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Efficiency and Productivity of the Life Insurance Industry in Malaysia

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Abstract

By using Data Envelopment Analysis (DEA) and Malmquist Total Factor Productivity (TFP) Index approach, this study aims to benchmark the technical efficiency and the productivity change measurement of the 12 life insurance companies in Malaysia. A balanced panel data collected from the annual report of the 12 life insurance companies in Malaysia for the 5 years period from 2014 to 2018 is used in the DEA approach. The effect of input variables (Commission and Management Expenses) and output variables (Premiums and Net Investment Income) on the efficiency scores evaluated using DEA is examined using the Tobit model. The efficiency scores of the life insurance companies evaluated using DEA show that Great Eastern Life Assurance (Malaysia) Berhad, Hong Leong Assurance Berhad and Manulife Insurance Berhad are the life insurance companies with the best efficiency, while Allianz Life Insurance Malaysia Berhad is the least efficient life insurance company. According to the Malmquist index evaluated, there is a deterioration of 0.9 percent in technical efficiency, 2.4 percent progression in technology, a change of -0.4 percent in pure technical efficiency, a change of -0.5 percent in scale efficiency and an improvement of 1.5 percent in TFP in the life insurance industry in Malaysia throughout the 5 years study period from 2014 to 2018. The result also reveals that the technological progression has caused the positive change in TFP. According to the result of Tobit analysis, premiums are found to have significant positive effect on the efficiency score. In contrast, both commission and management expenses have significant negative effect on the efficiency score. The only variable found to have no major effect on efficiency score is net investment income.

Keywords: *DEA approach, Tobit analysis, Efficiency, Life Insurance Companies, Malmquist Total Factor Productivity (TFP) Index*

1.0 Introduction

The insurance industry plays an important role in the modern economy and financial system. Insurance is aimed to provide protection against individuals by transferring or pooling the risks (Feldman and Brown, 2005). The insurance industry in Malaysia has a great potential to grow as stated by the Governor of Central Bank of Malaysia. This is because the insurance sector accounts for 5.8% of financial assets despite contributing just 1.7 percent of GDP in 2018 as mentioned by Governor of Central Bank. The ratio of total premiums to GDP is 4.8 percent in 2018, which is still low when compared to the other countries such as Thailand which had a ratio of 5.26 percent in 2018. There are also at least 8 million working-age individuals who have not owned any insurance policy (Bnm.gov.my, 2018). These show that there are many people in Malaysia that are not protected by insurance. Therefore, the industry should work more proactively to bring positive impacts to the economy and society of Malaysia by improving the efficiency and productivity to reach the 8 million people who do not own any insurance policy.

Amongst the many types of insurance industry in Malaysia, the life insurance industry is the one to focus on in this study Life insurance can help to protect the insured's beneficiaries when the insured passes away or becomes totally and permanently disabled by paying them an amount of money. According to the statistics shown in the annual report 2018 of the Life Insurance Association of Malaysia (LIAM), the life insurance industry in Malaysia has grown moderately from 2014 to 2018. The number of policies, sums insured and total premiums collected in the life industry have shown an increasing trend since 2014. The number of policies has increased from 12,455,970 units to 12,667,037 units. The total premiums collected from new customers have increased from RM8,949.3 million to RM10,303.5 million. In 2018, the life insurance industry had a registration of RM1.51 trillion in sum assured for all policies combined (LIAM, 2019). It shows an increase of 9.6% compared to 2017. Besides, according to the statistics by the Department of Statistics, Malaysia and Economic Planning Unit, life insurance has contributed an average of 2.82% to the gross domestic product (GDP) each year for the year 2012 to 2016 and there is room to improve it as compared to Thailand which is 3.60% per year in average. The demand for life insurance has increased over the years as more people are realising the benefits of life insurance.

The study of life insurance companies' efficiency and productivity in Malaysia is important in benchmarking the industry's growth during the study period in order to improve the industry's efficiency and productivity in the future.

2.0 Literature Review

There is a lot of research done for the insurance industry on efficiency and productivity but in different regions. Barros, Barroso, and Borges (2005) have done research on the evaluation of the efficiency and productivity of insurance companies in Portugal from 1996 to 2001. This study aimed to rank the performance of the selected companies based on the evaluation. This study found that some companies have increased in terms of productivity while some experienced decreasing productivity. Besides, Biener, Eling and Wirfs (2015) have done research to examine the determinants of efficiency and productivity in the Swiss insurance industry. Talat and Muhammad (2010) have done research that focused on the evaluation of the efficiency of the insurance industry in Pakistan. Besides, Gagandeep and Divya (2017) have studied the technical and scale efficiency of 20 insurers in India. For the financial period 2011-12 to 2015- 16, it was observed that Life Insurance Corporation was the most efficient insurance company compared to other insurers in India. There were also two past research done for the insurance industry in Slovakia by Zimková (2015) and Grmanová and Strunz (2017). The research done by Zimková (2015) aimed to determine the technical efficiency and super-efficiency of insurance companies in Slovakia. It was found that AXA Insurance Company was the most efficient company in Slovakia in 2013. On the other hand, Grmanová and Strunz (2017) did the research with a different objective. They aimed to examine the relationship between technical efficiency and profitability of insurance companies in Slovakia. The results showed that there was no significant relationship between efficiency and profitability.

As for the life insurance industry, Hsien-Da, Ya-Hui, and Meng-Long (2010) have examined Taiwan's life insurance industry in terms of technical efficiency and productivity changes. The results showed that the efficiency of Taiwan's life insurance companies was relatively low but most of the life insurance companies in Taiwan have increased in productivity. In the years 2008 to 2009, the average productivity of life insurance companies increased by 4.1 percent.

Furthermore, there was also past research done on the non-life insurance industry by Abidin and Cabanda (2011) and Indrarini, Canggih, and Alif Rusmita (2019) in Indonesia. Abidin and Cabanda (2011) focused on the evaluation of the efficiency of non-life insurance companies in Indonesia. The results showed that bigger companies were more efficient than small companies. Moreover, the research done by Indrarini, Canggih and Alif Rusmita (2019) focused on the determinants of the Islamic insurance industry in Indonesia. They found that return on equity and the firm size would affect the efficiency of the Islamic insurance company.

While in India, there are also several past research done on the non-life insurance industry. Bhishma Rao and Venkateswarlu (2015) and Ilyas and Rajasekaran (2019) have studied the efficiency and productivity of non-life insurers in India. Bhishma Rao and Venkateswarlu (2015) carried out the study by comparing the insurers from the private and public sectors. The results showed that the efficiency of non-life insurers from the public sector was higher than the efficiency of private sector non-life insurers and all non-life insurers have shown decline in their overall productivity in the study period. On the other hand, Ilyas and Rajasekaran (2019) focused on the determinants of efficiency and productivity of non-life insurers in India. They found that the financial crisis did not have a great impact on the efficiency of the non-life insurers.

In Malaysia, there were many past researches done on the insurance industry. Norma and Nur Edzalina (2011) have studied the efficiency of life insurance companies in Malaysia and Brunei. By comparison, they found that American International Assurance Co. Ltd. in Brunei had the highest productivity while Prudential Assurance Malaysia Bhd. had the lowest productivity. Furthermore, several research studies have been done on the efficiency and productivity evaluation of the insurance industry that focused on Malaysia. Each of them carried out the research from a different perspective.

Ahmad, Nawi and Aleng (2013) studied the relative efficiency of performance for the life and general insurance industry in Malaysia and identified the most efficient insurance company in Malaysia. Overall, the performance efficiency of the life and general insurance industry has improved over the years, where the life insurance industry increased from 0.01 to 0.17 and the general insurance industry increased from 0.02 to 0.04 over the study period.

Norma et al. (2006) and Baharin and Isa (2013) have studied the evaluation of efficiency of Takaful and conventional insurance companies in Malaysia. Norma et al. (2006) found that the bigger size companies were more efficient in generating more outputs by utilizing their inputs. Takaful National was also having good competitiveness compared to conventional companies although it was not among the best companies in Malaysia. The study done by Masud et al., (2019) focused on the evaluation of productivity of the life insurance institutions in Malaysia. They found that the overall growth of life insurance companies in Malaysia from 2012 to 2016 was 2.5% per year, which was very low compared to developed nations. The highest productivity progress was at a rate of 11.7% from 2012 to 2013 while the minimum productivity progress was only 0.2% from 2014 to 2015. This study was expected to bring impacts to the audience as the research gap is filled. This study will focus on the evaluation of both efficiency and productivity of the life insurance industry in Malaysia.

Although the life insurance industry was being studied, Ahmad, Nawi and Aleng (2013) compared the life and general insurance industry and Masud et al., (2019) was just measuring the productivity but not the efficiency. Hence, it is needed to highlight that this study is more advanced than the previous studies as three stages of the analysis process will be included to give a better overview of the performance of the life insurance industry in Malaysia as Tobit Regression Analysis will also be included in this study.

3.0 Methodology

This section introduces the research methodology of the study, which included DEA, Malmquist TFP Index, and Tobit regression analysis.

3.1 Data Envelopment Analysis (DEA)

Data Envelopment Analysis is a non-parametric linear-programming technique that aims to measure the relative efficiency of the decision-making unit (DMU) (Ling et al., 2018). DEA can be used when the comparison can hardly be made due to the inputs and outputs with different scales or different measurement units. DEA can also be used when simple comparisons using classic regression techniques cannot be applied to measure efficiency. Simple comparison means measuring the unit's efficiency using only one input and one output. However, in reality, one or multiple inputs needed to be taken into consideration to produce one or multiple outputs. Hence, DEA is used to evaluate the relative efficiency of each unit that involves multiple inputs and outputs by using a comparative approach (Ling et al., 2018). DEA adopts a DMU as the efficient frontier, based on the criterion where the DMU is consuming the least number of inputs to produce the highest number of outputs.

DEA can be used in two ways, which are input-oriented and output-oriented. The principle of input minimization is applied to the input-oriented model, which is to investigate the lowest possible number of inputs that should be used to produce a certain level of output. On the other hand, output-oriented models are adapted to the concept of output maximization, which is to identify the highest possible number of outputs that can be produced by using a certain number of inputs. Among the two models, the input-oriented DEA approach is frequently used by the researcher as it is easier to manage inputs compared to outputs (Aziz, Janor and Mahadi, 2013). The efficiency score generated by DEA ranged from 0 to 1. If the efficiency score generated is 1, it means that the DMU is efficient and lies on the frontier. It also means that the DMU has produced outputs by fully utilizing 100% of its inputs. The efficiency score generated is less than 1 indicating that the DMU is not efficient as its inputs are not fully utilized to produce outputs (Suzuki et al., 2011).

The following is the DEA model developed by Charnes et al. (1978):

$$\text{Max TE}_k = \frac{\sum_{r=1}^{s} u_{rk} Y_{rk}}{\sum_{i=1}^{m} v_{ik} X_{ik}} \text{ ---------- [1]}$$

Constraints;

$$\frac{\sum_{r=1}^{s} u_{rk} Y_{rj}}{\sum_{i=1}^{m} v_{ik} X_{ij}} \leq 1 \text{ -------------------- [2]}$$

$u_{rk} \geq 0$, $v_{ik} \geq 0$ ------------------------[3]

$j = 1, \ldots, n$

$r = 1, \ldots, s$; $i = 1, \ldots, m$

where the index representations are as shown below:

TEk: the DMU's technical efficiency, which is being assessed using m inputs to produce *s* outputs;
j: represents the DMUs, which ranges from 1 to *n* (there are *n* DMUs);
i: the input index, which ranges from 1 to *m* (there are *m* inputs);
r: the output index, which ranges from 1 to s (there are *s* outputs);
X_{ij} : represents the *j*th DMU's *i*th input value (X_{ik} represents the ith input value for the DMU that is being assessed);
Y_{rj} : represents the *j*th DMU's *r*th output value (Y_{rk} represents the rth output value for the DMU that is being assessed);
v_{ik} : the *i*th input's weight for the DMU that is being assessed;
u_{rk} : the *r*th output's weight for the DMU that is being assessed.

The ratio of weighted sum of multiple outputs to weighted sum of multiple inputs using equation [1]. Constraint [2] shows that if a DMU's weights are used for other DMUs, the efficiencies should be less than or equal to 100 percent. Constraint [3] indicates the weights' non-negativity.

3.2 Malmquist TFP Index

The Malmquist TFP Index is constructed using the Data Envelopment Approach (DEA) and estimated using Coelli's DEAP version 2.1. Malmquist TFP Index is used to differentiate between technical efficiency and technological transition due to the time factor. Following Fare et al. (1992), the input oriented Malmquist TFP Index for any two consecutive time *t* and *t*+1, can be written in the following way:

$$M_i^{t+1}(y^{t+1}, x^{t+1}, y^t, x^t) = \frac{D_i^{t+1}(y^{t+1}, x^{t+1})}{D_i^t(y^t, x^t)} \times \sqrt{\left[\frac{D_i^t(y^{t+1}, x^{t+1})}{D_i^{t+1}(y^{t+1}, x^{t+1})} \times \frac{D_i^t(y^t, x^t)}{D_i^{t+1}(y^t, x^t)}\right]} \text{ --------------[4]}$$

$M_i^{t+1}(y^{t+1}, x^{t+1}, y^t, x^t)$ = TFP change --------------- [5]

$\frac{D_i^{t+1}(y^{t+1}, x^{t+1})}{D_i^t(y^t, x^t)}$ = technical change

= pure technical efficiency change $\times$ scale efficiency change -------------------------------[6]

$$\sqrt{\left[\frac{D_i^t\,(y^{t+1},x^{t+1})}{D_i^{t+1}(y^{t+1},x^{t+1})} \times \frac{D_i^t\,(y^t,x^t)}{D_i^{t+1}(y^t,x^t)}\right]}$$ = technological change --[7]

TFP change = technical efficiency change × technological change ----------[8]

The equation [4] represents the productivity changes from period *t* to period *t*+1, where the value of larger than 1 implies an increase in overall output from period *t* to the next period *t*+1. However, if the value is smaller than 1, it shows a decrease in TFP. If the Malmquist production index's value is 1, it indicates that total factor productivity remains the same from period *t* to period *t*+1.

The ratio [6] measures the technical efficiency change, where the distance between DMU and the frontier is calculated in period *t*+1 as opposed to period *t*. If the technical efficiency change has a value of 1, the DMU has the same distance from the frontiers in period *t* + 1 and *t*. If the technical efficiency change has a value of greater than 1, it means that the DMU has a smaller distance with the frontier in period *t*+1 compared to period *t*. Conversely, if the technical efficiency change has a value of smaller than 1, it means that the DMU has a greater distance with the frontier in period *t*+1 compared to period *t*. The index of technical efficiency change was further broken down into pure technical efficiency change and scale efficiency change. Technical efficiency change is measured with constant returns to scale (CRS), while pure technical efficiency change is measured with variable returns to scale (VRS). The scale efficiency change is the ratio of technical efficiency change to the pure technical efficiency change.

The ratio [7] captures the shift in technology between two successive time periods. If technological change has a value of 1, it indicates that there is no shift in the technology frontier. If technological change has a value smaller than 1, it shows the regression of technology. If technological change has a value greater than 1, it indicates the improvements in technology. Hence, it can be concluded the distance between DMUs and the change in the production frontier over time (technological shift) or the industry production frontier (technical efficiency change) can affect the TFP change shown in equation [8] (Price and Weyman-Jones, 1996).

3.3 Tobit Regression Analysis

Truncated or censored regression analysis is another name for Tobit regression analysis. Tobit regression analysis is used to examine the linear relationship between multiple independent variables and a non-negative dependent variable (Ling et al., 2018). In this study, the dependent variable is the DEA efficiency scores while commission, management expenses, net investment income, and premium are the independent variables. Generally, the dependent variable is either left-censored or right-censored. When the values fall at or below the limit set, left-censoring or censoring from below will occur. When the values fall at or above the set limit, however, right-censoring or censoring from above occurs.

There is also a two-limit Tobit model where the data are censored from both sides. Since the efficiency score is always ranged from 0 to 1 (Das and Ghosh, 2006; Banker et al., 2010), the upper limit of efficiency scores is 1. Hence, the right-censored Tobit regression model is suitable for analysis purposes. Tobit regression coefficients have a similar interpretation manner as OLS regression coefficients. However, the linear effect does not take place on the observed outcome but it is on the latent variable. For example, for each unit of increment in the corresponding predictor, how many units of changes is shown by the latent variable which is the expected efficiency scores. The Tobit model is drawn up as follows:

$$\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \ldots + \hat{\beta}_n X_n$$

where:

$\hat{Y}$: dependant variable
$\hat{\beta}_0$: constant
$\hat{\beta}_1, \hat{\beta}_2, \ldots, \hat{\beta}_n$: regression coefficient(s)
$X_1, X_2, \ldots, X_n$: independent variable(s)

3.4 Research Framework

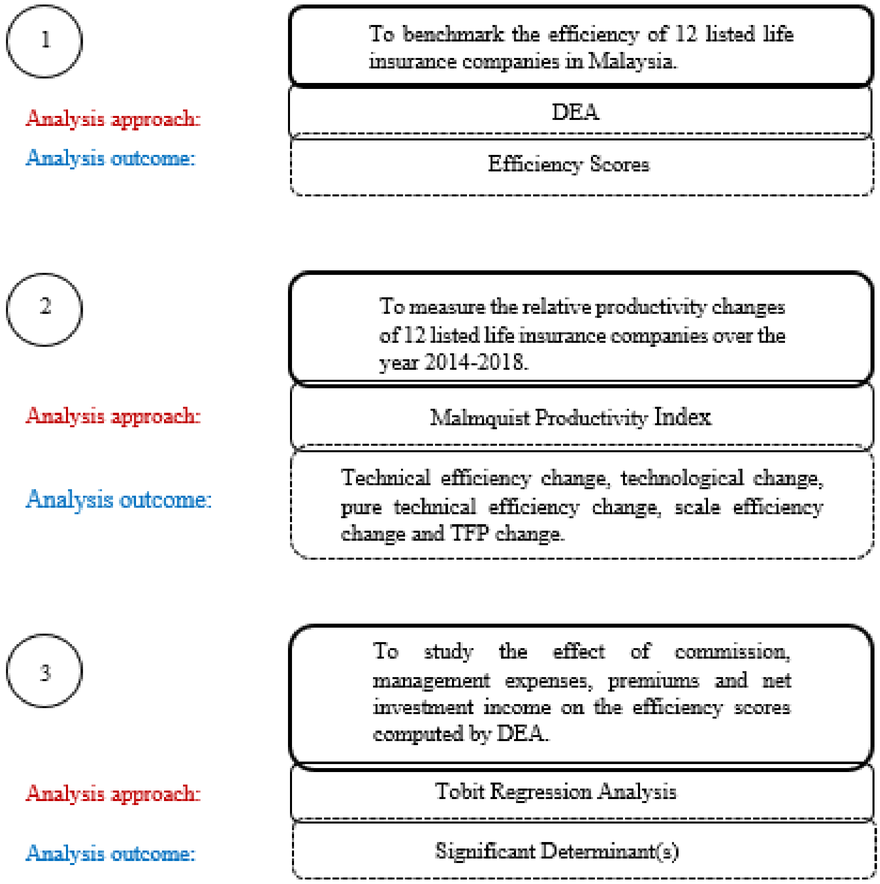
The overall design of the analysis procedure to be conducted in this study will be briefly explained. Figure 1 on the next page shows the procedure of different stages to find the determinants of efficiency. The efficiency scores for the 12 selected listed life insurance companies will be computed by using the DEA approach. The inputs are commission and management expenses, while the outputs selected are net investment income and premium. Then, by using the same data set, the relative productivity changes of the 12 listed life insurance companies over the years 2014 to 2018 will be evaluated by applying the Malmquist Productivity Index approach. Then, Tobit regression analysis will be used to examine the effect of commission, management expenses, net investment income, and premium on the efficiency scores that were computed by DEA earlier. In this step, the dependent variable is DEA efficiency scores while commission, management expenses, net investment income, and premium are the independent variables. This research framework which consists of three analysis steps will give a more detailed overview of the performance of the life insurance industry in Malaysia in terms of efficiency and productivity. The final step analyses the effect of the interest variables on efficiency and will show the audience how significantly the variables affect the life insurance companies' efficiency.

3.5 Data and Selection of Variables

The secondary data were extracted from the annual report of each life insurance company covering from 2014 to 2018. A balanced panel data was used in this study which were collected from 12 life insurance companies listed in Malaysia. Initially, all 16 members of the Life Insurance Association of Malaysia (LIAM) were considered, but four of them are not included in this study for some reasons. Two of them are life reinsurance companies which are different from the normal insurance companies and might not be relevant to this study. Another two of them have adjusted their business structure during this study period and hence do not have available data for analysis. As a result, this study only included 12 of them. Despite only 12 companies being evaluated, all the companies are listed in Malaysia which is a good representative of the life insurance industry in Malaysia.

Based on the review of the literature, there are various options for choosing inputs and outputs that are acceptable for assessing the life insurance companies' efficiency and productivity analysis. Due to the availability of data and based on the reviewed literature, commission and management expenses were selected as inputs; Premiums and net investment income were selected as outputs. Commission and management expenses were chosen as input because they are the resources utilized by the insurance companies to generate revenue. Premiums were selected as the output variable because they play the role of risk pooling and risk bearing of the insurance companies. Net investment income was also selected as the output variable as it contributes to a large portion of net profit. Hence, there were two inputs and two outputs selected for the DEA model. Table 1 shows the summary of past research that has used these input and output variables.

Figure 1: Procedure of different stages to find the determinants of efficiency



4.0 Results and Discussion

This section presents and discusses the evaluated relationships between variables, efficiency scores using DEA, Malmquist Total Factor Productivity (TFP) Index, and lastly, the Tobit regression analysis.

Table 2 shows the evaluated efficiency scores of 12 life insurance companies in Malaysia during the year 2014 through 2018 using the input-oriented constant return to scale (CRS)-DEA model. During these 5 years, 4 to 5 life insurance companies achieved an efficiency score of 1, which means that they have fully utilized their input to produce output. There are three life insurance companies that reveal the best efficiency, which is having a full DEA efficiency score throughout the entire study period. The companies positioned in the top rank are Great Eastern Life Assurance (Malaysia) Berhad (GELM), Hong Leong Assurance Berhad (HLA), and Manulife Insurance Berhad (Manulife). The outcomes indicate that these three companies are considered as the criterion for the other nine life insurance companies.

Input	Output
Commission: Bhishma Rao and Venkateswarlu (2015), Norma and Nur Edzalina (2011), Norma et al. (2006), Shazali and Alias (2000) and Masud et al. (2019)	Premiums: Norma et al. (2006), Bhishma Rao and Venkateswarlu (2015), Talat and Muhammad (2010), Gagandeep and Divya (2017), Zimková (2015), Grmanová and Strunz (2017), Norma and Nur Edzalina (2011), Baharin and Isa (2013), Masud et al. (2019) and Abidin and Cabanda (2011)
Management Expenses : Gagandeep and Divya (2017), Hsien-Da, Ya-Hui and Meng-Long (2010), Abidin and Cabanda (2011), Bhishma Rao and Venkateswarlu (2015), Norma and Nur Edzalina (2011), Norma et al. (2006), Shazali and Alias (2000), Ahmad, Nawi and Aleng (2013) and Masud et al. (2019)	Net Investment Income: Benyoussef and Hemrit (2019), Norma et al. (2006), Bhishma Rao and Venkateswarlu (2015), Talat and Muhammad (2010), Gagandeep and Divya (2017), Grmanová and Strunz (2017), Norma and Nur Edzalina (2011), Baharin and Isa (2013), Masud et al. (2019) and Abidin and Cabanda (2011)

Table 1 - Input and Output Variables for Life Insurance Efficiency Evaluation

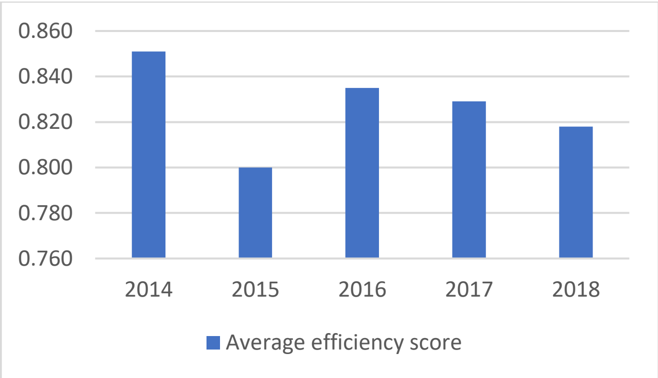
There are only three life insurance companies for the second rank of efficiency which is slightly better. AIA Berhad (AIA), AmMetLife Insurance Berhad (AmMetLife) and Gibraltar BSN Life Berhad (Gibraltar BSN) have an efficiency score of 1 in at least one of the five years of the entire study period. Unfortunately, there are six life insurance companies that are positioned at the third rank, which means they do not have good efficiency. The companies that never gained a full efficiency score of 1 during the five-year study period are AXA AFFIN Life Insurance Berhad (AXA Affin), Allianz Life Insurance Malaysia Berhad (ALIM), MCIS Insurance Berhad (MCIS), Prudential Assurance Malaysia Berhad (PAMB), Sun Life Malaysia Assurance Berhad (Sun Life) and Tokio Marine Life Insurance Malaysia Berhad (Tokio Marine Life). In average, ALIM is the least efficient among the 12 life insurance companies. The average efficiency score of ALIM is 0.380, indicating an inefficiency of 62 percent. ALIM would need to reduce its input or improve the output by 62 percent to become efficient.

Table 2 - Efficiency Scores of Input-Oriented CRS-DEA Model for 12 Life Insurance Companies (2014-2018)

Companies	2014	2015	2016	2017	2018	Average
Best efficiency						
GELM	1.000	1.000	1.000	1.000	1.000	1.000
HLA	1.000	1.000	1.000	1.000	1.000	1.000
Manulife	1.000	1.000	1.000	1.000	1.000	1.000
Moderate-better efficiency						
AIA	0.920	0.948	1.000	0.950	0.974	0.958
Gibraltar BSN	1.000	0.790	1.000	1.000	1.000	0.958
AmMetLife	0.874	1.000	0.901	0.812	0.818	0.881
Least efficiency						
Tokio Marine Life	0.943	0.847	0.952	0.992	0.844	0.916
MCIS	0.832	0.722	0.813	0.789	0.773	0.786
PAMB	0.745	0.725	0.734	0.716	0.711	0.726
Sun Life	0.935	0.644	0.619	0.637	0.618	0.691
AXA Affin	0.592	0.550	0.604	0.688	0.682	0.623
ALIM	0.374	0.378	0.391	0.359	0.400	0.380
Mean of efficiency score	0.851	0.800	0.835	0.829	0.818	0.827
Number of companies with best efficiency	4	4	5	4	4	

In general, there are only four efficient life insurance companies for the year 2014, 2015, 2017, and 2018, while at most five efficient life insurance companies in the year 2016. The lowest average efficiency score was 0.800 in 2015 and the highest average efficiency score was 0.851 in 2014. Generally, the graph in Figure 2 shows a decreasing trend in the average efficiency scores during the study period 2014-2018. However, the lowest average efficiency scores in 2015 are consistent with the decay in pure technical efficiency. For Sun Life and Tokio Marine Life, their regression is due to both decay in pure technical efficiency and scale efficiency. There are four companies, on the other hand, did not experience changes in technical efficiency.

Figure 2 - Average Efficiency Scores of 12 Life Insurance Companies (2014-2018)



4.1 Malmquist TFP Index

Table 3 presents the Malmquist index summary of the 12 life insurance companies. Based on the result, improvements have been observed in 25 percent of the companies in terms of their annual technical efficiency average value, about 42 percent regressed, and about 33 percent showing no changes. Among the companies that improved in technical efficiency, AXA AFFIN weak performance of the life insurance industry shown in the government economic report 2015. The life insurance sector has a net capital loss of RM2.6 billion as a result of equity mark-to-market valuation (Treasury, 2019). with a 3.6 percent has the greatest increment, followed by ALIM and AIA with an increase of 1.7 percent and 1.4 percent respectively. Among the companies that experienced a deterioration in technical efficiency, AmMetLife and MCIS regressed due to the decrement in scale efficiency. Besides, PAMB deteriorated due to the decay in pure technical efficiency. For Sun Life and Tokio Marine Life, their regression due to both decay in pure technical efficiency and scale efficiency. There are four companies, on the other hand, did not experienced changes in technical efficiency.

DMU	effch	techch	pech	sech	tfpch
AXA AFFIN	1.036	1.029	1.006	1.030	1.066
AIA	1.014	1.001	1.000	1.014	1.015
ALIM	1.017	0.997	1.013	1.004	1.015
AmMetLife	0.984	1.024	1.015	0.969	1.008
GELM	1.000	0.996	1.000	1.000	0.996
Gibraltar BSN	1.000	1.121	1.000	1.000	1.121
HLA	1.000	0.983	1.000	1.000	0.983
Manulife	1.000	1.043	1.000	1.000	1.043
MCIS	0.982	1.013	1.000	0.982	0.995
PAMB	0.988	0.991	0.986	1.003	0.980
Sun Life	0.902	1.074	0.959	0.940	0.969
Tokio Marine Life	0.973	1.028	0.973	0.999	1.000
MEAN	0.991	1.024	0.996	0.995	1.015
	effch<1 = 5	techch<1 = 4	pech<1 = 3	sech<1 = 4	tfpch<1 = 5
	effch=1 = 4	techch=1 = 0	pech=1 = 6	sech=1 = 4	tfpch=1 = 1
	effch>1 = 3	techch>1 = 8	pech>1 = 3	sech>1 = 4	tfpch>1 = 6

Notes: effch: Technical efficiency change, techch: Technological change, pech: Pure technical efficiency change, sech: Scale efficiency change, tfpch: TFP change

* Geometric means are used to calculate the Malmquist index averages

tfpch = effch × techch = pech × sech × techch

Table 3: Summary of Firm Means for Malmquist Index

The results also present that the annual means has a 2.4 percent increment in technology. An improvement was observed in about 67 percent of the companies, but about 33 percent of the companies declined technologically during the study period. Among the eight companies that show improvement, Gibraltar BSN has shown the greatest improvement of 12.1 percent. Conversely, among the four companies with technology decrement, HLA declined the most with a change of - 1.7 percent, whereas ALIM, GEMB and PAMB only slightly declined for 0.3 percent, 0.4 percent and 0.9 percent respectively. The annual average TFP for the study period has a positive change of 1.5 percent. 50 percent of the companies shows an improvement, about 42 percent shows deterioration, while about 8 percent shows no changes. Gibraltar BSN is observed to have the highest increase of 12.1 percent in TFP. Note that the factor productivity increase of Gibraltar BSN is solely due to the improvement in technology. AmMetLife and Manulife also have an increase in TFP solely driven by technological improvement, while ALIM’s TFP increment is solely driven by technical efficiency improvement. Both technical efficiency and technology progression of AXA AFFIN and AIA have contributed to TFP improvement. No changes are observed in Tokio Marine Life’s TFP due to the offset. On the other hand, PAMB declined the most with a change of -2 percent due to the regression in both technical efficiency and technology. GELM and HLA declined in TFP with a change of -0.4 percent and -1.7 percent respectively, which solely caused by the regression in technology. The decrement in technical efficiency of MCIS also contributes to TFP reduction. Table 4 reveals the Malmquist index summary of annual means for five years of study period from 2014 to 2018. It should be noted that the change in pure technical efficiency and/or scale efficiency can influence technical efficiency change. Also, change in technical efficiency and/or technology can affect TFP change. The outcomes in Table 4 exhibit that the annual technical efficiency of the companies has an index of 0.991 in average, which indicates that there is a deterioration of 0.9 percent throughout the study period. This decrement is contributed by the regression of both pure technical efficiency and scale efficiency. Pure technical efficiency has a change of -0.4 percent and scale efficiency has a change of -0.5 percent. However, TFP shows an improvement of 1.5 percent. The increment is mainly driven by the technological improvement with a change of 2.4 percent. In brief, it can be deduced that the productivity of life insurance industry in Malaysia throughout the five years study period from 2014 to 2018 increases, as a result of technological progression.

Year	effch	techch	pech	sech	tfpch
2014/2015	0.937	1.133	0.994	0.943	1.061
2015/2016	1.044	0.894	1.009	1.035	0.934
2016/2017	0.992	1.061	0.998	0.994	1.053
2017/2018	0.993	1.024	0.983	1.010	1.017
MEAN	0.991	1.024	0.996	0.995	1.015

Notes: * Geometric means are used to calculate the Malmquist index averages

Table 4 - Summary of Annual Means for Malmquist Index

4.2 Tobit Regression Analysis

Table 5 exhibits the outcomes of Tobit regression of life insurance companies’ efficiency score on commission, management expenses, premiums and investment income. Twenty-one of the sixty data points are found to have a full efficiency score of one.

Table 5 - Tobit Regression Analysis

ES, Ŷ	Coefficient	Std. Error	z-Statistic	Prob.	[95% Conf. Interval]	
COM, X_1	-5.19e-10	2.08e-10	-2.498391	0.0125	-9.36e-10	-1.03e-10
ME, X_2	-1.08e-09	2.31e-10	-4.696296	0.0000	-1.55e-09	-6.22e-10
PRE, X_3	1.50e-10	6.31e-11	2.376243	0.0175	2.34e-11	2.77e-10
INV, X_4	1.50e-10	1.48e-10	1.015013	0.3101	-1.46e-10	4.46e-10
_cons	0.915557	0.034760	26.339560	0.0000	0.845868	0.985246
Summary:			Right-censored data at ES ≥ 1: 21 Uncensored data: 39 Left-censored data: 0			

Notes: Efficiency score (ES)

(1) Estimated Tobit regression model:

$$\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \ldots + \hat{\beta}_n X_n$$

$$ES = 0.915557 - (5.19e^{-10})COM - (1.08e^{-09})ME + (1.50e^{-10})PRE + (1.50e^{-10})INV$$

"ES" represents the efficiency score
"COM" represents the commission
"ME" represents the management expenses
"PRE" represents the premiums
"INV" represents the net investment income

(2) Interpretation of coefficients:

$\hat{\beta}_1 = -5.19e^{-10}$

For every increase of 1 ringgit in commission, life insurance companies' efficiency score is expected to reduce by $\mathbf{5.19e^{-10}}$, provided that other variables are kept constant. Note that commission is an input. When the output volume is unable to increase by increasing the input volume, the efficiency will become lower. Thus, commission and efficiency score are expected to have a negative relationship.

$\hat{\beta}_2 = -1.08e^{-09}$

For every increase of 1 ringgit in management expenses, life insurance companies' efficiency score is expected to reduce by $\mathbf{1.08e^{-09}}$, provided that other variables are kept constant. Management expenses is considered as an input, like commission. Therefore, management expenses and efficiency score have an inverse relationship.

$\hat{\beta}_3 = 1.50e^{-10}$

For every increase of 1 ringgit of premiums, life insurance companies' efficiency score is expected to increase by $\mathbf{1.50e^{-10}}$, provided that other variables are kept constant. Premiums are an output. When the output volume is increased when keeping the input volume a constant, the efficiency will be improved. When the premiums increased, it implies that the company is efficiently using their resources to generate revenue. Hence, it can be deduced that premiums and efficiency score have a positive relationship.

$\hat{\beta}_4 = 1.50e^{-10}$

For every increase of 1 ringgit in net investment income, life insurance companies' efficiency score is expected to increase by $\mathbf{1.50e^{-10}}$, provided that other variables are kept constant. By applying again the output concept, the increasing of output volume would improve efficiency, and everything else should be kept constant. Therefore, net investment income and efficiency score are positively correlated.

(3) Significant of parameter coefficients:
H_0: $\beta_j = 0$ (X_j *is not significant*)
H_1: $\beta_j \neq 0$ (X_j *is significant*)
where $j = 1, 2, 3, 4$

Table 5 exhibits the P-value of each independent variables. The result indicates that commission, management expenses and premiums have significant effect on the life insurance companies' efficiency score. It is because their P-value is less than the significant level of 5% and hence reject null hypothesis. There is sufficient evidence to deduce that at significant level of 5%, both commission and management expenses have significant negative impact on the efficiency score, whereas premiums have significant positive impact on the efficiency score. Simultaneously, at significant level 5%, net investment income has a P-value of 0.3103, which is much greater than α value of 0.05. This indicates that net investment income is the only variable that has no significant impact on the efficiency score.\

5.0 Conclusion

The observed results of this study reveal the following. Firstly, the efficiency scores of life insurance companies in Malaysia evaluated using DEA show that Great Eastern Life Assurance (Malaysia) Berhad, Hong Leong Assurance Berhad, and Manulife Insurance Berhad are the companies with the best efficiency, while Allianz Life Insurance Malaysia Berhad is the least efficient insurance company among the 12 life insurance companies. Second, based on the result of Malmquist TFP Index, technical efficiency shows a 0.9 percent deterioration, technology has a progression of 2.4 percent, pure technical efficiency has a 0.4 percent regression, scale efficiency also regressed for 0.5 percent and a TFP has a 1.5 percent progression in the life insurance companies throughout the period of 2014 to 2018. Third, the Malmquist TFP approach shows that the positive change in TFP was contributed by the progression in technology. Fourth, the result of Tobit analysis indicates that both commission and management expenses have a significant negative impact on the efficiency score, while premiums have a significant positive impact on the efficiency score. Fifth, the only variable that has no significant impact on efficiency score is net investment income. In terms of research activities in the future, the methodology used in this research paper may apply to the non-life insurance industries as well. Moreover, future research might consider investigating the relationships between macroeconomic factors and efficiency. Besides that, network DEA which is one of the extensions of DEA be adopted in future research to account for the internal frameworks of a technology process and then the efficiency of each sub-process can be measured.

5.1 Limitation

Some potential limitation includes a small sample size as it did not consider all the life insurance companies in Malaysia. Besides that, it only uses a short study period of a few years.

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