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Efficiency of General Insurance in Malaysia Using Stochastic Frontier Analysis

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ABSTRACT

General insurance comprises insurance of property against fire and burglary, floods, storms, earthquakes and so on. The purpose of the current study is to measure the relative efficiency of general insurance in Malaysia by using SFA for the year 2007 until 2009, consist of 26 general insurance companies by using the software FRONTIER to obtain the maximum likelihood (ML) and to get the relative efficiency. The finding showed that *Oriental Capital Assurance* Bhd (*OCA*) is at rank 1 for the three years. 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 insurence are very low.

Keywords: efficiency, stochastic frontier analysis, specification of Battese and Coelli, general insurance.

1. INTRODUCTION

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. 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 (ArticleWorld, 2012).

This study aims to measure the relative efficiency of 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 general insurance industry.
ii. Identify the most efficient general insurance companies based on relative efficiency scores.
iii. Analyze the comparative efficiency of general insurance companies in Malaysia.
iv. To estimate technical efficiency of general insurance by using Stochastic Frontier Analysis.

2. LITERATURE REVIEW

Fetcher et al. (1993) 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 (2004) have examined the relationship between cost inefficiency and profit for the life insurance industry in the United States. Profit is important for an insurance firm because of capital gains and determines the potential of a firm. Greene and Segal (2004) distinguish the cost of efficiency using the stochastic frontier which this method using inefficient means for searching the diversity of firms and output. They also proposed that the cost efficiency in the life insurance industry will be strong when there is turnover and inefficiency occurs when the gain is measured by return on equity.

Fenn et al. (2007) had use 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 use data set of 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 showed 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. (2007) 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 (2007) investigates the technical efficiency of a sample of Turkish life insurance firms using the deterministic data envelopment analysis (DEA), chance-constrained data envelopment analysis (CCDEA) and stochastic frontier analysis (SFA) for the period 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. From the result, the three techniques suggest that there is a significant inefficiency problem in the Turkish life insurance industry over the sample period.

For the theoretical of stochastic frontier functions have not explicitly formulated a model for the inefficiency effects. Empirical papers, in which the issue of the explanation of the inefficiency effects has been raised include Kalirajan (1981, 1982, 1989), Kalirajan and Flinn (1983), and Kalirajan and Shand (1989). Their studies adopt a two-stage approach. The first stage involves the specification and estimation of the stochastic frontier production function and the prediction of either the inefficiency effects or the technical efficiencies of the firms involved. The second stage of the analysis involves the specification of a regression model for either the predicted inefficiency effects or the levels of technical efficiency of the firms in terms of various explanatory variables and an additive random error. The parameters of this second-stage inefficiency model have been generally estimated by using ordinary least-squares regression.

Study in Malaysia conducted by Shazali and Alias (2000) 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. 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. 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 also found that the efficiency of technology development and contribute to the overall productivity in the industry.

3. SPECIFICATION OF STOCHASTIC FRONTIER MODEL

Berger et al. (1993) and Berger and Humphrey (1997) has 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 (2004) 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 (1992).

SFA is a way in economic modeling. Aigner, Lovell, and Schmidt (1977), Meeusen and van den Broeck (1977), and Battese and Cora (1977) 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 (Aigner, et al., 1977), truncated normal (Stevenson, 1980), exponential (Meeusen and van den Broeck, 1977) and gamma (Greene, 1980 and Stevenson, 1980).

Battese and Coelli (1992) 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, σ^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 (μ, σ^2_U). Also, V_{it} is assumed to be independent of the U_{it}. The model may be formed as follows:

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

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 general insurance industry in Malaysia.

According to the equation, the model for a specific general insurance used in this study is:

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

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

x_{3it} = total liabilities and assets 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, σ^2_v) and captures statistical noise, measurement error, and other random.

Battese and Coelli (1992) 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-speciflc 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-speciflc 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-speciflc variables.

The variance parameters are:

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \qquad (3)$$

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*) (Richmond, 1974). 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 (Coelli, 1996).

$$\gamma = \sigma_u^2 / \sigma^2 \qquad (4)$$

So that $0 \leq \lambda \leq 1$.

Given the specification of the stochastic frontier model in Equation (1), the technical efficiency of production of the i^{th} firm given the level of inputs is defined as

$$TE_i = \exp(-u_i) \qquad (5)$$

So that $0 \leq TE_i \leq 1$ are inversely related to technical inefficiency (Khairo and Battese, 2005). In this study, the parameter γ is important because it facilitates the analysis of the efficiency of general insurance companies to be studied efficiently or not. The test statistic t and t distribution are used. Significance level used in this study are 0.05 and 0.01. The hypothesis of the study is as follows:

H_0 : γ = 0 where, technical inefficiency of the insurance company investigated

H_1 : γ > 0 where, technical efficiency of the insurance company investigated

4. RESULTS ANALYSIS

This study discusses about the general insurance company 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. The total number of observations from this study is 26 firm operating in Malaysia general insurence industry over the period 2007 to 2009. 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 for general insurance. This positive improvement show that the insurance industry has been in high demand among the people. It was found that all general insurance companies to perform as indicated when their efficiency is at 0.8 or 80% and above.

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 positionis 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 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.

Table 1: 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)

Figure 1 shows the relative efficiency of general insurance companies for a period of 3 years commencing from 2007 to 2009. From the diagram below, can conclude that the performance efficiency of the general insurance industry increased by an increase of 0.02 (2%) to 0.04 (4%) per year.

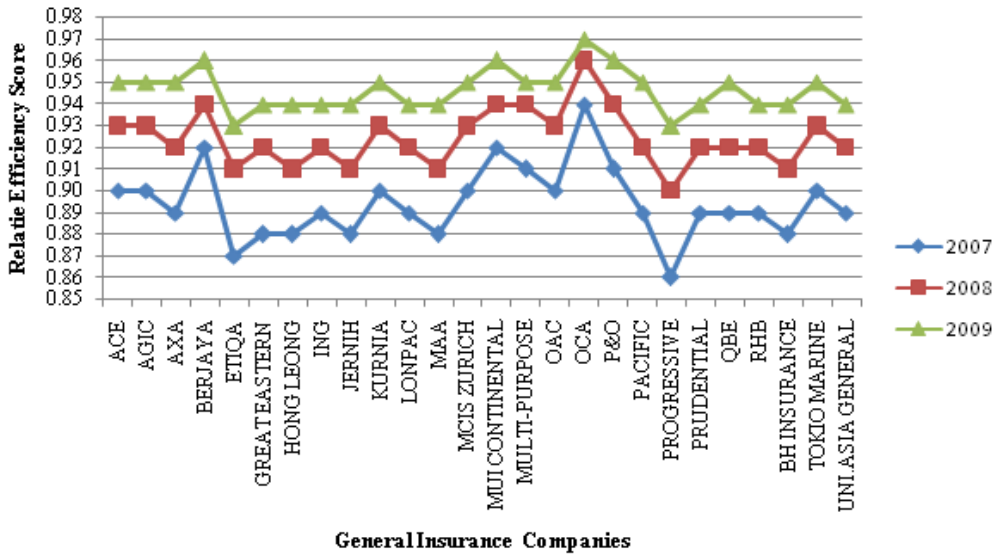

Figure 1: Relative Efficiency Score for General Insurance Companies from Year 2007 to 2009

Table 2 presents the maximum likelihood estimate (MLE) for the parameters of the linear production function and realated statistical tests results obtained from the stochastic frontier analysis. The estimated production function parameters indicated that net investment income, management expenses, total liabilities and assets, annual premium and net claims paid by the company. The estimated sigma-squared (σ^2) in this study is 0.02455 and it statistically different from zero at one percent. The result indicates that the one-sided error term dominates the symmetry error indicating a good fit and the correctness of the specified distributional assumptions.

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 $(t = 0.19281 > t_{0.01} = 2.375)$. 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 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 insurence 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 2: Results of Maximum Likelihood Estimation for the General Insurance Industry

Parameters	**Coefficient**	***t*-ratio**
Constant	β_0 = 0.52997	0.29619
Net investment income	β_1 = 0.21778	3.6814**
Management expenses	β_2 = -0.03655	-0.6083
Total liabilities and assets	β_3 = -0.08534	-1.0769
Annual premium	β_4 = 0.90460	16.7974**
Net claims paid by the company	β_5 = 0.02082	0.59588
Sigma-squared $(\sigma^2 = \sigma_{u^2} + \sigma_{v^2})$	$\sigma^2 = 0.02455$	5.95461**
Gamma $(\gamma = \sigma_{u^2} / \sigma^2)$	γ = 0.03975	0.19281
Log Likelihood Function	35.65203	

*Significantat level, 0.01**,0.05**

5. CONCLUSION AND DISCUSSION

This study focuses on stochastic frontier analysis approach (SFA) that involves econometric methods used to analyze the efficiency of general insurance companies in Malaysia. Battese and Coelli model (1992) is used to obtain the relative efficiency of general insurance companies from year 2007 to 2009. From the study, the relative efficiency for general insurance companies have been increasing from year to 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 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. MLE found that the elasticity of the total profits for annual premium is the highest 0.9046 and the second highest is net investment income where the elasticity of the total profit is 0.2178. The results of this study also assessed by looking at the efficiency score. According to the rank of efficiency included in this study can help people in selecting and evaluating general insurance companies that have good performance. This study 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. This study can also be used as a benchmark in determining the efficiency of insurance companies in Malaysia according to the appropriate model.

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