Electronic Journal of Business and Management
ICDBSE Special Issue, 2024 pp. 106-121
e-ISSN:2550-1380-ISSN

A Comparative Analysis of Efficiency of General Insurance Companies in Malaysia And Singapore: Application of DEA and Tobit Analyses

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Abstract

This study aims to measure and compare the efficiency level of the general insurers in Malaysia and Singapore from the year 2017 to 2021, and to identify the key factors affecting the efficiency of the general insurers in the two neighbouring countries. To compute the efficiency scores of each selected general insurer, the Data Envelopment Analysis (DEA) linear programming approach is applied. Two selected input variables are management expenses and total assets, while the two output variables are net insurance premium and investment income. Tobit Regression Analysis is then used to test the significance of each variable used in the study. The DEA results show that the difference between the general efficiency level of the 15 general insurers in Malaysia and Singapore respectively, is not significant. There is only one general insurer in Malaysia which achieves full efficiency from 2017 to 2021, and there are two fully efficient general insurers in Singapore. Management expenses are the only variable that is tested to be statistically significant in all three Tobit models computed. This is backed up with evidence from other literature and professional opinions which imply that management expenses are the key thing to be controlled in terms of efficiency performance for general insurers.

Keywords: *Efficiency, General Insurer, Data Envelopment Analysis, Tobit Regression Analysis*

1.0 Introduction

The insurance industry in Malaysia is regulated by the Insurance Act (1996), and strictly governed by *Bank Negara Malaysia*, which is the Central Bank of Malaysia. Similarly, the insurance industry in Singapore is governed by the Monetary Authority of Singapore, under the Insurance Act (Cap. 142). According to *Persatuan Insurans Am Malaysia* (PIAM), which is the General Insurance Association of Malaysia, there are 21 direct general insurers registered and currently operating in Malaysia as of the end of 2021 (PIAM, 2021). On the other hand, the General Insurance Association of Singapore has reported 39 direct general insurers in the country (GIA, 2021).

The general insurance industry has been a concern over the last decade, and one of the main reasons is the issue of climate change. Changing climate conditions are impacting the non-life insurance industry due to the higher claims resulting from catastrophes happening around the world. Climate change is both a threat and an opportunity for the insurance industry. Increased claims are considered a threat for insurers, while it is also an opportunity for the insurers to work out innovative products, based on the current needs of the society, with a change of climate. To elaborate, climate change has resulted in more disasters such as flooding, prolonged droughts, earthquakes, and more. These unexpected events are estimated to have contributed up to 50% of the global insured claims and losses in 2019 (Rachlin, 2020).

Many literatures discussing the efficiency of insurers, focus more on countries with the oldest insurance markets, such as India, USA, and the UK, or the countries with higher populations such as China, Indonesia, and more. Therefore, another reason behind this study is due to the small number of studies available with a focus on the Association of Southeast Asian Nations (ASEAN) insurance markets, where Malaysia and Singapore are part of ASEAN countries. In addition, the majority of research and literature available for ASEAN insurance markets focuses on life insurers. In short, since the non-life insurance markets in both countries are evolving but have not been widely studied, this study aims to investigate whether Singapore, which has a smaller but more open market will have higher efficiency over Malaysia, which has a bigger but more regulated market, or vice versa. The efficiency levels of the insurers are determined by Data Envelopment Analysis (DEA) method. Moreover, this study could support the determinants behind the findings of the efficiency and of general insurers, which may be valuable for business development purposes in the general insurance markets. Justifications of determinants are carried out using Tobit Regression Analysis.

The significance of this study is to contribute to the literature on the general insurance sector, which is a key player among the financial sectors in the Association of Southeast Asian Nations (ASEAN) countries, including Malaysia and Singapore. This study is also useful for the general insurers and related stakeholders for example investors, insurance experts, academicians, etc. To examine the efficiency of general insurance companies in both Malaysia and Singapore, a sample of 15 general insurance companies has been taken from each country. To ensure the fairness of the study, 11 out of 15 companies are direct general insurers, and the remaining 4 are composite insurers, which offer both life and general insurance products but manage their life and non-life businesses separately. The data is collected from the companies' annual financial statements for the years 2017 to 2021, and for the composite insurance companies, only the data from the general business are accounted. The efficiency performance and analysis are firstly measured by the Data Envelopment Analysis (DEA) method and the determinants are justified using the Tobit Regression Analysis method.

2.0 Literature Review

Efficiency refers to how well the usage and resource allocation of an insurer are to produce their services and generate revenue. There are numerous studies discussing the performance of the insurance markets across the world. Compared to the studies on life insurance, general insurance has a smaller body of literature. A study uses a sample of 53 general insurers in Australia and has used the method of Data Envelopment Analysis (DEA) to measure technical, allocative, and cost efficiency indices. It has shown that the top 20 percent of the Australian general insurers in terms of the company's size have performed more efficiently compared to the other firms. Tobit Regression Model is one of the regression tests used for this study, and the regression test suggests that cost efficiency is significantly related to the proportion of non-

premium revenue generated and the size of the total assets of a general insurer (Worthington & Hurley, 2000).

Furthermore, a study written by Noreen (2020) has employed both DEA and Tobit regression models, to estimate the risk management efficiency and justify the determinants, for the non-life insurers in Pakistan, for the period ranging from 2009 to 2018. The DEA analysis shows that the overall average efficiency score has increased by 8% from 2009 to 2018, and Tobit estimates suggest that the insurers could improve their efficiency level by increasing their underwriting and investment activities. The linear programming method is a common approach under DEA. A paper studied by Choo (2012), applies the DEA linear programming approach to study the efficiency of the Japanese non-life insurance industry. The paper reveals that efficiency increases with the larger size of the company but decreases when it exceeds the minimum efficient scale.

India has one of the oldest insurance markets in the world, and hence an expanding body of literature has been studied over the years. A study that measures the efficiency of private general insurers, with the use of the DEA method, shows that private insurers in India have taken advantage of technological, efficiency, and scale efficiency change. It also concludes that the public general insurers in India should grow and expand their business activities, in order to survive in the competitive market (Kansra & Singh, 2021). Another study on non-life insurance industry in India shows that the market is moderately efficient in terms of technical, scale, cost as well as allocative efficiency, with a great space for improvement from 2005 to 2016. Under the use of DEA bootstrap model, it has been found that public insurers are better in terms of cost-efficiency measurement compared to private insurers. A positive age-efficiency relationship for the non-life insurers in India has also been observed in this past research (Iiyas & Rajasekaran, 2019).

A study on the investigation of the relative efficiency of general insurance in Malaysia from the year of 2007 to 2009, has been conducted with the use of Stochastic Frontier Analysis (SFA). This study shows that the relative efficiency has been increasing on a yearly basis within the selected period, and the Oriental Capital Assurance Berhad (OCA) is ranked first by having the highest efficiency score compared to other insurers (Nawi, Ahmad, & Aleng, 2012). The researcher has chosen DEA method over the SFA method as it allows a breakdown of technical and change efficiency and calculation of constant returns to scale economies for every sample involved in this study. Another study on the investigation of managerial and profitability efficiency of general insurance companies in Malaysia from the year of 2008 to 2011, has been conducted with the use of Data Envelopment Analysis (DEA) method. A sample of 20 general insurance companies has been selected, and this study shows that the efficiency performance has been decreasing. The study suggests that general insurers should implement strategies to improve their managerial efficiency, and good managerial strategies will lead to higher profitability efficiency (Kweh & Azizan, 2015).

A study based on Malaysian general insurance companies, utilizing the DEA method, has selected management expenses and commission fees as its input variables, and the chosen output variables are net premium and investment income (Mahyideen, Aziz, Yaakob, Rusli, & Mohamad, 2021). Commission fees are not chosen to be applied in this paper, as it was not categorised separately in the financial statements of Singaporean general insurers. A DEA-based paper that applies the linear programming method to study the efficiency of insurance companies in Ethiopia, has chosen total assets and total expenditures as its input variables (Sharew & Fentie, 2018). Total assets have also been selected as one of the input variables in a

paper studying the insurance industry in Kenya, with the use of both DEA and Tobit regression models (Ochola, 2017). Outputs selection of premiums and investment income are chosen by Diacon (2001) who has written a paper to examine the efficiency of 431 general insurers in the United Kingdom (UK).

DEA is chosen for this study as it allows the breakdown of technical and change efficiency and calculation of constant returns to scale economies for every sample involved in the study. The researcher has chosen Tobit Regression for this study over other methods as it addresses the significant censoring of variables used (Jaloudi, 2019). To sum up, this study aims to conduct a comparative efficiency analysis of the efficiency performance of general insurers in two neighbouring countries, Malaysia and Singapore from 2017 to 2021.

3.0 Methodology

The data applied in this study is obtained from the annual report and financial statements from the selected general insurance companies for the years 2017 to 2021. To be more specific, the data for the selected general insurance companies in Malaysia are obtained from the financial statements available from each of the company's official website. The data for general insurers in Singapore is obtained from the financial reports available via the Monetary Authority of Singapore. A sample of 15 general insurers would be taken from each country for this study. To ensure the relevancy of the study, 11 out of 15 samples are direct general insurers ("G"), and the remaining 4 are composite insurers ("C") operating in Malaysia (see Table 4) and Singapore (see Table 5).

Table 1: Input and Output Variables

Countries	Input Variables	Output Variables
Malaysia and Singapore	Management Expenses (ME) (Salleh, 2012) (Antonio, Ali, & Akbar, 2013)	Net Insurance Premium (IP) (Diacon, 2001) (Grmanová & Strunz, 2017)
	Total Assets (TA) (Ochola, 2017) (Sharew & Fentie, 2018)	Investment Income (II) (Diacon, 2001) (Grmanová & Strunz, 2017)

By considering the data availability in the context of general insurers in both Malaysia and Singapore, the selected input variables are management expenses and total assets, while the output variables are net insurance premium and investment income, as summarised in Table 1. The literature review in the previous section shows that they are also considered for a wide range of literature focusing on insurer's efficiency studies. Some variables used in other literature such as the number of total employees, total expenditures, and total equity are not applied in this study, due to the broadness of variables and limitations to obtain accurate information.

According to the *Perbadanan Insurans Deposit Malaysia* (PIDM), which is the Malaysia Deposit Insurance Corporation (MDIC), a government agency that monitors the Takaful and Insurance Benefits Protection, management expenses reported by an insurer refer to all expenses relating to its insurance business, other than claims and commissions. Based on Monetary Authority of Singapore's Notice 131 which was firstly established in 2013, management expenses in the financial statements of insurers carry the same definition as in Malaysia, hence it is suitable to be chosen for comparison. The second input is total assets,

which includes to both fixed assets and current assets of the selected insurers over the study period. The output variable of net insurance premium refers to the net sales received from customers' premiums, while the investment income refers to the revenue generated from the insurers' investments. These two outputs are selected because they are the first and second main source of an insurer (Jayasundara, 2017).

Figure 1: First Stage of Research Flow – Data Envelopment Analysis (DEA)

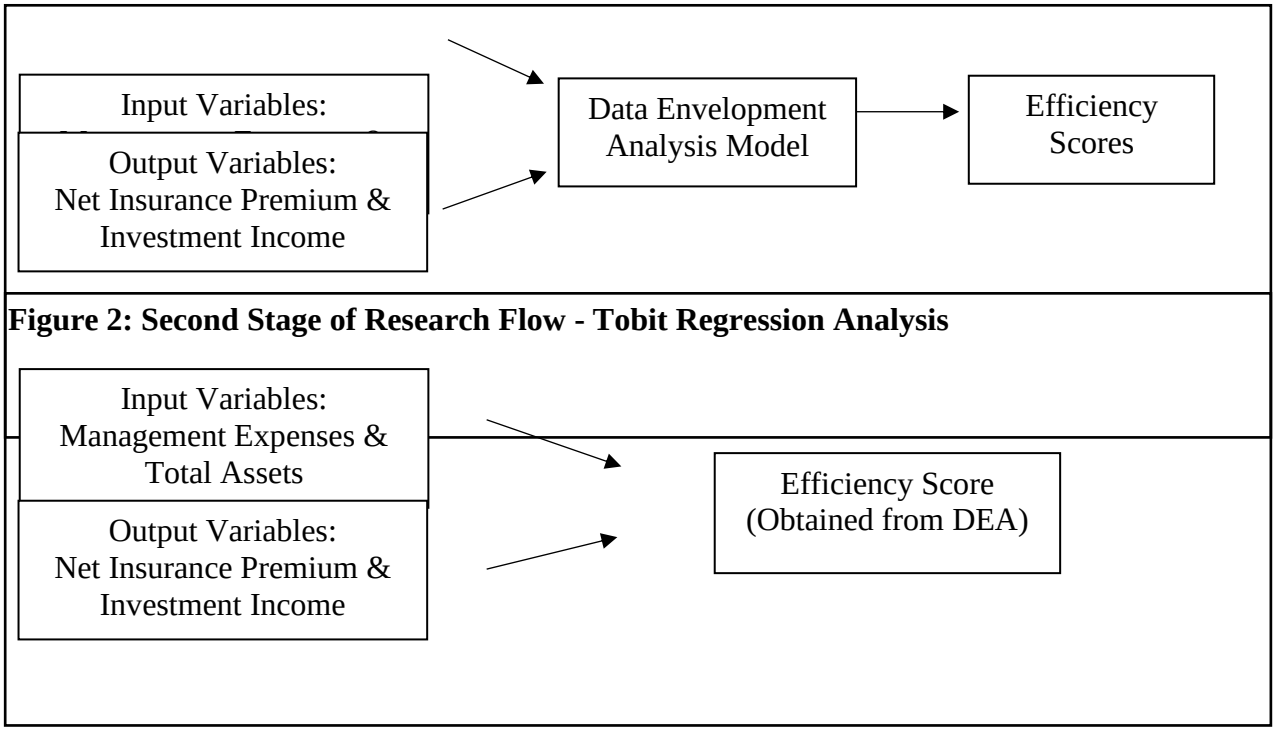

Figure 2: Second Stage of Research Flow - Tobit Regression Analysis

Figures 1 and 2 outline the research flow of the two different stages of the research procedure, which are conducted using Data Envelopment Analysis (DEA) and Tobit regression Analysis. In the first stage, selected data outlined in Table 1, including two inputs (MA and TA) and two outputs (IP and II) are utilized to compute efficiency scores for the 30 selected general insurers under the DEA method. At the end of the first stage, an efficiency score is computed for each selected general insurer, for each year from the year period of 2017 to 2021. This method of DEA allows benchmarking of the efficiency of each selected general insurer from the 30 samples.

The same dataset is then used for Tobit Regression Analysis in the second stage, to study the significance of the variables on the efficiency scores generated in the first stage. As illustrated in Figure 2, in order to conduct Tobit Regression Analysis, the inputs and outputs used in the first stage, including MA, IP, TA and II are considered independent variables, while the dependent variable is the efficiency scores obtained from DEA. The DEA stage provides a clear overview of the efficiency of the selected general insurers in Malaysia and Singapore from 2017 to 2021, for comparison. The Tobit Regression Analysis justifies how significantly the selected variables affect the efficiency of the general insurers.

3.1 Data Envelopment Analysis (DEA)

In this study, Data Envelopment Analysis (DEA) approach is used to assess the production efficiency of a decision-making unit (DMU). The relative efficiency score for each DMU is

generated by DEA, and the results are analysed based on a comparison of DMU across each sample. DEA is a non-parametric linear programming approach to transform several inputs into several outputs (Iiyas & Rajasekaran, 2019). Introduced by Charnes (1978), DEA is a common mathematical programming approach that implements linear programming to develop production frontiers and efficiency measurements. The DEA-based linear programming approach is applied in this study, to measure the efficiency level of every selected general insurance company. In general, the efficiency score computed by DEA ranges from 0 to 1 (or 100%). The efficiency level of 100% indicates that resources are fully utilized and transformed into outputs, and DMU is considered to be efficient and is positioned on the frontier. On the other hand, an efficiency score of less than 1 shows that DMUs are inefficient, as part of the inputs are possibly being wasted or the outputs are not being maximised given the amount of input variables. In simpler words, the lower the efficiency score, the less efficient the company (Charnes, 1978).

The overall technical efficiency refers to the number of inputs that can be reduced or minimized, given that there is no impact on the output levels of a DMU, which is each general insurer in this study. It is measured by the Charnes, Cooper, and Rhode (CCR) model which assumes constant returns to scale (CRS), and CRS is only applicable when DMU operates on an optimal scale.

The CCR model is outlined as follows: $Max\ TE_m = \sum_{j=1}^{J} U_{jm}\, Y_{jm}$

Subject to $\sum_{j=1}^{J} U_{jm}\, Y_{jm} - \sum_{j=1}^{J} V_{im}\, X_{im} \leq 0, for\ all\ i$

and $\sum_{j=1}^{I} V_{im}\, X_{im} = 1$

Where the representations of indexes are as follow:

TE_m: the technical efficiency of the mth DMU

U_{jm}: the weight of the jth output for the mth DMU

Y_{jm}: the value of the jth output for the mth DMU

V_{im}: the weight of the ith input for the mth DMU

X_{im}: the value of the ith input for the mth DMU

$U_{jm}, V_{im} \geq 0\ ; i = 1,2, \dots I\ ; j = 1,2, \dots, J$

3.2 Tobit Regression Analysis

Tobit Regression Analysis is selected to be used to determine the factors affecting the efficiency scores of the selected general insurance companies in Malaysia and Singapore from 2017 to 2021. Tobit regression, proposed by Tobin (1958), can also be known as the censored regression analysis. It is a method based on the principle of maximum likelihood estimation, widely used to obtain parameter estimation with high accuracy and consistency, to examine the types of external or operational factors which may cause an impact on the efficiency scores. Tobit

Regression Analysis (TRA) is chosen instead of other methods as it allows significant censoring of variables applied in the study.

To perform this analysis, explanatory variables such as management expenses, total assets, net insurance premium, and investment income are considered independent variables, while the efficiency score computed using DEA is the dependent variable. Generally, under the Tobit regression model, either left-censoring or right-censoring can account for the dependent variable. Since the efficiency score applied in this study could not exceed 1, the right-censored Tobit regression model is utilized for analysis purposes, where in other words, any values (efficiency scores) that go beyond 1 are censored. In short, as the input-oriented DEA models compute technical efficiency scores that fall between the range of 0 to 1, the Tobit Regression Analysis can be used to determine the relationship between the score and the selected input and output variables (factors).

The general Tobit regression model is outlined as: $Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon_i$

And the representations of indexes are as follows:

Y_i : the dependent variable

$X_1, X_2, \ldots, X_n$: the independent variable(s)

β_0: the constant

$\beta_1, \beta_2, \ldots, \beta_n$: the regression coefficient(s)

$\varepsilon_i \sim N(0, \sigma^2)$: the error term (assumed to be normally distributed)

4.0 Results and Discussion

During the period of study from 2017 to 2021, Allianz General Insurance Company (Malaysia) Berhad reported the highest amount of all input and output variables, while Progressive Insurance Berhad had the lowest amount of all inputs and outputs, among the 15 general insurers. While in Singapore, AIG Asia Pacific Insurance Pte. Ltd reports the highest management expenses, while NTUC Income Insurance Co-operative Limited had the highest record of net insurance premiums and investment income. Table 3 also shows that the lowest investment income reported over 2017 to 2021, is by the United Overseas Insurance Ltd, with an investment loss of $5,659,818. The standard deviations of all variables across both countries, are close to the means reported, implying that the structure of the selected general insurers are close to one another in the scale of operations.

Table 2: Descriptive Statistics of General Insurers in Malaysia (2017 to 2021)

Descriptive Statistics (RM)	Management Expenses	Total Assets	(Net) Insurance Premiums	Investment Income
Max	399,347,000	7,366,536,000	2,124,142,000	189,684,000
Min	29,464,845	503,101,681	51,084,542	10,070,705
Mean	159,075,709	2,406,751,072	661,966,484	58,840,502
Std. Dev	89,506,333	1,660,727,144	484,263,271	43,233,832

Table 3: **Descriptive Statistics of General Insurers in Singapore (2017 to 2021)**

Descriptive Statistics (SGD)	Management Expenses	Total Assets	(Net) Insurance Premiums	Investment Income
Max	114,364,038	3,065,446,834	356,957,259	89,848,440
Min	6,690,599	78,814,628	2,323,260	-5,659,818
Mean	34,133,703	662,076,858	113,354,977	12,387,705
Std. Dev	27,935,611	594,790,480	88,492,086	17,035,058

4.1 Data Envelopment Analysis

Referring to Table 4, Allianz General Insurance Company (Malaysia) Berhad is the only general insurer with a full efficiency score from 2017 to 2021. From Table 5, two general insurers achieved consistent efficiency scores of 1, including Liberty Insurance Pte Ltd and MS First Capital Insurance Limited. The results show that Allianz General Insurance Company (Malaysia) Berhad is considered the benchmark company to the other selected samples in Malaysia, while Liberty Insurance Pte Ltd and MS First Capital Insurance Limited acted as the benchmarks for Singaporean general insurers.

Table 4: Efficiency Scores of DEA Model for General Insurers in Malaysia (2017 – 2021)

No	Company Name & Business[1]		2017	2018	2019	2020	2021	Average
1	AIG Malaysia Insurance Berhad	G	0.8837	1.0000	1.0000	0.9702	0.9250	0.9558
2	Allianz General Insurance Company (Malaysia) Berhad	C	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	AXA Affin General Insurance Berhad	C	0.9811	0.9687	1.0000	0.9928	0.9314	0.9748
4	Berjaya Sompo Insurance Berhad	G	0.9304	0.9005	0.9303	0.9161	0.7575	0.8870
5	Chubb Insurance Malaysia Berhad	G	1.0000	0.9509	0.9727	1.0000	1.0000	0.9847
6	Great Eastern General Insurance (Malaysia) Berhad	C	0.8690	0.9025	0.9400	1.0000	0.7261	0.8875
7	Liberty Insurance Berhad	G	0.9411	1.0000	0.9899	1.0000	0.8816	0.9625
8	Lonpac Insurance Berhad	G	0.9771	0.9344	1.0000	1.0000	0.9501	0.9723
9	MSIG Insurance (Malaysia) Berhad	G	1.0000	0.9761	1.0000	0.8921	0.8760	0.9489
10	Pacific & Orient Insurance Co. Bhd	G	1.0000	0.9911	1.0000	1.0000	0.6503	0.9283
11	Progressive Insurance Berhad	G	0.8124	0.8316	0.7617	0.7919	0.7703	0.7936

12	QBE Insurance (Malaysia) Berhad	G	1.0000	0.8534	0.9623	0.9608	0.8370	0.9227
13	RHB Insurance Berhad	G	0.8236	0.8559	0.9016	1.0000	0.9707	0.9104
14	The Pacific Insurance Berhad	G	0.5377	0.5442	0.6880	0.7725	0.6531	0.6391
15	Tokio Marine Insurans (Malaysia) Berhad	C	1.0000	0.9292	0.9318	1.0000	0.8966	0.9515
Number of Companies with Best Efficiency			6	3	6	8	2	-
Average Efficiency			0.9171	0.9092	0.9386	0.9531	0.8551	0.9146*

Notes:

1. Business: G refers to General Insurer, C refers to Composite Insurer
2. *Refers to the average of the 15 general insurers in Malaysia from 2017 to 2021

Table 5: Efficiency Scores of DEA Model for General Insurers in Singapore (2017 – 2021)

No	Company Name & Business[1]		2017	2018	2019	2020	2021	Average
1	AIG Asia Pacific Insurance Pte. Ltd.	G	0.4447	0.5383	0.3878	0.3704	0.3987	0.4280
2	Chubb Insurance Singapore Limited	G	0.5557	0.6208	0.4613	0.4483	0.4399	0.5052
3	EQ Insurance Company Ltd	G	0.9311	1.0000	1.0000	0.9745	1.0000	0.9811
4	Etiqa Insurance Pte. Ltd.	C	0.8149	0.6463	0.8892	0.6764	0.7726	0.7599
5	Great Eastern General Insurance Limited	C	0.9129	0.8942	0.5920	0.5239	0.5116	0.6869
6	Liberty Insurance Pte Ltd	G	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	Lonpac Insurance Bhd	G	0.4508	0.7582	0.5242	0.5910	0.6141	0.5876
8	MS First Capital Insurance Limited	G	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	MSIG Insurance (Singapore) Pte. Ltd.	G	1.0000	0.9318	1.0000	0.7814	0.6953	0.8817
10	NTUC Income Insurance Co-operative Limited	C	1.0000	0.7942	1.0000	1.0000	1.0000	0.9588
11	QBE Insurance (Singapore) Pte Ltd	G	0.3256	0.6271	0.4457	0.7362	0.4600	0.5189
12	Sompo Insurance Singapore Pte. Ltd.	G	0.6034	0.6714	0.6957	0.6247	0.5181	0.6227
13	Starr International Insurance (Singapore) Pte. Ltd.	G	0.2735	0.0404	1.0000	1.0000	0.1988	0.5025

14	Tokio Marine Insurance Singapore Ltd	C	0.8151	1.0000	0.8049	1.0000	0.7763	0.8793
15	United Overseas Insurance Ltd	G	1.0000	0.4379	1.0000	0.6275	1.0000	0.8131
Number of Companies with Best Efficiency			5	4	7	5	5	-
Average Efficiency			0.7418	0.7307	0.7867	0.7569	0.6924	0.7417*

Notes:

1. Business: G refers to General Insurer, C refers to Composite Insurer
2. *Refers to the average of the 15 general insurers in Singapore from 2017 to 2021

Referring to Table 4, Pacific Insurance Berhad has the lowest average efficiency score of 0.6391, implying a mean of 36.09 percent of inefficiency, compared to insurers with a maximum efficiency score of 1. In other words, The Pacific Insurance Berhad may need to reduce its inputs by around 36.09 percent to become efficient. Apart from Allianz General Insurance Company (Malaysia) Berhad which achieves full efficiency, the majority of other general insurers fall within the range of the second rank of efficiency, with an average efficiency score ranging from 0.7936 to 0.9847. These selected insurers are performing at a moderate-better efficiency level, and there are two of the insurers, Chubb Insurance Malaysia Berhad and Pacific & Orient Insurance Co. Bhd have achieved full efficiency score of 1, in 3 out of the 5 years of the study period.

For general insurers in Singapore as summarised in Table 5, AIG Asia Pacific Insurance Pte. Ltd. reports the lowest mean efficiency score of 0.4280, among all 15 samples. It suggests that on average, AIG Asia Pacific Insurance Pte. Ltd. is required to reduce over half of its inputs to achieve efficiency. Among the insurers that fall within the second rank of efficiency, with an average efficiency score ranging from 0.7599 to 0.9811, NTUC Income Insurance Co-operative Limited achieved an efficiency score of 1, in 4 out of the 5 years of the investigation period. From 2017 to 2021, around 2 to 8 general insurers in Malaysia achieved an efficiency score of 1, while around 4 to 7 general insurers in Singapore achieved an efficiency score of 1. By solely looking at the results, it is noticed that the general insurers in Singapore have a relatively stable efficiency level compared to Malaysia since the range of the total number of efficient insurers is smaller than in Malaysia. For example, the general insurers in Malaysia with a full efficiency score of 1 have dropped from 8 to 2 from 2020 to 2021, while Singapore maintains at 5 general insurers.

Among the 15 general insurers in Malaysia chosen for this study, the average efficiency score from 2017 to 2021 is 0.9146, computed with the use of DEA linear programming approach. This result is aligned with a similar DEA-based paper studied by Kweh and Azizan (2015), reveals that the overall efficiency of 16 general insurers in Malaysia is 0.8900 on average from 2008 to 2011, which may imply that the efficiency score is considered stable over the last decade. However, it can also be argued that there is a 6-year gap between 2011 and 2017, which may have some unstable efficiency levels or uncertainties during the years not accounted for in the study.

Another DEA-based paper which examines the efficiency of general insurers in Malaysia shows that Liberty Insurance Berhad and MSIG Insurance (Malaysia) Berhad are efficient for the year 2018 (Mahyideen, Aziz, Yaakob, Rusli, & Mohamad, 2021). This aligns with the results of this study, by referring to Table 4, Liberty Insurance Berhad is considered as efficient as it has an

efficiency score of 1 as of 2018, while MSIG Insurance (Malaysia) Berhad has a score of 0.9761, close to 1.

4.2 Tobit Regression Analysis

The estimated Tobit regression model is outlined as below

$$ES = \hat{\beta}_0 + \hat{\beta}_1 ME + \hat{\beta}_2 TA + \hat{\beta}_3 IP + \hat{\beta}_4 II$$

Based on Table 6 to 8, the Tobit regression models for Model 1 to Model 3 are:

Model 1: $ES = 0.8265 - (1.89\text{e}^{-09})ME - (1.17\text{e}^{-10})TA + (9.80\text{e}^{-10})IP + (8.18\text{e}^{-10})II$

Model 2: $ES = 0.6740 - (8.14\text{e}^{-09})ME - (1.07\text{e}^{-10})TA + (3.18\text{e}^{-09})IP + (1.41\text{e}^{-08})II$

Model 3: $ES = 0.8197 - (3.47\text{e}^{-09})ME - (1.36\text{e}^{-10})TA + (5.49\text{e}^{-10})IP + (1.19\text{e}^{-08})II$

Table 6: Tobit Regression Results for General Insurers in Malaysia (Model 1)

ES	Coefficient	Standard Error	P-Value	95% Confidence Interval	
ME	$-1.89e^{-09}$	$5.10e^{-10}$	0.000205	$-2.89e^{-09}$	$-8.94e^{-10}$
TA	$-1.17e^{-10}$	$2.56e^{-11}$	$4.43e^{-06}$	$-1.68e^{-10}$	$-6.73e^{-11}$
IP	$9.80e^{-10}$	$1.59e^{-10}$	$7.57e^{-10}$	$6.68e^{-10}$	$1.29e^{-09}$
II	$8.18e^{-10}$	$1.22e^{-09}$	0.502207	$-1.57e^{-09}$	$3.21e^{-09}$
Constant	0.826500	0.026330	$< 2e^{-16}$	0.774913	0.878113

Table 7: Tobit Regression Results for General Insurers in Singapore (Model 2)

ES	Coefficient	Standard Error	P-Value	95% Confidence Interval	
ME	$-8.14e^{-09}$	$1.46e^{-09}$	$2.65e^{-08}$	$-1.10e^{-08}$	$-5.27e^{-09}$
TA	$-1.07e^{-10}$	$7.36Ee^{-11}$	0.147754	$-2.51e^{-10}$	$3.77e^{-11}$
IP	$3.18e^{-09}$	$8.20e^{-10}$	$1.08e^{-04}$	$1.57e^{-09}$	$4.78e^{-09}$
II	$1.41e^{-08}$	$3.80e^{-09}$	0.000108	$6.64e^{-09}$	$2.15e^{-08}$
Constant	0.674000	0.052890	$< 2e^{-16}$	0.570362	0.777702

Table 8: Tobit Regression Results for General Insurers in Malaysia and Singapore (Model 3)

ES	Coefficient	Standard Error	P-Value	95% Confidence Interval	
ME	$-3.47e^{-09}$	$8.00e^{-10}$	$1.44e^{-05}$	$-5.04e^{-09}$	$-1.90e^{-09}$
TA	$-1.36e^{-10}$	$4.41e^{-11}$	$2.07e^{-03}$	$-2.22e^{-10}$	$-4.94e^{-11}$
IP	$5.49e^{-10}$	$2.88e^{-10}$	0.056670	$-1.56e^{-11}$	$1.11e^{-09}$
II	$1.19e^{-08}$	$2.39e^{-09}$	$6.34e^{-07}$	$7.23e^{-09}$	$1.66e^{-08}$
Constant	0.819700	0.032190	$< 2e^{-16}$	0.756582	0.882749

4.3 Interpretation of Coefficients

Model 1: $\hat{\beta}_0 = 0.8265$ Model 2: $\hat{\beta}_0 = 0.6740$ Model 3: $\hat{\beta}_0 = 0.8197$

Among all 30 samples, the overall estimated efficiency score of a general insurer is 0.8197, given ME, TA, IP, and II are kept at zero. In other words, all selected general insurers achieved an efficiency score of around 0.8, having 20% of inefficiency, when all other variables are not accounted. $\hat{\beta}_0$ represents the constant of the model, and the constant of general insurers in Singapore of 0.6740 is relatively lower compared to Malaysia of 0.8265.

Model 1: $\hat{\beta}_1 = -(1.89\text{e}^{-09})$ Model 2: $\hat{\beta}_1 = -(8.14\text{e}^{-09})$ Model 3: $\hat{\beta}_1 = -(3.47\text{e}^{-09})$

The $\hat{\beta}_1$ represents the coefficient of ME (input). Keeping other factors constant, when an increase in input is unable to produce more output, it results in a lower efficiency level, therefore $\hat{\beta}_1$ has a negative relationship with efficiency score. The results of Model 2 show that, for every increase of $1 spent on ME, the efficiency score of Singaporean insurers is expected to decrease by 8.14e^{-09} on average, ceteris paribus.

Model 1: $\hat{\beta}_2 = -(1.17\text{e}^{-10})$ Model 2: $\hat{\beta}_2 = -(1.07\text{e}^{-10})$ Model 3: $\hat{\beta}_2 = -(1.36\text{e}^{-10})$

The $\hat{\beta}_2$ represents the coefficient of TA (input). Similar to $\hat{\beta}_1$, $\hat{\beta}_2$ has a negative relationship with efficiency score. The results of Model 3 show, for every increase of one unit spent on TA, the efficiency score of the insurer is expected to decrease by 1.36e^{-10} on average, ceteris paribus.

Model 1: $\hat{\beta}_3 = 9.80\text{e}^{-10}$ Model 2: $\hat{\beta}_3 = 3.18\text{e}^{-09}$ Model 3: $\hat{\beta}_3 = 5.49\text{e}^{-10}$

The $\hat{\beta}_3$ represents the coefficient of IP, which is an output. The results of Model 1 show that, for every increase of RM1 gained on IP, the efficiency score of general insurers in Malaysia is expected to increase by 9.80e^{-10} on average, ceteris paribus. Unlike input, output has a positive relationship with efficiency score, as when there is an increase in output produced by a constant level of inputs, the efficiency level will increase.

Model 1: $\hat{\beta}_4 = 8.18\text{e}^{-10}$ Model 2: $\hat{\beta}_4 = 1.41\text{e}^{-08}$ Model 3: $\hat{\beta}_4 = 1.19\text{e}^{-08}$

The $\hat{\beta}_4$ represents the coefficient of II (output). The results of Model 3 imply for every increase of one unit gained on II, the efficiency score of the selected insurer in Malaysia/Singapore is expected to increase by 1.19e^{-08} on average, ceteris paribus. Therefore, II has a positive relationship with efficiency score.

4.4 Significance of Variables

Model 1: The p-value of each independent variable in Table 6 shows that ME, TA, IP are significant, as their computed p-value is less than $\alpha = 0.05$, and hence H_0 is rejected. However, II has a p-value of 0.502207, hence it is failed to reject H_0. Its confidence interval between $-1.57e^{-09}$ and $3.21e^{-09}$, contains zero hence it also proves that this output variable is insignificant for the Tobit regression model for the 15 general insurers in Malaysia.

Model 2: The p-value of each independent variable in Table 7 shows that ME, IP, II are significant, as their computed p-value is less than $\alpha = 0.05$, and hence H_0 is rejected.

However, the variable of TA reports a p-value of 0.147754, hence it is failed to reject H_0. Its confidence interval of between $-2.51e^{-10}$ and $3.77e^{-11}$, contains zero hence it also proves that this input variable is insignificant under this Tobit regression model for the 15 Singaporean general insurers.

Model 3: The p-value of each independent variable in Table 8 shows that ME, TA, II are significant, as their computed p-value is less than $\alpha = 0.05$, and hence H_0 is rejected. However, the variable of IP has a p-value of 0.056670, which is slightly higher than $\alpha = 0.05$, hence it has failed to reject H_0. Its confidence interval between $-1.56e^{-11}$ and $1.11e^{-09}$, contains zero hence it proves that this input variable is insignificant under this model for the 30 general insurers.

To sum up, it is noticed that management expenses are tested to be statistically significant across all 3 Tobit regression models, while the other variables are tested statistically insignificant in 1 out of 3 Tobit regression models. This aligns with the results of a paper that concludes that the expense ratio (management expenses as a percentage of premium) has significantly influenced the efficiency level of the general insurers in Indonesia (Abdina, Prabantariksob, Fahmy, & Farhan, 2022). Total Assets are found to have a negative relationship with efficiency score. It is tested to be significant in Models 1 and 3, and insignificant in Model 2. Based on the other literature, the results of the significance of total assets are also not consistent. A paper studying the determinants of efficiency performance in general insurers in Kenya shows that total assets have a significant effect on the results (Murigu, 2014). However, another paper concludes that total assets are not found to be significant towards the efficiency performance of general insurers in Kenya (Ochola, 2017).

Referring to Tables 6 to 8, the two output variables, net insurance premium, and investment income are found to have a positive relationship with the efficiency level of general insurers. Both variables are tested to be significant in only two out of the three Tobit models. In the study done by Ochola (2017), it is also found that net insurance premiums and investment income are not statistically significant towards the efficiency of general insurers.

In a private interview with an experienced general insurance actuary, the professional expresses that among the 4 selected variables used in this study, management expenses are the key to efficiency as it is a huge financial component of general insurers. Management expenses include both variables and fixed expenses, and in general, the biggest component is salaries, followed by IT costs, bank charges, and more. According to the actuary, total assets are not considered as a significant variable towards efficiency as not all assets are utilized fully to support business operations, hence they are not directly related to the outputs produced. While for net insurance premiums and investment income, each general insurer seeks out a different portion of premiums towards reinsurers and implements different strategies in terms of investment, hence they may not be the main factors towards efficiency. In short, the results of this study align with the professional opinions shared by the general insurance actuary.

5.0 Conclusion

Referring to Table 4 and Table 5, the average level of efficiency of general insurers in Malaysia over the 5 years is 0.9146, and it is 0.7417 for Singapore. Among the 15 general insurers in Malaysia, the highest average efficiency score was reported in 2020, with a score of 0.9531, while it reported the lowest average efficiency score of 0.8552 in 2021. For the 15 general insurers in Singapore, the highest mean efficiency score is 0.7864 as of 2019, while its lowest

record also happened in 2021, with a score of 0.6924. It is noticed that over the 5-year period, the lowest efficiency level reported in both countries is in 2021. This may be due to the implementation of the new financial accounting standard, named International Financial Reporting Standard (IFRS) 17, which requires all general insurers globally to follow a standardized way to report their accounts. This standard is effective as of 1st January 2023, and parallel runs and practices are required to be performed a few years before the effective year (Owais & Dahiyat, 2021). This change involves higher costs, which implies higher management expenses are needed to cope with this new implementation, hence higher inputs may cause a negative impact on efficiency level, given the same output.

Despite Singapore has lower mean efficiency score compared to Malaysia, there are 2 general insurers in Singapore which are fully efficient throughout the study period (Liberty Insurance Pte Ltd and MS First Capital Insurance Limited), while there is only one insurer, named Allianz General Insurance Company (Malaysia) Berhad, considered as fully efficient in Malaysia. In terms of the comparison of the total number of (full) efficient general insurers, the results of 25 and 26 in Malaysia and Singapore respectively, imply that the general level of efficiency in both countries is approximately the same. Furthermore, this study shows that management expenses are consistently proven to be significant in all three Tobit models for each group of data. The other variables, including total assets, net insurance premium, and investment income are tested to be insignificant in one out of the three Tobit models, respectively. Therefore, this study is unable to conclude that these three variables are completely significant towards the efficiency performance.

6.0 References

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