies. Overall results shown that every year there are an increasing from 0.02 (2%) to

0.04 (4%) for each year in general insurance industry and it shows that the performances of general insurance industry are in a good condition. The 0.03975 value for the variance gamma (γ) parameter in this study is far from one, suggesting that all of the residual variations are not due to the inefficiency effects, but to random shocks. It can therefore, be concluded that the technical inefficiency effects associated with the production of the total profits by the input of the general insurance are very low. This study can be used as a benchmark in determining the efficiency of insurance companies in Malaysia.

Key words: efficiency, stochastic frontier analysis, Battese and Coelli model, life and general insurance

INTRODUCTION

Life insurance provides financial protection to a person against unforeseen circumstances such as death. Life insurance is a contract between the acquirer policy with an insurance company as the insurer, to pay a certain sum, together with bonus, when this policy is due or the insured's death. The coverage period for life insurance is more than a year. This means that the periodic premium payments monthly, quarterly or yearly to be paid by the insured. Examples of those covered by life insurance are death during the policy period, earnings at retirement, illness and disability [18]. General insurance comprises insurance of property against fire and burglary, floods, storms, earthquakes and so on. It covers personal insurance as well as insurance against accidents and also covers health insurance and liability insurance which guards legal liabilities. Then again it covers other areas such as errors and omissions, insurance for professionals, credit insurance etc. Most general insurance policies are annual and the premium payment is in advance. No risk commences unless you have paid the premium. In some long term policies companies have the facility of collecting premiums periodically [2].

Specific Objectives

This study aims to measure the relative efficiency of 13 life and 26 general insurance companies in Malaysia from 2007 to 2009. The main objectives identified are as follows:

- i. Measure the relative efficiency of performance for the life and general insurance industry.
- ii. Identify the most efficient companies based on relative efficiency scores.
- iii. Analyze the comparative efficiency of insurance companies in Malaysia.

LITERATURE REVIEW

Fetcher et al. [11] has been using the Stochastic Frontier Analysis (SFA) to analyze the cost and efficiency of life insurance and general insurance in France using data from 1984 to 1989. From the study found that the average level of efficiency for life insurance is 30% and general insurance is 50%. Greene and Segal [14] have examined the relationship between cost inefficiency and profit for the life insurance industry in United States. Profit is important for an insurance firm because of capital gains and determines the potential of a firm. Greene and Segal [14] distinguish the cost of efficiency by using stochastic frontier (SF) where this method using inefficient means for searching the diversity of firms and output. They also propose that the cost efficiency in the life insurance industry will become stronger when the turnover and inefficiency occurs where the gain is measured by return on equity. Fenn et al. [10] has uses stochastic frontier analysis to estimate Flexible Fourier cost and profit functions for European insurance companies. They also adopt a maximum likelihood approach to estimation in which the variance of both one-sided and two-sided error terms is modeled jointly with the frontiers. This approach causes that simultaneously control for the impact of heteroscedasticity on the estimation of scale economies as well as estimating the effect of firm size and market structure on X-inefficiency. Separate frontiers are estimated for life, nonlife and composites companies and using a set data from the financial reports for the period 1995 to 2001. This provides technical and non-technical accounts at year-end for life, non-life and composite insurance businesses in 14 major European countries. The result show that estimates most European insurers are operating under conditions of decreasing costs, and that company size and market share are significant factors determining X-inefficiency with respect to both costs and profits. Fenn et al. [10] also state that the larger firms and those with high market shares tend to have more cost inefficiency but less profit inefficiency.

Kasman and Turgutlu [15] investigate the technical efficiency of a sample from Turkish life insurance firms by using DEA (data envelopment analysis), CCDEA (chance-constrained data envelopment analysis) and SFA (stochastic frontier analysis) from 1999 to 2005. The main objective is to provide new information on the effect of methodological choice on the estimated efficiency by applying econometric and mathematical programming techniques to the same data set of Turkish life insurance firms. The empirical results show that the parametric and non-parametric methods provide similar rankings of firms but they differ significantly when the mean efficiency scores are considered. From the results suggest that the stochastic structure of the CCDEA approach does not eliminate the fundamental differences between DEA and SFA. Besides that, the three techniques suggest that there is a significant inefficiency problem in the Turkish life insurance industry over the sample period.

Shazali and Alias [20] review the performance of productivity and efficiency the life insurance industry for the community in Malaysia. This study is an attempt to measure productivity in the life insurance industry based on the method of Malmquist Non-parametric Index. Just as the manufacturing sector, this sector's future growth depends on its ability to compete efficiently. The ability to provide efficient service is an important source of competitive advantage in the era of globalization. The study found that although the insurance industry productivity is increase but the relative growth of life insurance is still low compared with the actual growth of the Malaysian economy. Furthermore, the efficiency of technology development and contribute to the overall productivity in the industry.

SPECIFICATION OF STOCHASTIC FRONTIER MODEL

Berger et al. [7] and Berger and Humphrey [6] have introduced two techniques to measure efficiency. There are several econometric (parametric approach) and linear programming (nonparametric approach). The parametric approach has the advantage of allowing noise in the measurement of inefficiency. However, the approach needs to specify the functional form for production, cost or profit. Coelli [9] state that the non-parametric approach is simple and easy to calculate since it does not require the specification of the functional. The method for this study is Stochastic Frontier Analysis (SFA) by using the model of Battese and Coelli [3]. SFA is a way in economic modeling. Aigner et al. [1], Meeusen and van den Broeck [16], and Battese and Cora [4] introduced the parametric approach to estimate stochastic production frontiers. These approaches specified a parametric production function and a two-component error term. One component, reflecting the influence of many unaccountable factors on production as well as measurement error, is considered “noise” and is usually assumed to be normal. The other component describes inefficiency and is assumed to have a one-sided distribution, of which the conventional candidates include the half normal [1], truncated normal [21], exponential [16] and gamma [21].

Battese and Coelli [3] assume a traditional random error (V_{it}) and a nonnegative error term (U_{it}) representing the technical inefficiency. Here, V_{it} is assumed to be independent and identically distributed, *i.i.d* $N(0, \sigma^2_V)$ and captures statistical noise, measurement error, and other random events (i.e., economic situations, quakes, weather, strikes and luck) that are beyond the company's control. The non-negative error term (U_{it}) captures the inefficiency and is assumed to be *i.i.d* as truncations at zero of the $N(\mu, \sigma^2_U)$. Also, V_{it} is assumed to be independent of the U_{it} . The model may be formed as follows:

$$Y_{it} = X_{it}\beta + (V_{it} - U_{it}) \quad i = 1, \dots, K; t = 1, \dots, T$$

where Y_{it} is output of the i^{th} firm in the t^{th} time period; X_{it} is a $K \times 1$ vector of inputs of the i^{th} firm in the t^{th} time period; β is a $K \times 1$ vector of unknown parameters; V_{it} and U_{it} are assumed to have normal and half-normal distribution, respectively. This method can compile the efficiency of the insurance company according to its function and not using a specific distribution function. Features found in this method are suitable for measuring the efficiency of insurance companies because it will be arranged in the most efficient level. With the information obtained from this study can help rehabilitate the making of new policies for improvement and further enhance the growth of the life and general insurance industry in Malaysia.

The stochastic frontier model to panel data which can be expressed as:

$$\ln Y_{it} = \beta_0 + \beta_1 \ln x_{1it} + \beta_2 \ln x_{2it} + \beta_3 \ln x_{3it} + \beta_4 \ln x_{4it} + \beta_5 \ln x_{5it} + (V_{it} - U_{it})$$

where,

Y_{it} = total profits of companies of the i^{th} company in the t^{th} time period

β = vector of unknown parameters to be estimate

x_{1it} = net investment income of the i^{th} company in the t^{th} time period

x_{2it} = total liabilities and assets of the i^{th} company in the t^{th} time period

x_{3it} = management expenses of the i^{th} company in the t^{th} time period

x_{4it} = annual premium of the i^{th} company in the t^{th} time period

x_{5it} = net claims paid by the company of the i^{th} company in the t^{th} time period

U_{it} = non-negative random variables, associated with technical inefficiency of total profits of companies.

V_{it} = assumed to be independent and identically distributed (i.i.d) $N(0, \sigma^2_v)$ and captures statistical noise, measurement error, and other random.

Battese and Coelli [3] has proposed a stochastic frontier production function is defined for panel data on firms, in which the non-negative technical inefficiency effects are assumed to be a function of firm-specific variables and vary over time. The inefficiency effects are assumed to be independently distributed as truncations of normal distributions with constant variance, but means which are a linear function of observable firm-specific variables. The generalized likelihood-ratio test is considered for testing the null hypotheses, that the inefficiency effects are not stochastic or that they do not depend on the firm-specific variables. Reviews of the literature of these studies are as Forsund, Lovell and Schmidt [12],

Schmidt [19], Bauer [5] and Greene [13]. The maximum-likelihood method is applied for the estimation of the parameters of the model and the prediction of the technical efficiencies of the firms over time. This method gives more satisfactory results as more efficient than the method of ordinary least squares (OLS) [17]. Parameters (γ) must be in the range between 0 and 1. Parameters for the stochastic production function estimated using the maximum-likelihood estimation method and the calculation by using the Frontier Version 4.1c [8]. In this study, the parameter γ is important because it facilitates the analysis of the efficiency of life and general insurance companies to be studied efficiently or not. The test statistic t and t distribution are used. Significance level used was = 0.05. The hypothesis of the study is as follows:

$$H_0: \gamma = 0 \text{ (Technical inefficiency of the insurance company investigated)}$$

$$H_1: \gamma > 0 \text{ (Technical efficiency of the insurance company investigated)}$$

RESULTS ANALYSIS

This study discusses about the life and general insurance company industry where efficiency score indicates the highest value is the most efficient and reflects the company is able to maximize the input which is very well without any problems. This time period was chosen because the time had remained in a stable phase after a variety of the economic recovery process in Malaysia. The results showed an increase from year to year as shown in Table 1 and Table 2 for both insurance company. This positive improvement show that the insurance industry has been in high demand among the people. It was found that all both insurance companies to perform as indicated when their efficiency is at 0.8 or 80% and above.

The result showed that MAYBAN LIFE company is at rank 1 for the three years and it has a relative efficiency score higher than most other companies. Efficiency scores for MAYBAN LIFE company starts from 0.97 in 2007 and increased to 0.99 in 2009. Score for the second position is GREAT EASTERN company, MAA company and MCIS ZURICH company. All three of these insurance companies get score as much as 0.90 in 2007 and increased to 0.99 (rank 1) in year 2008 and 2009. Besides that, Uni Asia Life obtain a score of 0.95 in 2007 (rank 3). In 2008 the UNI ASIA LIFE showed an increase of 0.03 (0.98) and in 2009 the score was 0.99 (rank 1). The last position is CIMB AVIVA company obtained score 0.74 (rank 9) in 2007, 0.91 (rank 5) in 2008 and 0.97 (rank 3) in 2009. Mean of efficiency score of life insurance companies were increasing from year to year presented in Table 1. Every company indicates good performance by the year to manage the company's management expenses as well as possible in order to profit the whole companies. The performance efficiency of the life insurance industry increased by an increase of 0.1 (1%) to 0.17 (17%).

Table 1: Relative Efficiency Score for Life Insurance Companies from Year 2007 to 2009

No.	Insurance Companies	Efficiency Score			Rank		
		2007	2008	2009	2007	2008	2009
1	ALLIANZ LIFE	0.94	0.98	0.99	4	2	1
2	AXALIFE	0.88	0.96	0.99	7	3	1
3	CIMB AVIVA	0.74	0.91	0.97	9	5	3
4	ETIQA	0.94	0.98	0.99	4	2	1
5	GREAT EASTERN	0.96	0.99	0.99	2	1	1
6	HONG LEONG	0.94	0.98	0.99	4	2	1
7	ING	0.89	0.96	0.99	6	3	1
8	MAA	0.96	0.99	0.99	2	1	1
9	MANULIFE	0.93	0.98	0.99	5	2	1
10	MAYBAN LIFE	0.97	0.99	0.99	1	1	1
11	MCIS ZURICH	0.96	0.99	0.99	2	1	1
12	PRUDENTIAL	0.83	0.94	0.98	8	4	2
13	UNI ASIA LIFE	0.95	0.98	0.99	3	2	1
Mean of efficiency score		0.91	0.97	0.99			

Sources: Model Output Display by Battese and Coelli (1992)

The result showed that *Oriental Capital Assurance Bhd (OCA)* is at rank 1 for the three years and it has a relative efficiency score higher than most other companies. Efficiency scores for OCA company starts from 0.94 in 2007 and increased to 0.97 in 2009. Score for the second position is BERJAYA and MUI CONTINENTAL. All two of these insurance companies get score as much as 0.92 in 2007, increased to 0.94 for year 2008 and 0.96 in 2009. Besides that, Pacific & Orient (P & O) insurance obtain a score of 0.91 in 2007 (rank 3). In 2008 the P & O insurance company showed an increase of 0.03 (0.94) and in 2009 the score was 0.96. The last position is PROGRESSIVE company obtained score 0.86 (rank 8) in 2007, 0.90 (rank 6) in 2008 and 0.93 (rank 5) in 2009. Mean of efficiency score of general insurance companies were increasing from year to year presented in Table 2. Every company indicates good performance by the year to manage the company's management expenses as well as possible in order to profit the whole companies. The performance efficiency of the general insurance industry increased by an increase of 0.02 (2%) to 0.04 (4%) per year.

Table 2: Relative Efficiency Score for General Insurance Companies from Year 2007 to 2009

	Insurance Companies	Efficiency Score			Rank		
		2007	2008	2009	2007	2008	2009
1	ACE	0.90	0.93	0.95	4	3	3
2	AGIC	0.90	0.93	0.95	4	3	3
3	AXA	0.89	0.92	0.95	5	4	3
4	BERJAYA	0.92	0.94	0.96	2	2	2
5	ETIQA	0.87	0.91	0.93	7	5	5
6	GREAT EASTERN	0.88	0.92	0.94	6	4	4
7	HONG LEONG	0.88	0.91	0.94	6	5	4
8	ING	0.89	0.92	0.94	5	4	4
9	JERNIH	0.88	0.91	0.94	6	5	4
10	KURNIA	0.90	0.93	0.95	4	3	3
11	LONPAC	0.89	0.92	0.94	5	4	4
12	MAA	0.88	0.91	0.94	6	5	4
13	MCIS ZURICH	0.90	0.93	0.95	4	3	3
14	MUI CONTINENTAL	0.92	0.94	0.96	2	2	2
15	MULTI-PURPOSE	0.91	0.94	0.95	3	2	3
16	OAC	0.90	0.93	0.95	4	3	3
17	OCA	0.94	0.96	0.97	1	1	1
18	P&O	0.91	0.94	0.96	3	2	2
19	PACIFIC	0.89	0.92	0.95	5	4	3
20	PROGRESSIVE	0.86	0.90	0.93	8	6	5
21	PRUDENTIAL	0.89	0.92	0.94	5	4	4
22	QBE	0.89	0.92	0.95	5	4	3
23	RHB	0.89	0.92	0.94	5	4	4
24	BH INSURANCE	0.88	0.91	0.94	6	5	4
25	TOKIO MARINE	0.90	0.93	0.95	4	3	3
26	UNI.ASIA GENERAL	0.89	0.92	0.94	5	4	4
Mean of efficiency score		0.89	0.92	0.95			

(Sources: Model Output Display by Battese and Coelli, 1992)

Table 3 presents the maximum likelihood estimate (MLE) for the parameters of the linear production function and related statistical tests results obtained from the stochastic frontier analysis. For the life insurance, the value of gamma (γ) for the method of maximum likelihood estimate is equal to 0.26059. The result obtained from testing the hypothesis of a life insurance company is calculated t statistic is 2.69752 and it is greater than the critical value of t statistics 2.023 ($t_{calculated} = 2.69752 > t_{5\%,39} = 2.023$). Therefore, the null hypothesis is rejected at significance level 0.05. This indicates a significant relationship between net

investment income, management expenses, annual premium and net claims paid by company. Can be concluded that the life insurance company in 2007, 2008 and 2009 was at an efficient level. Results of maximum likelihood estimation (MLE) found that the elasticity of the total profits for management expenses is the highest 0.5298. This means that with an increase 1% in input management expenses will increase by 0.5298% on the profitability of life insurance companies. For the input of the net investment income, the elasticity of the total profit is 0.375. This means that 1% increase in net investment income input resulted in an increase of 0.375% on the profitability of insurance companies.

The result obtained from testing the hypothesis of a general insurance company is calculated t statistic is 0.19281 and it is less than the critical value of t statistics 2.375 ($t_{calculated} = 0.19281 > t_{1\%, 78} = 2.375$). Therefore, the null hypothesis is not rejected at significance level 0.01. This indicates is not significant relationship between net investment income, management expenses, annual premium, total liabilities and assets and net claims paid by company. The 0.03975 value for the variance gamma (γ) parameter in this study is far from one, suggesting that all of the residual variations are not due to the inefficiency effects, but to random shocks. It can therefore, be concluded that the technical inefficiency effects associated with the production of the total profits by the input of the general insurance are very low. Nevertheless, the gamma which is statistically significant suggests that the traditional (OLS) function is not an adequate presentation.

Results of maximum likelihood estimation (MLE) found that the elasticity of the total profits for annual premium is the highest 0.9046. This means that with an increase 1% in input annual premium will increase by 0.9046% on the profitability of general insurance companies. For the input of the net investment income, the elasticity of the total profit is 0.2178. This means that 1% increase in net investment income input resulted in an increase of 0.2178% on the profitability of general insurance companies.

Table 3: Results of maximum likelihood estimation (MLE)

Parameters	Coefficient		t-ratio	
	Life	General	Life	General
Constant	$\beta_0 = 1.65237$	$\beta_0 = 0.52997$	4.50138*	0.29619
Net investment income	$\beta_1 = 0.37518$	$\beta_1 = 0.21778$	5.38110*	3.6814**
Total liabilities and assets	$\beta_2 = 0.06545$	$\beta_2 = -0.08534$	0.28111	-1.0769
Management expenses	$\beta_3 = 0.52983$	$\beta_3 = -0.03655$	2.25917*	-0.6083
Annual premium	$\beta_4 = -0.10944$	$\beta_4 = 0.90460$	-5.72135*	16.7974**
Net claims paid by the company	$\beta_5 = 0.08542$	$\beta_5 = 0.02082$	2.91575*	0.59588
Gamma	$\gamma = 0.26059$	$\gamma = 0.03975$	2.69752*	0.19281

Significantat level, 0.05*, 0.01**

DISCUSSION AND CONCLUSION

This study focuses on stochastic frontier analysis approach (SFA) that involves econometric methods used to analyze the efficiency of life insurance companies in Malaysia. Battese and Coelli model (1992) is measure to investigate the relative efficiency of life insurance companies over the period 2007 to 2009. From the study, the relative efficiency for life insurance companies have been increasing from year by year. Companies who posted scores the highest relative efficiency for life insurance is Mayban Life company with the score 0.97 in 2007 and 0.99 in 2008 and 2009. In addition, the efficiency performance of the life insurance industry increased by an increase from 0.1 (1%) to 0.17 (17%) by year. Companies who posted scores the highest relative efficiency for general insurance is Oriental Capital Assurance Bhd (OCA) is at rank 1 for the three years and it has a relative efficiency score higher than most other companies. Efficiency scores for OCA company starts from 0.94 in 2007 and increased to 0.97 in 2009. In addition, the efficiency performance of the general insurance industry increased by an increase of 0.02 (2%) to 0.04 (4%) by year. The 0.03975 value for the variance gamma (γ) parameter in this study is far from one, suggesting that all of the residual variations are not due to the inefficiency effects, but to random shocks. The results of this study also assessed by looking at the efficiency score. According to the rank of efficiency included in this study will help people in selecting and evaluating life insurance companies that have good performance and also will help the management and administration of insurance firms involved in making and improves the weaknesses, such as formulating business strategy or marketing strategy to attract customers who can benefit the firm. As conclusion, this stdy can be used as a benchmark in determining the efficiency of insurance companies in Malaysia, according to the appropriate model.

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