

Box Cox- Fourier Flexible Functional Forms in Stochastic Metafrontier Analysis: The Cost Efficiency of the Insurance Industry in Malaysia

(Analisis Perbatasan Meta Stokastik Menggunakan Fungsian Fleksibel Box-Cox Fourier:
Kecekapan Kos Industri Insurans di Malaysia)

Roziana Baharin

Zaidi Isa

Universiti Kebangsaan Malaysia

ABSTRACT

Takaful insurance industry is growing rapidly after nearly 30 years of operation. It is therefore desirable for the performance of this industry to be assessed to measure its level of achievement. Since the industry comprises conventional and Takaful insurance industries, then the form of organisation may affect the efficiency. This study used the Meta Stochastic Analysis Parametric Approach in order to measure the relationship between efficiency and organisational structure for family Takaful operators and life insurance operators in Malaysia. The analysis of this study applied the modified Box Cox Fourier functional form for a period of time ranging from 2004 to 2015. The findings showed that there is a significant difference in cost efficiency between the Takaful industry and the life insurance industry. Overall, the Takaful industry has lower cost efficiencies than conventional insurance, proving that the form of organisation has an effect on efficiency. The findings also showed that the average difference in cost efficiency is influenced by technology level gaps.

Keywords: Efficiency; insurance; takaful; stochastic metafrontier

ABSTRAK

Industri insurans takaful berkembang pesat selepas hampir 30 tahun beroperasi. Oleh itu, wajar untuk prestasi industri ini dinilai untuk mengukur tahap pencapaian. Oleh kerana industri terdiri daripada industri insurans konvensional dan takaful, maka bentuk organisasi boleh menjejaskan kecekapan. Kajian ini menggunakan pendekatan Analisis Perbatasan Meta Stokastik untuk mengukur hubungan antara kecekapan dengan struktur organisasi ke atas pengendali takaful keluarga dan pengendali insurans hayat di Malaysia. Analisis kajian ini menggunakan bentuk fungsian Box Cox Fourier yang diubahsuai, untuk tempoh masa antara tahun 2004 hingga 2015. Penemuan kajian menunjukkan bahawa terdapat perbezaan yang signifikan dalam kecekapan kos antara industri Takaful dan industri insurans hayat. Secara keseluruhan, industri Takaful mempunyai kecekapan kos yang lebih rendah daripada insurans konvensional, membuktikan bahawa bentuk organisasi mempunyai kesan ke atas kecekapan. Penemuan kajian juga menunjukkan bahawa perbezaan purata kecekapan kos dipengaruhi oleh jurang tahap teknologi.

Kata kunci: Kecekapan; insurans; takaful; perbatasan meta stokastik

INTRODUCTION

Takaful industry in several regions of the world has witnessed tremendous development. Therefore, to enhance the growth of the Takaful industry in line with the growth of conventional insurance industry, it needs to improve its efficiency. Efficiency is the measure of relative performance for decision-making units (DMUs). The vast size of the Muslim market which has yet to be fully explored is sufficient to support a vibrant growth for the industry in the future. Based on this background, this study aimed to measure and compare the efficiency of the Takaful and insurance operators by using the frontier efficiency methodologies. Given that these industries are most likely exposed to different environmental backgrounds, such as laws and regulations, the most

appropriate method in measuring the efficiency of these DMUs is metafrontier analysis. The findings of this research can provide valuable insights for the government as well as the players in the industry so that they can cooperate in investigating the problems and weaknesses in the implementation of industrial efficiency.

Thus, the results of this research were aimed at measuring the level of competence and organisational form factor in the dual financial system in Malaysia. This is because efficiency issues are important in financial services sector. As such, this study focused on the level of cost efficiency, by measuring a firm's performance against firms with best practices. The Takaful industry operates cooperatively by providing a similar protection service to one another akin to services by conventional insurance operators. However, since Takaful insurance operations



are based on Shariah principles, this organisational structure restricts the ability of Takaful insurers to generate additional capital and invest in shareholders and shareholders' funds. According to Abouzaid (2007) and Swiss Re (2008), the Takaful market needs more liquidity in terms of investment for the purpose of attracting capital investors. Hence, the firm's objective is to optimise operational costs for Takaful operators, especially when the global financial crisis has led to a decrease in customer demand (Ernst & Young, 2009).

The Family Takaful market is expected to help boost economic growth in Malaysia. The Takaful industry in Malaysia is expected to continue to grow from its conventional counterparts, in which accumulating to 30.5% from the overall life market based on the new business premiums, up to 28.8% at the end of 2016. Family Takaful represents more than 60% of the total new business in Malaysia (Fitch ratings Report, 2017). It is one of the financial services sectors that plays an important role in supporting economic and social development. Although the Takaful industry continues to maintain strong performance amid competitive environmental challenges, Malaysia's Takaful market penetration level is still lower than in other developed countries. This is evidenced by the fact that the percentage of people covered by the Takaful family contracts in Malaysia is still very low compared to conventional insurance.

For the last three decades, the Islamic financial institutions have been developing rapidly. However, it seems that many research studies mainly concentrated on issues related to development and performance of banking and financial markets and thus neglecting the important sector which is insurance. Hence, the objective of this paper was to measure the performance of the Takaful industry in Malaysia as compared to the conventional industry. Consequently, researchers see that there is a need for a study on the level of competence and form of organisation that exist in the insurance industry in Malaysia, i.e., the Takaful industry and the conventional insurance industry. The study on efficiency issues of the Takaful industry is especially important in the dual finance system in Malaysia, with Takaful operators operating in line with the conventional insurance industry. The restructuring of the newly introduced Malaysian financial system over the past decade is also expected to have an impact on the level of efficiency of insurance companies and Takaful operators. Hence, information on the company's performance evaluation can be used for the purpose of improving the overall quality of operations and contributing to the achievement of its competitiveness.

In general, the purpose of this study is to examine the relationship between efficiency and organisational form in the Malaysian Takaful industry compared to the conventional insurance industry. In particular, this study aimed to measure the cost efficiency of both industries by using more flexible functional forms in the measurement

approach. Hence, the main contribution of this study is to show the position of the Takaful industry in terms of efficiency level. So far, it will help regulators take steps towards enhancing Takaful efficiency if they are behind conventional insurance efficiencies.

Most past research found in Malaysia aimed at investigating the relationship between efficiency and organisation forms as well as applied a non-parametric approach, Data Envelopment Analysis (DEA). However, this study used a parametric approach, namely the Stochastic Metafrontier Analysis (SMFA) by applying the modified Box Cox Fourier functional form. Here, we focused on the Stochastic Frontier Analysis (SFA) parametric technique, specifically the Metafrontier method which is one of the most widely used econometric method applied to the parametric approach, which was introduced to efficiency studies by Battese et al. (2004). The stochastic metafrontier analysis approach applied in this research facilitates the comparison of performance for different industrial groups assessed as it operates under different technologies. Thus, this method is best suited for comparing the efficiency scores between the Takaful industry and the conventional insurance industry in Malaysia generally. According to Gallant (1981; 1982), the Fourier Flexible functional form provides a global approximation to an unknown data generating process. This functional form is based on the development of the second series of Taylor sequences, where the development of the Fourier series is decapitated and then added to the development of the two logarithms. This expansion of the logarithm was replaced with the Box-Cox transformation, which in turn made this functional form more robust in estimating errors and nested tests carried out on some functional forms in empirical studies.

The organisation of this study is as follows. Section 2 presents the literature review related to the field of stochastic frontier efficiency studies and results of previous studies. Section 3 is devoted to the methodology in relation to efficiency measurement. The discussion of the sample data and empirical specification of the Stochastic Metafrontier are explained in Section 4. The final section presents the overall conclusion of this research analysis.

LITERATURE REVIEW

Since the concept of efficiency was introduced by Farrell (1957), operationalised by Charnes et al. (1978), and later improved by Banker et al. (1984), there have been many efficiency studies in various areas being studied including the area of insurance. Although there is a large and growing body of literature exploring insurance firm efficiency and insurance industry all over the world, there is significantly less literature in efficiency studies of Takaful industry as well as Takaful operators. However, because of the vast untapped markets

for Takaful, globalisation, competition, and changing of local regulations, several attempts have been made to study the Takaful industry efficiency. Previously, the cost efficiency of both conventional insurance and Takaful industry in Malaysian market was studied by Norashikin et al. (2012). Their findings indicated that there was a significant difference in cost efficiency between these two industries. Besides that, most of the previous studies in insurance adapted frontier efficiency methodologies to achieve the most comprehensive view of firm performance.

The methodology of frontier efficiency in measuring the performance of the firm relative to the best practice frontiers from the firms in the industry within the financial firms is assumed to be crucial and has more advantages as compared to financial ratio analysis (Berger & Humphrey, 1997; Cummins et al., 1999). This new benchmarking technique allows summary of firm performance in one statistics in a multidimensional framework (Cummins et al., 1999). Generally, the frontier efficiency methodology is divided into two main categories, namely non-parametric (mathematical programming) approach and the parametric (econometric) approach.

Although the non-parametric and parametric methodologies are different in terms of model specification, both are served to estimate the best practice frontier, with the efficiency of specific decision-making units (DMUs) measured relative to the frontier (Cummins & Zi 1998). Both approaches have been used in various studies of efficiency and neither is considered as being dominant over another. In recent years, a non-parametric frontier efficiency methodology that has become increasingly important is the data envelopment analysis (DEA), which was first introduced by Charnes et al. (1978). Meanwhile, for a parametric approach, the stochastic frontier analysis (SFA) is the most prominent, which was proposed by Aigner et al. (1977). However, in DEA, the differences among various DMU of dissimilar environmental backgrounds, such as law and regulations, economic civilisation, and political backgrounds are easily being neglected (Hao 2007). Therefore, DEA is not quite suitable for efficiency studies involving DMUs across countries or regions. Hence, the metafrontier approach can overcome these obstacles.

Frontier efficiency analysis evolved by measuring the effect of organisational forms on efficiency. The hypotheses that are the basis of this issue are the hypotheses of spending priorities (Mester 1991) and the management's discretionary hypothesis (Mayers & Smith 1988). The Takaful operator is the same as the form of a mutual organisation, owned by the policyholder; whereas, the insurance firm refers to the form of a stock organisation, owned by a shareholder. The spending priority hypothesis states that the performance of the mutual insurance operator is less efficient than the operator of the stock organisation, influenced by the authority by the management. Whereas,

the management's discretionary hypothesis states that mutually-owned firms are more efficient because they are less influenced by management's authority (Cummins & Weiss 2000). There are many disagreements on this issue by past researchers. However, most studies have found that stock firms are more efficient than mutual firms (Cummins et al., 1999; Brockett et al., 2005). However, in comparison to 15 European countries, Diacon et al. (2002) found that mutual ownership of the form is more effective in controlling the owner's conflict of ownership as the owner of the policyholder; and therefore, a mutual company is more efficient than a stock company. Likewise, Eling and Luhn (2010) were of the opinion that mutual companies are more efficient than stocks. However, Brockett et al. (2005) suggested that stock firms are more effective than joint companies.

The contradiction between these two opinions has infused doubts over the efficiency measurement of the Malaysian Takaful industry in comparison to conventional insurance. Although the issue of insurance efficiencies was widely covered by most researchers, very few studies were conducted in Malaysia. Norma et al. (2006) investigated the eligibility of eleven life insurance operators and one Takaful operator, i.e., Takaful Nasional between 2002 and 2005. This study found that the pure efficiency of the National Takaful was below the industry average, while the scale efficiency change was equivalent to the industry average. Nonetheless, Norashikin et al. (2011) argued that it was not a complete review in assessing the efficiency of Takaful operators by comparing it to eleven insurers. Hence, they conducted a comprehensive study on the two forms of organisations that existed in the Malaysian insurance industry. As a result, they found that lower market share existed in the Takaful industry resulting in lower technical efficiencies compared to conventional insurance.

Previous research by Cummins et al. (1999) conducted a research on cost and technical cost estimated with DEA and Malmquist Index approach applications. The study for the period of 1981 until 1990 involved a total of 206 stock insurers and 211 joint insurers in the United States. The results of the analysis showed that the boundaries of the cost of shares dominated the shared cost boundaries. Hence, it is clear that firms with different forms of organisation have comparative advantages in minimising the cost of production and cost of agents.

This result is also consistent with a study by Brockett et al. (2005), which identified a significant difference between the stock form and the common form. What is interesting from the results of this study is that stock companies are more efficient than joint companies. Hence, the findings of this study are in line with the hypothesis of the spending priority in which the joint venture company fails to select the optimum input mixture thus eliminating cost minimisation.

In the insurance industry, two types of organisational forms exist, especially in Muslim countries and perhaps

western countries that consist large Muslim populations. The Takaful contributions grew by 22% yearly and are expected to increase in growth by year 2020 (Ernst and Young, 2013). According to a report by Takaful Re (2014), there is a huge potential for the Takaful industry regardless it has religious inclinations, lack of exposure about insurance products, or even less distribution and insurance coverage. These studies, henceforth, have raised the questioning of the implications of organisational differences in performance efficiencies between the conventional insurance industry and the Takaful industry in Malaysia. Thus, the objective of this study was to measure the relationship between efficiency and organisational form. Since most studies were more focused on nonparametric approaches, this study aimed at meeting the previous research gap survey.

METHODOLOGY

THE EFFICIENCY CONCEPT

Estimation of Cost Efficiency For an empirical analysis of efficiency measurement, estimation should be made on the production function, cost function, or profit function of a firm. Hence, this involves the selection of an appropriate functional form for more accurate budgeting results. In the context of this study which aimed at measuring the cost efficiency of the Takaful industry and the conventional insurance industry, it was an estimation of cost function based on the relationship between market price and competition, apart from the use of technology.

To see the value of a firm's competence, it could be measured by the proportion of resources used efficiently. Thus, the firm's cost efficiency would include $[0, 1]$, where the value of one is a firm with best practices in the observation borders.

Following Aigner et al. (1977), the cost efficiency function can be specified as follows;

$$\ln TC_{kt} = x_{kt}\beta + \varepsilon_{kt} \quad (1)$$

Where :

$\ln TC_{kt}$ is the natural logarithmic of the observed total costs

x_{kt} is a vector of input prices and output quantities

β is a vector of parameters of the Stochastic frontier function

ε_{kt} composed error measurement consists of noise and inefficiency

Measurement Techniques There are two types of methodology in measuring the efficiency, which are the parametric and the nonparametric methods. The parametric methods consist of the Stochastic Frontier Approach (SFA), the Thick Frontier Approach (TFA), and the Distribution-Free Approach (DFA). On the other hand, nonparametric efficiency estimation techniques are Data

Envelopment Analysis (DEA) and Free Disposable Hull analysis (FDH).

Typically, nonparametric techniques only focus on technological optimisation, but neglect economic optimisation by ignoring price information. Furthermore, nonparametric methods assume a deterministic procedure instead of a stochastic procedure. In other words, another drawback of this method is that it usually does not allow for random errors in the data. Thus, there is no way to derive inferences of the estimated parameters or conduct statistical hypothesis tests (Berger & Mester 1997).

Here, we focused on the Stochastic Frontier Analysis (SFA) parametric technique, specifically the Metafrontier method, which is one of the most widely used econometrics methods applied to the parametric approach. It was introduced to efficiency studies by Battese et al. (2004).

The stochastic metafrontier analysis approach applied in this research facilitates the comparison of performance for different industry groups assessed as it operates under different technologies. This is best suited for comparing the efficiency scores between the Takaful industry and the conventional insurance industry in Malaysia.

Stochastic Metafrontier Cost Analysis Typically, stochastic frontier analysis as stated in equation [1] is in the opinion that all firms use the same production technology. This analysis will then apply the Meta stochastic approach to identify and evaluate whether there are differences in technology used by Takaful firms and conventional insurance. This issue is due to Shariah constraints that restrict the use of certain technologies and products of insurance firms.

Under this model, firms are not assumed to share the same production technology characterised by stochastic boundary functions. Metafrontier is defined as a deterministic parametric function of the specified functional form so that the values are not greater than the stochastic determinants of the group boundary production function involved for all groups and periods of time (Battese et al. 2004).

The Metafrontier function model for the insurance firms in the industry expressed by Battese et al. (2004) as follows;

$$Y_{kt}^* \equiv f(x_{kt}, \beta^*) = e^{x_k \beta^*} \quad (2)$$

Where

Y_{kt}^* represents the output of the insurance firms k in period t

x_{kt} is a vector of input prices and output quantities

β is a vector of parameters of the Stochastic frontier function

$e^{x_k \beta^*}$ this expression assumes that the exponent of the frontier production function is linear in the parameter vector, $\beta(k)$, so that x_k is a vector of functions (e.g., logarithms) of respective group or firm

β^* is a vector of parameters of the Metafrontier function to be estimated such as :

$$x_{kt}\beta^* \leq x_{kt}\beta \quad (3)$$

The equation (2) can be reformulated in its general form for the purpose of the Metafrontier function derivation as follows:

$$Y_{kt}^* = e^{x_{kt}\beta^* + v_{kt} + u_{kt}} \quad (4)$$

Where

Y_{kt}^* represents the output of the insurance firms k in period t

x_{kt} is a vector of input prices and output quantities

v_{kt} is the unexplained portion of the cost of i th output in the j th firm.

u_{kt} represents a the random effect of the j th firm

Alternatively we can express the equation by :

$$Y_{kt} = e^{u_{kt}} \times \frac{e^{x_{kt}\beta^*}}{e^{x_{kt}\beta}} \times e^{x_{kt}\beta^* + v_{kt}} \quad (5)$$

The $e^{u_{kt}}$ represents the cost efficiency relative to the stochastic frontier of bank k at time t in the j -th group.

$$CE = \frac{Y_{kt}}{e^{x_{kt}\beta^* + v_{kt}}} = e^{u_{kt}} \quad (6)$$

With $0 \leq CE_{kt} \leq 1$

The $\frac{e^{x_{kt}\beta^*}}{e^{x_{kt}\beta}}$ represents the Technology Gap Ratio

(TGR) and measures the difference in the range of frontier production between each different for the j th group compared to the output produced by the functional form of the Metafrontier.

$$TGR_{kt} = \frac{e^{x_{kt}\beta^*}}{e^{x_{kt}\beta}} \quad (7)$$

With $0 \leq TGR_{kt} \leq 1$

The cost efficiency relative to the Metafrontier is defined as follows:

$$CE_{kt}^* = \frac{e^{x_{kt}\beta^* + v_{kt}}}{Y_{kt}} \quad (8)$$

An alternative expression for the CE^* could be computed as follows

$$CE_{kt}^* = TC \times TGR_{kt} \text{ with } 0 \leq CE_{kt}^* \leq 1 \text{ and } CE_{kt}^* \leq CE_{kt} \quad (9)$$

Following Battese et al. (2004), there are three steps to estimate the Metafrontier model. First, the coefficient of the $\widehat{\beta}_j$ for the β_j parameters of the stochastic frontier for the j -th group need to be estimated. Second, the value of, $\widehat{\beta}^*$, for the β^* parameters of the Metafrontier function is estimated. By using the criterion of sum of squares of deviations, we can identify the best envelopes of the estimated deterministic components of the estimated stochastic frontiers for the different groups. Finally, by

using $CE_{kt}^* = CE_{kt} \times TGR_{kt}$, the relative cost efficiencies of the Metafrontier function is calculated. The equation $TGR_{kt} = e^{x_{kt}\beta^* - x_{kt}\beta}$ is the estimate for the TGR for the i th firm in the j th group relative to the industry potential, obtained by using the estimates for the parameters involved.

The constrained linear least method is used in order to minimise the distance of the j th group relative to the industry potential.

Then, arrange the constraints such that $x_{kt}\beta^* \leq x_{kt}\widehat{\beta}$ is respected and bound the results of the β^* such that it smoothly envelopes the minim estimators of j th group.

This leads to the following optimization problem, which β^* is estimated by solving a quadratic programming (QP) problem:

$$\min L^{**} = \sum_{t=1}^T \sum_{k=1}^N (x_{kt}\widehat{\beta} - x_{kt}\beta^*) \text{ with } x_{kt}\beta^* \leq x_{kt}\widehat{\beta} \quad (10)$$

The objective of the approach is to minimise the sum of squares of the deviations between the meta-frontier and the frontier of the individual countries. Thus, this paper applied the methodology of metafrontier stochastic analysis to measure the efficiency score of both insurers by using the maximum likelihood method and the optimisation procedure. As a result, the larger the technology gap ratio is for a firm, the higher the weight will be that is being assigned to it.

The Box Cox Fourier Functional Form Specification The Fourier flexible form has been proven by Gallant (1981) as having the capability to approximate a function as closely as desired in Sobolev norm. The low-order polynomial is included to alleviate the approximation effects resulting from Gibbs phenomenon (Eubank & Speckman 1990). The Fourier flexible form nests the popular translog form by replacing an alternative low-order polynomial and yet still maintain the desirable qualities of the original form.

Thus, we can rewrite equation (1) as,

$$\begin{aligned} \ln TC = & \alpha_0 + (\alpha_1 \ln Q^2) + [(\beta_1 \ln P_1) + (\beta_2 \ln P_2) + \\ & (\beta_3 \ln P_3)] + \frac{1}{2} [(\delta_1 \ln Q^{2+\lambda}) + ((\gamma_1 \gamma_2 \ln P_1 \ln P_2) + \\ & (\gamma_2 \gamma_3 \ln P_2 \ln P_3) + (\gamma_3 \gamma_1 \ln P_3 \ln P_1) + \\ & (\rho_1 \rho_1 \ln P_1 \ln Q^2) + (\rho_2 \rho_1 \ln P_2 \ln Q^2) + \\ & (\rho_3 \rho_1 \ln P_3 \ln Q^2)] + [a_1 \cos(Q') + b_1 \sin(Q')] \\ & + \zeta \end{aligned} \quad (11)$$

Where:

$\ln TC$ = natural logarithmic of the observed total costs

Q' = vector of scaled value of logarithmic output to fit in the interval $[0, 2\pi]$

$\ln Q$ = natural logarithmic of outputs

$\ln Q^2$ = natural logarithmic of output (Box Cox transformations)

$\ln P_i$ = natural logarithmic of the i -th input prices

Where $\alpha_i, \beta_i, \delta_{ij}, \gamma_{lm}, \rho_k$ are the unknown parameters of the cost functions, and $Q' = (0.2\pi - \mu^*a + \mu^* \ln Q)$,

TABLE 2. Mann Whitney Test Result for Different Organization Form

Organization Form	Type of Firm	Mean Rank	Sum of Rank	Sig.
Takaful Industry	Takaful operators	4.50	26.00	0.038*
	Life Insurers	9.50	52.00	

0.05 level of significance *

0.01 level of significance**

the hypothesis of identical frontiers for conventional and Takaful industry and this is consistent with Cummins et al. (1999). But, the authors also obtained no significant difference between the stock own and pooled frontiers, which contradicts our findings. As a conclusion, we follow Cummins et al. (1999) and conclude that the rejection of identical frontiers shows that to measure the efficiency of both the conventional and Takaful industry, it should be on different frontiers and not solely based on the pooled frontier. Thus, the economic interpretation of this result is that in order to produce their respective outputs, the conventional and Takaful industry use different technologies.

The results pertaining to the parameters and metafrontier value for the Box Cox Fourier functional form are reported in Table 3. Overall, there are substantial differences between the meta-frontier coefficients and the corresponding coefficients of the SFA for entire sample. There is a likelihood that there are a few industries that adopt inferior technology for the creation of various financial services. This measure makes their meta-cost efficiency measures slightly low. Furthermore, financial markets in Malaysia have become more competitive since the implementation of the second series of financial market development was introduced in 2016 to expand and deepen financial markets in the country. This also led to the shrink in technology gap between the insurance groups when the measures were evaluated under different technologies. The results showed that the average efficiency score was increased and this indicates that the insurers and Takaful operators are being competitive among each firm (Cummins1999).

Now, the Wakalah model has been widely used in Takaful industry operations. This model illustrates the relationship between operator and Takaful participants based on agency contracts. This clearly shows that the Takaful party is the agent who takes actions for participants in investment and underwriting arrangements. Hence, this often raises issues such as conflict between management of Takaful operators and participants (policyholders). This will lead to higher management costs over operating activities and consequently there are inefficiencies in cost. This situation clearly contributes to the ineffectiveness of the Takaful operators rather than the insurance industry.

According to market power theory, firms with larger gross premiums have larger market share, and this makes the insurance industry more efficient than the Takaful industry. Hence, the low cost efficiency in the Takaful

TABLE 3. Estimates for Parameters of the Stochastic Metafrontier Models using Box Cox Fourier Form

Unknown parameters	Group 1	Group 2	Metafrontier
	1.35 (0.94)	0.69 (0.22)	2.214
	-0.76 (0.55)	0.60 (0.46)	0.061
	0.25 (0.29)	-1.25 (0.56)	0.987
	0.46 (0.33)	0.145 (0.077)	0.087
	0.89 (0.35)	0.334 (0.089)	0.195
	0.45 (0.11)	1.97 (0.87)	0.045
	-0.04 (0.16)	0.03 (0.35)	0.004
	0.145 (0.38)	0.45 (0.24)	0.035
	0.055 (0.47)	0.87 (0.54)	0.014
	0.074 (0.051)	0.15 (0.04)	0.147
	0.98 (0.44)	0.73 (0.59)	0.037
	1.07 (0.78)	0.041 (0.027)	0.065

Note : Numbers in the parentheses are standard errors

industry is attributable to relatively low market share. Thus, the Takaful operator must increase the demand for Takaful products to enable the market share to increase. To achieve this goal, Takaful operators are encouraged to implement various channels to generate demand for family Takaful products.

CONCLUSION

The findings have important implications to show the significant difference between the Takaful industry and the insurance industry. On average, the Takaful industry provides an estimate of the value of more cost-effective efficiencies compared to the conventional insurance industry. Thus, it is clear that the form of organisation has an impact on the firm's competence.

The results of the study showed that the Takaful industry is more efficient than the conventional insurance industry. Hence, the organisational structure that led the firm to a higher incidence of higher agency costs arose from higher management costs and staff costs. The findings also showed that Takaful firms did not successfully use the combined inputs and outputs, and the failure to use optimum technology was another possible cause. In summary, cost inefficiency is due to technical inefficiency and inefficiencies of provisions. According to market power theory, it is thought that the smaller market share in the Takaful industry will lead to a lower level of cost efficiency. This study is consistent with Hao (2007), Chou and Hao (2005), Hu et al. (2009), and Barros et al. (2010).

Studies on the efficiency of the Takaful industry with the application of the frontier method are still underdeveloped, although there were some studies using the Data Envelopment Analysis (DEA) technique by Abd Kader et al. (2010) and Marie et al. (2009), and in Malaysia (Norashikin et al. 2011; Norma et al. 2006). This study was conducted to improve the study on the efficiency and shape of the organisation for the insurance industry in Malaysia with the application of the Stochastic Metafrontier Analysis (SMFA) method. Such a study was conducted to measure the efficiency and comparability of the form of organisation for the insurance industry in Malaysia.

Overall, the findings support the importance of an analysis of organisational form and its implications on the efficiency of both the Takaful industry and the conventional insurance industry in Malaysia. Thus, the main objective of this study was to compare the relationship between the organisational form and the existing competencies between the Takaful industry and the conventional insurance industry in Malaysia. Hence, the analysis of this study was conducted to estimate the cost efficiency score of the two insurance industries. The main contribution of this study is to identify the level of Takaful industry position compared to the conventional insurance industry. As such, enhancement measures can be designed for the purpose of improving the performance of the Takaful industry if the achievement is somewhat lagging behind the conventional insurance industry. Future studies are recommended in order to compare the performance of international competitiveness and to test other factors that influence the efficiency of the study so that the study is more comprehensive.

REFERENCES

- Aigner, D.J., Lovell C.A.K. & P. Schmidt. 1977. Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics* 6: 21–37.
- Abouzaid, C. 2007. The Role of pure re-takaful operators versus conventional reinsurers: Envisioning the future. In *Islamic Insurance: Trends, Opportunities and the Future of Takaful*, edited by Jeffer. S. Euromoney, London.
- Abdul Kader, H., Adams, M.B. & Hardwick, P. 2010. The cost efficiency of takaful insurance companies. *Geneva Papers on Risk and Insurance: Issues and Practice* 35: 161–181.
- Altunbas, Y., M.H. Liu, P. Molyneux & R. Seth. 2000. Efficiency and risk in Japanese banking. *Journal of Banking and Finance* 24: 1605–1628.
- Altunbas, Y., Gardener, E. P. M, Molyneux, & Moore, B. 2001. Efficiency and risk in European banking. *European Economic Review* 45: 193–1955.
- Altunbas, Y., Evans, L. & Molyneux, P. 2001. Bank ownership and efficiency. *Journal of Money, Credit and Banking* 926–954.
- Banker, R.D., Charnes, A., & Cooper, W.W. 1984. Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Journal of Management Science* 30(9).
- Barros, P., & Obijiaku, E. L. 2007. *Technical Efficiency of Nigerian Insurance Companies*. Department of Economics, Institute for Economics and Business Administration (ISEG), Technical University of Lisbon. Working Papers No. 18.
- Battese, George E, D.S. Prasada Rao & Christopher J.O'Donnell. 2004. A metafrontier production function for estimation of technical efficiencies and technology gaps for firms operating under different technologies. *Journal of Productivity Analysis* 21: 91–103.
- Berger, A.N., Leusner J.H. & J. Mingo. 1996. The efficiency of bank branches. *Journal of Monetary Economics* 40: 141–162.
- Berger, A.N. & R. DeYoung, 1996. Problem loans and cost efficiency in commercial banks. *Journal of Banking and Finance* 21: 849–870.
- Berger, A.N. & L.J. Mester. 1997. Inside the black box: What explains differences in the efficiencies of financial institutions? *Journal of Banking and Finance* 21: 895–947.
- Berger, A. N., Cummins, J. D., & Weiss, M. A. 1997. The coexistence of multiple distribution systems for financial services: The case of property-liability insurance. *Journal of Business* 70 (4): 515–546.
- Berger, A. N., Cummins, J. D., & Weiss, M. A., Zi, H. 2000. Conglomeration versus strategic focus: Evidence from the insurance industry. *Journal of Financial Intermediation* 9 (4): 323–362.
- Berger, A.N. and Humphrey, D.B. 1997. Efficiency of financial institutions: International survey and directions for future research. *EJOR* 98(2): 175–212.
- Brockett, P. L., Cooper, W. W., Golden, L. L., Rousseau, J. J., & Wang, Y. 2005. Financial intermediary versus production approach to efficiency of marketing distribution systems and organizational structure of insurance companies. *Journal of Risk and Insurance* 72(3): 393–412.
- Charnes, A., Cooper, W. W., & Rhodes, E. 1978. Measuring the efficiency of decision making units. *European Journal of Operational Research*. 2(6): 429–444.
- Cummins, J. D., & Zi, H. 1997. Comparison of frontier efficiency methods: An application to the US life insurance industry. *Journal of Productivity Analysis* 10(2): 131–152.
- Cummins, J. D., Weiss, M. A., & Zi, H. 1999. Organizational form and efficiency: The coexistence of stock and mutual

- property-liability insurers. *Management Science*. 45(9): 1254–1269.
- Cummins, J. D., & Weiss, M. A. 2000. Analyzing Firm Performance in the Insurance Industry Using Frontier Efficiency Methods. *Handbook of Insurance Economics*. Kluwer Academic Publishers, Boston, MA.
- Cummins, J. D., Rubio Misas, M., & Zi, H. 2004. The effect of organizational structure on efficiency: Evidence from the Spanish insurance industry. *Journal of Banking and Finance* 28(12): 3113–3150.
- Cummins, J. D. & Zi, H. 1998. Comparison of frontier efficiency methods: An application to the US life insurance industry. *Journal of Productivity Analysis* 10(2): 131–152.
- Coelli, T.J., 1996. A Guide to FRONTIER Version 4.1: A computer program for stochastic frontier production and cost function estimation, Working Paper, Centre for Efficiency and Productivity Analysis.
- Coelli, T.J., Prasada Rao D.S. & G. Battese, 1998. An Introduction to Efficiency and Productivity Analysis, Norwell, Kluwer.
- Diacon, S. R., Starkey, K., & O'Brien, C. 2002. Size and efficiency in European long- term insurance companies: An international comparison. *Geneva Papers on Risk and Insurance* 27(3): 444–466.
- Dietsch, M. & Weill, L. 2000. The Evolution of Cost and Profit Efficiency in European Banking. In *Research in Banking and Finance*. Vol. 1, edited by I.Hasan and W.Hunter. JAI Press/Elsevier.
- Eling, M., & Luhnen, M. 2010. Frontier efficiency methodologies to measure performance in the insurance industry: Overview, systematization, and recent developments. *Geneva Papers on Risk and Insurance* 35(2): 217–265.
- Erhemjamts, O., & Leverty, J. T. 2007. The Demise of the Mutual Organizational Form: An Investigation of the Life Insurance Industry. Working Paper.
- Eubank, R.L., & Speckman, P. 1990. Curve fitting by polynomial trigonometric regression. *Biometrika* 77: 1–9.
- Ernst & Young. 2009. *The World Takaful Report*. London: Ernst & Young, London.
- Farrell, M.J. 1957. The measurement of productive efficiency. *Journal of the Royal Statistical Society, Series A, General*. 120 (3): 253–281.
- Fitch Ratings Report, 2017. <http://www.theedgemarkets.com/article/fitch-malaysias-takaful-growth-continued-outpace-conventional-insurance-1h17>
- Fenn, P., Vencappa, D., Diacon, S., Klumpes, P., & O'Brien, C. 2008. Market structure and the efficiency of European insurance companies: A stochastic frontier analysis. *Journal of Banking and Finance* 32 (1): 86–100.
- Fitch Ratings Report, 2017. Malaysia's takaful growth continued to outpace conventional insurance in 1H17. <http://www.theedgemarkets.com/article/fitch-malaysias-takaful-growth-continued-outpace-conventional-insurance-1h17>.
- Gallant, A. R. 1981. On the bias in flexible functional forms and an essentially unbiased form: The fourier flexible form. *Journal of Econometrics* 15: 211–245.
- Gallant, A. R. 1982. Unbiased determination of production technologies. *Journal of Econometrics* 20: 285–323.
- Gardner, L. A., & Grace, M. F. 1993. X-efficiency in the US life insurance industry. *Journal of Banking and Finance* 17(2-3): 497–510.
- Grace, F.M. & Timme, S. G. 1992. An examination of cost economics in the united states life insurance industry. *Journal of Risk and Insurance* 59:72–103.
- Greene, W. H., & Segal, D. 2004. Profitability and efficiency in the US life insurance industry. *Journal of Productivity Analysis* 21(3): 229–247.
- Habhajan, S. 2018. Malaysia's takaful growth outpacing conventional insurance. Retrieved 5 February 2018 from <https://themalaysianreserve.com/2018/02/05/malaysias-takaful-growth-outpacing-conventional-insurance/>.
- Hamim, S.A.M., Naziruddin, A. & Syed M. Al-Habshi. 2006. A conceptual framework for and survey of banking efficiency study. *Unitar E Journal* 2(2)
- Hao, J. C. J., 2007. Efficiency test on Taiwan's life insurance industry-using xefficiency approach. *Information and Management Sciences* 18(1): 37–48.
- Hu X., Zhang C, Hu J & Zhu N. 2009. Analyzing efficiency in the Chinese life insurance industry. *Management Research News* 32(10): 905–920.
- Huang, W. 2007. Efficiency in the China Insurance Industry: 1999–2004. Working Paper .
- Jeng, V., & Lai, G. C. 2005. Ownership structure, agency costs, specialization, and efficiency: Analysis of Keiretsu and independent insurers in the Japanese nonlife insurance industry. *Journal of Risk and Insurance* 72 (1): 105–158.
- Jeng, V., Lai, G. C., & McNamara, M. J. 2007. Efficiency and demutualization: Evidence from the U.S. life insurance industry in the 1980s and 1990s. *Journal of Risk and Insurance* 74 (3): 683–711.
- Klumpes, P. J. M. 2004. Performance benchmarking in financial services: Evidence from the UK life insurance industry. *Journal of Business* 77 (2): 257–274.
- Klumpes, P. J. M. 2007. Consolidation and Efficiency in the Major European Insurance Markets. Working Paper, Imperial College, London.
- Marie, A., Rao, A. & Kashani, H. 2009. Cost efficiency and value driver analysis of insurers in an emerging economy. *Managerial and Decision Economics* 30: 265–280.
- Mayers, D., & Smith, C. W. 1988. Ownership structure across lines of property-casualty insurance. *Journal of Law and Economics* 31: 351–378.
- McAllister, P.H. & D. McManus. 1993. Resolving the scale efficiency puzzle in banking. *Journal of Banking and Finance* 17: 389–405.
- Mester, L. J. Agency costs among savings and loans. 1991. *Journal of Financial Intermediation* 1: 257–278.
- Mitchell, K. & N.M. 1996. Onvural, economies of scale and scope at large commercial banks: Evidence from the fourier flexible functional form. *Journal of Money, Credit, and Banking* 28: 178–199.
- Norma, Shabri, Rosylin, Jarita & Rahim. 2006. Measuring efficiency of insurance and takaful companies in Malaysia Using Data Envelopment Analysis (DEA). *Review of Islamic Economics* 10(2): 5–26.
- Norashikin, Syed Othman Alhabshi & Obiyathulla Bacha. 2011. Organizational form and efficiency: The coexistence of family takaful and life insurance in Malaysia. *Journal of Global Business and Economics* 3(1).
- Swiss Re. 2008. Insurance in the Emerging Markets: Overview and Prospects for Islamic Insurance, Sigma No.,5. Swiss Re Publications, Zurich.

Takaful Re. 2014. World Islamic Insurance Directory 2014 (Singapore: Middle East Insurance Review).
Vencappa, D., Fenn, P. & Diacon, S. 2008. Parametric decomposition of total factor productivity growth in the European insurance industry: Evidence from life and non-life companies, Working Paper.

Roziana Baharin
Fakulti Ekonomi dan Pengurusan
Universiti Kebangsaan Malaysia
43600 UKM Bangi Selangor
MALAYSIA
E-mail: roziana.baharin@ukm.edu.my

Zaidi Isa*
Fakulti Sains dan Teknologi,
Universiti Kebangsaan Malaysia
43600 UKM Bangi Selangor
MALAYSIA
E-mail: zaidiisa@ukm.edu.my

*Corresponding author