

Efficiency Analysis of Life Insurance Companies in Ghana

Gregory Abe-I-Kpeng^{1*}, Elvis Adam Alhassan², Christian John Etwire²

¹Department of Industrial Mathematics, C. K. Tedam University of Technology and Applied Sciences, Navrongo, Ghana

²Department of Mathematics, C. K. Tedam University of Technology and Applied Sciences, Navrongo, Ghana

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Abstract Insurance can be seen to be a mechanism of risk transfer as well as a platform for investment to conserve against losses, providing a peaceful mind. In the insurance market, we have non-life and life insurance firms usually referred to as insurers and the individuals who own the insurance policy are called policy holders. Data Envelopment Analysis was used to assess the technical, scale and overall efficiencies of some life insurance firms in Ghana from 2010 to 2013. Commission, management expenses and capital were taken as inputs by insurance firms to yield claims, investment income and net premiums as outputs. This study showed that life insurance firms in Ghana functioned averagely at a technical efficiency of 88%, an average scale efficiency of 93% and an average overall efficiency of 82%. This clearly revealed that scale efficiency was largely responsible for the efficiency of life insurers instead of technical efficiency (managerial skills). The effects of dimension and market share on life insurer efficiency were established using the Mann Whitney U test. The study showed that market share significantly results in high life insurer efficiency, which agrees with previous studies in the insurance industry [1, 2]. Large insurers did not automatically lead to greater efficiency than small insurers in terms of capital-this result differs from that of [2] where general insurance firms in Ghana that have larger dimension led to higher efficiencies.

Keywords Insurance, Data Envelopment Analysis, Life Insurers, Relative Efficiencies, Insurance Companies

1. Introduction

Nowadays, no insurance company will like to be classified as averagely performing in a highly competitive insurance market. Identifying a maximal performance path will lead to benchmarking. Using Data Envelopment Analysis (DEA), not only can we identify top performers in an industry such as insurance, but also identify the alternative means to enable under-performing companies to become top performers. The purpose of the measurement of efficiency is to examine the performance of a firm in relation to the "best practice" frontiers, which are firms of highest efficiencies in the industry. [3] developed the theory on the measurement of firms' productive efficiency. Contemporary frontier efficiency techniques focus measuring firms in an industry against each other which is related to the traditional methods such as ratio analysis.

However, these techniques are regarded superior to other methods because they put together distinct measures of an organization productivity into one easily measurable statistic that distinguishes between organizations based on an advanced multifaceted framework [4]. In most cases, this statistic is normalized in the range of 0 and 1, with the least (most) efficient organization receiving the value of 0 (1). The firm's improvement potential in terms of efficiency is determined by the variance between a firm's assigned value and the value of 1 [5].

Since the introduction of Data Envelopment Analysis (DEA) by [6], many efficiency and productivity studies have been carried out by researchers in various fields

using different DEA models. DEA has been employed to estimate the performance of many organizations in recent times. Areas that have received a great deal of attention by researchers are manufacturing, governmental organizations and financial sectors with most studies involving the banking industry. The insurance industry has also gained increased attention. Most of the efficiency studies that we found in the literature concerning the insurance industry were done in developed countries [7]. We found only four efficiency studies, using DEA undertaken in only two West African countries – Nigeria and Ghana. Even though the insurance industry in Ghana dates back to the colonial period and is gaining public attention in recent years, we could find two performance studies of the Ghanaian general insurance using DEA but no performance studies of the Ghanaian life insurance industry specifically that uses this well established and elegant performance measurement tool (DEA).

Performance assessment in the private sector is typically based on ratios. The best-known ones are financial ratios. The popularity of these ratios is mainly due to their simplicity and ease of calculation, however, each ratio gives only a partial picture of a company's performance outlook. We note however, that the National Insurance Commission always present in its annual financial reports some performance measures using ratio analysis such as claims ratio, expense ratio, return on equity ratio, combined ratio, retention ratio, gross premium to equity ratio, investment to total assets ratio, return on assets ratio, among others, but these measurements may not allow for proper ranking of the life insurance companies in the country since they give different impressions about the companies. Using the state-of-arts techniques to study the efficiency of Ghanaian life insurance firms is therefore essential. The need for life insurance companies to operate economically and efficiently in order to deal with competition and exploit opportunities to grow cannot be over emphasized. Firms that are able to successfully deal with these issues will have a competitive advantage over their peers; others that are unable to effectively address these issues are likely to struggle and fizzle out. Methods of efficiency measurement can be classified into three main categories: parametric, non-parametric and ratio indicators. Ratios are among the easiest methods, but their disadvantage is that they calculate just a few indicators and cannot influence overall company efficiency. DEA models can give rise to new options to improve productivity compared to other techniques. Linear programming is the foundation of DEA methodologies grounded on the optimization platform. Thus, what distinguishes other methods from the DEA is that it points out the most efficient ways of performance instead of averages.

In recent times, Frontier efficiency analysis has been applied to evaluate the performance of firms in many sectors of several economies. The financial sector is one such sector where frontier efficiency methods have been

greatly applied with the insurance industry receiving great attention in recent times. [7] found out that efficiency analysis was applied in the insurance sector in 87 studies.

In 1994, a single European insurance license was established. Following the implementation of this license, intercountry efficiency studies received attention [8]. Out of 15 EU countries that were sampled for the duration 1996-1999, they found results from 450 insurance companies that showed that insurance companies in Denmark, Spain, Sweden and UK scored better in technical efficiencies than their mates in other parts of Europe. Also, UK insurance companies appeared to have low levels of scale and allocative efficiencies. Within the period of this study, we observed that studies on efficiency were mostly done in the insurance industry in developed nations. [1] examined the performance of the Nigerian insurance market from 2001 to 2005, while [2] examined the technical efficiencies of general insurance companies in Ghana. [9] used a two-stage efficiency model to evaluate the determinants of efficiency of insurance companies in Nigeria. [10] assessed the cost efficiency of insurance firms in Ghana. Hence as far as we know, this study may be the first efficiency study on the life insurance sector in Ghana. Thus, three non-parametric studies were done in West Africa, but one paper on non-life insurance was done in Kenya [11].

When it comes to efficiency study using DEA, the suitable selection of outputs and inputs is critical. We discuss here the selection of outputs and inputs utilized in the study. In the field of insurance, there are mainly three kinds of inputs that are mostly considered. They are material and business services, capital and labour. Labour is further grouped into agent labour and office-home labour. Labour as an input is further divided because many insurance firms use the support services of other companies for the promotion and selling of policies. For instance many of the insurance firms in Ghana do mostly have agencies at the district and regional capitals.

Transportation expenses as well as telecommunication expenses are put under material and business services. Debt, equity and physical capital are the subdivisions of capital. Physical assets such as computers and working premises are classified as physical capital. Mostly, insurers maintain working capital to serve as their pledge to settle claims. Data inadequacy (most inputs are often not recorded in the insurance firms' annual reports) brought about the streamlining of the scheme of input option by merging materials and business services as well as labour to get management costs which includes commissions. This streamlining is a common practice in many efficiency studies such as in [2] and [7]. Furthermore, the operating costs ought to be regarded as a sole input with the aim to decrease the number of parameters that will be required to be calculated. Net assets are represented by some insurance companies as total equity. In this study, the inputs are: capital, operating/management costs and commission.

The three ways of selecting output measures in insurance industries are user-cost, intermediation and the value-added approaches. In taking into consideration insurers that take funds from policy holders, pay taxes, claims, cost and invest them as financial intermediaries, the intermediation approach is used. The user-cost approach is employed when considering the net contribution to revenue to determine outputs. However, when considering their contribution to value by selecting outputs, the value-added approach is used. From 87 studies examined, [7] observed that 74 of them employed the value-added method to select their outputs. They indicated that [7] observed that debate as to if premiums or claims are much suitable as far as the value-added approach is concerned among researchers. Their studies also found out that 40 used claims as output, 31 used premiums as output, two used both premiums and claims and one did not use any of the two. It was deduced that as to which proxies are most appropriate, there is no recognizable trend. In our research, we used both premiums and claims as output measures as in [2]. We also used investment income and premium as output measures since insurance firms can be regarded as organizations that seek to increase their wealth from capital. Thus, our study used three outputs: net claims incurred, net earned premiums and capital/investment income. Group data of fifteen (15) insurance firms for the period 2009-2013 was used in the study. Thus, a total of seventy five (75) observations were obtained.

2. Materials and Methods

Fourteen life insurance firms are considered for the period 2010 to 2013. Thus, we obtain fifty six (56) observations (14 companies in 4 years). Our choice thus, follows the DEA condition that, the whole number of observations be three times more than the summation of the number of outputs and inputs [3].

The aim of the research is to do efficiency analysis of life insurance firms in Ghana and to determine how some input variables influence efficiency/productivity. To find technical efficiency, [12] DEA model was utilized and in order to determine how some variables play a part to performance, the Mann-Whitney U-test was employed to test the hypotheses.

2.1. DEA Model

The choice of the DEA model to employ in productivity analysis is mostly based on the type of data. Performance analysts most often make sure their models are invariant translational whenever their data involves negative or zero or both. They also will have to make sure the DEA model being used is invariant units whenever the variables are different dimensions.

Studies on efficiency in the insurance field mostly use claims as output notwithstanding the fact that claims are

undesirable to insurers [2]. In this study, we treat claims as an unwelcome/undesirable outcome. When outputs that are undesirable are generated together with outputs that are desirable, it is reasonable to give credence to the Decision-Making Unit (DMU) that produces an output that is desirable and punish it for generating output that is undesirable if calculating the efficiency of the DMU [12]. Therefore, we used the model of [12] because insurance claim is an output that is undesirable to insurance firms.

In [12] a model was proposed as:

$$\begin{aligned}
 & \text{Minimize } \theta \\
 \text{Subject:} & \\
 & Y^d \lambda \geq y_j^d \\
 & Y^u \lambda \leq \theta y_j^u \tag{1.1} \\
 & X \lambda \leq \theta x_j \\
 & \lambda \geq 0, j = 1, \dots, M
 \end{aligned}$$

where θ is the input-oriented efficiency measurement score for DMU_j ; the d -by- M matrix is Y^d which constitute the output that is desirable; DMU_j associated vector is y_j^d ; u -by- M matrix of undesirable output is given by Y^u ; y_j^u is a vector of undesirable output of DMU_j ; n -by- M matrix of inputs is X and $M - by - 1$ vector of coefficients given by λ is the levels of intensity for DMUs in the setting up of the reference efficiency frontier. In order to determine the efficiencies of the insurance firms, the model in (1.1) is used under the Variable>Returns-to-Scale (VRS), which separates overall efficiency from technical efficiency.

The VRS model is given as follows:

$$\begin{aligned}
 & \text{Minimize } \theta \\
 \text{Subject to:} & \\
 & Y^d \lambda \geq y_j^d \\
 & Y^u \lambda \leq \theta y_j^u \tag{1.2} \\
 & X \lambda \leq \theta x_j \\
 & f_M \lambda = 1 \\
 & \lambda \geq 0, \quad j = 1, \dots, M
 \end{aligned}$$

where the $1 - by - M$ vector of ones is given by f_M .

2.2. Mann-Whitney U-test

Managerial skills of an insurance firm positively affect its efficiency. In order to check this assumption/hypothesis, the life insurance firms are grouped by capital management expenses and the sample classified into subsets.

3. Results and Discussions

Relying on the Mann Whitney U test, results of the test

of hypothesis concerning the managerial expenses of Ghanaian life insurance firms are given. Technical, scale and overall efficiencies of these firms under study are also examined.

3.1. Descriptive Statistics

Brief descriptive statistics regarding the outputs and inputs of the life insurance firms are presented here. SIC Life and Enterprise Life had the highest amount of output. Enterprise Life recorded the highest investment income while SIC Life had highest in net premiums and claims. Express Life recorded the lowest in all the outputs. For

the inputs, Enterprise Life recorded the highest in capital and commission while SIC Life recorded the highest in management expenses. Donewell Life had the lowest capital; Glico Life recorded the minimum in management expenses and Express Life had the minimum commission.

3.2. Overall Efficiencies of Ghanaian Life Insurance Firms

The global/overall efficiencies of the life insurance firms for the period of study are briefly presented in this section. Table 2 and figure 1 show the overall efficiencies of the life insurance firms.

Table 1. Life Insurer Input/Output Data Statistics for the period of study, 2010-2013

Statistics	Life Insurer Input Data (GH ₵)			Life Insurer Output Data (GH ₵)		
	Capital	Commission	Management Expenses	Net Premiums	Investment Income	Claims Incurred
Minimum	(8,563,608)	79,300	26,783	541,202	90,063	8,427
Maximum	58,090,930	23,934,676	21,406,152	126,790,109	57,083,110	68,845,574
Mean	10,345,513	2,250,869	5,593,972	22,158,520	4,565,593	7,430,197
Standard Deviation	14732218.08	4374661.357	4956418.194	29697385.89	8853863.397	11848814

Table 2. Overall Efficiencies of Ghanaian Life Insurance Firms

Company	2010	2011	2012	2013
Donewell	1	1	1	1
Enterprise	1	0.949933431	1	1
Ghana Union	0.79067194	0.628365069	0.608904353	0.731629462
Metropolitan	0.68054626	0.661438165	0.905843013	1
Provident	0.77034	1	1	1
Star Life	1	1	0.779188703	0.746772121
SIC Life	0.88946718	1	0.953307258	1
Unique	0.69712064	0.750410244	0.731448272	0.769712271
Vangaurd	1	0.963144946	0.777982898	0.657893438
Express Life	1	1	1	0.513759159
Phoenix Life	0.84155562	1	0.615473771	0.582752263
Glico Life	1	1	1	1
Ghana Life	0.44218017	0.412715443	0.483802502	0.519251879
UT life	0.49016563	0.497615977	0.54881188	0.616718078

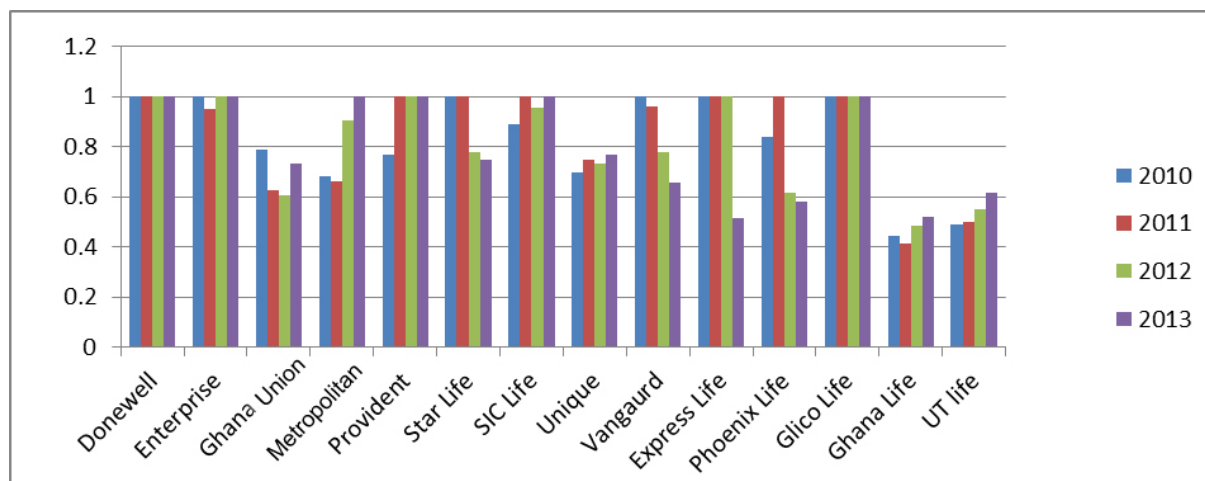


Figure 1. Overall Efficiencies of Ghanaian Life Insurance Firms

Table 3. Technical Efficiencies of Ghanaian Life Insurance Firms

Company	2010	2011	2012	2013
Donewell	1	1	1	1
Enterprise	1	0.951	1	1
Ghana Union	1	0.955223	0.826925	0.872068
Metropolitan	0.702164	0.671303	0.908986	1
Provident	0.843587	1	1	1
Star Life	1	1	0.801507	0.823239
SIC Life	0.893797	1	1	1
Unique Life	0.934659	0.914065	0.873697	0.83025
Vanguard	1	0.975725	0.785078	0.674492
Express Life	1	1	1	0.515762
Phoenix Life	1	1	0.688907	0.594028
Glico Life	1	1	1	1
Ghana Life	0.637626	0.501429	0.527924	0.53891
UT life	1	0.796827	0.635899	0.670237

We observed from figure 1 and table 2 that:

- 1) Ghana life insurance firm recorded the minimum overall efficiency for the period of study in 2011. This stood at 41% (0.4127).
- 2) Glico Life and Donewell Life recorded 100% consistently for the whole four-year period of our study. Enterprise Life, Provident Life and Express Life also recorded 100% for three different years.
- 3) Though a few Life insurance firms performed at 100% efficiency, most of them underperformed during the study.
- 4) Life insurance firms performed at an average overall efficiency of 82%. This is an indication that Ghanaian

life insurance firms still need to explore avenues for improving and increasing efficiency

3.3. Technical Efficiencies of Ghanaian Life Insurance Firms

The technical efficiencies of the Ghanaian Life Insurers are shown in Table 3 and in Figure 2.

We noticed the following from Table 3 and Figure 2.

- 1) In 2011, Ghana Life recorded the minimum technical efficiency which stood at 50% (0.5014).
- 2) The life insurance firms demonstrated to have more technical efficiencies as compared to overall efficiencies.

- 3) In 2010, Donewell Life, Enterprise Life, Star Life, Vanguard Life, Express Life and Glico Life operated in the most productive scale size whereas Donewell Life, Provident Life, Star Life, SIC Life and Glico Life were fully efficient in 2011. Similarly, in 2012, Donewell Life, Enterprise Life, Provident Life, Express Life and Glico Life were globally efficient while Donewell Life, Enterprise Life, Provident Life, SIC Life and Glico Life were fully efficient.
- 4) Donewell Life and Glico Life operated in the most productive scale size and thus were globally efficient for the whole period of our study.

3.4. Scale Efficiencies of Ghanaian Life Insurance Firms

Scale efficiency reveals the effect of a DMU's size on efficiency and shows inefficiency as a result of inappropriate size of a DMU. If a DMU advances towards the best size, the technical and overall efficiency can be enhanced at the same level of inputs. It is the extent to which a firm can make use of returns to scale by changing the size towards optimal scale. The scale efficiencies of life insurers are shown in table 4 and figure 3.

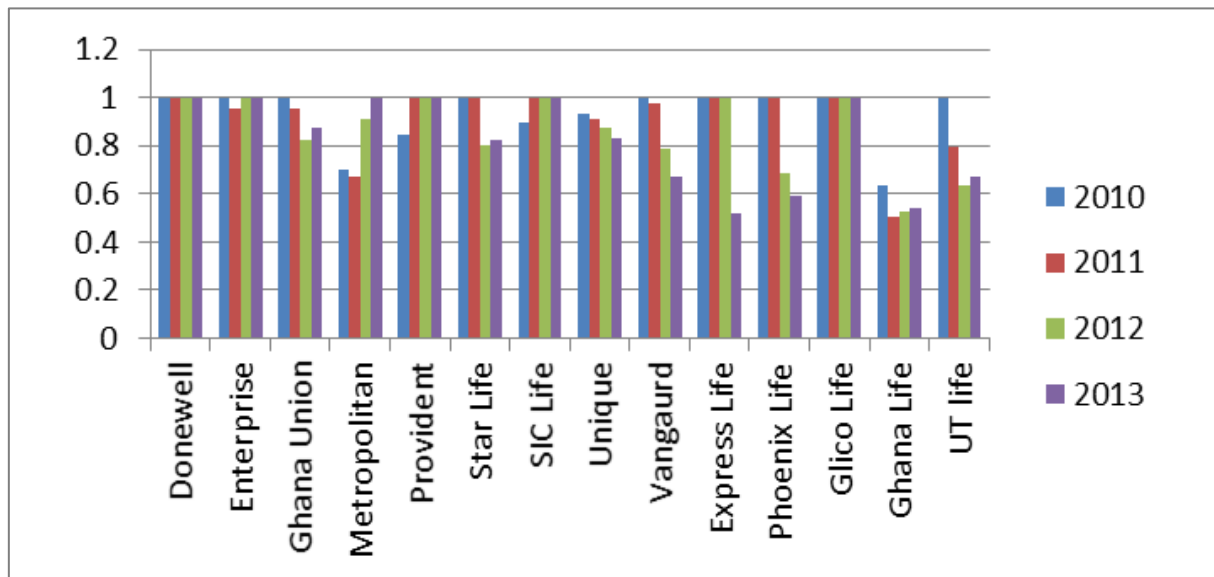


Figure 2. Technical Efficiencies of Ghanaian Life Insurance Firms

Table 4. Scale Efficiencies of Ghanaian Life Insurance Firms

Company	2010	2011	2012	2013
Donewell	1	1	1	1
Enterprise	1	0.998878	1	1
Ghana Union	0.790672	0.65782	0.736348	0.838959
Metropolitan	0.969213	0.985304	0.996542	1
Provident	0.913172	1	1	1
Star Life	1	1	0.972154	0.907115
SIC Life	0.995155	1	0.953307	1
Unique	0.745856	0.820959	0.837188	0.927085
Vanguard	1	0.987107	0.990962	0.975391
Express Life	1	1	1	0.996117
Phoenix Life	0.841556	1	0.893407	0.981018
Glico Life	1	1	1	1
Ghana Life	0.693479	0.823078	0.916425	0.963523
UT life	0.490166	0.624497	0.863049	0.920149

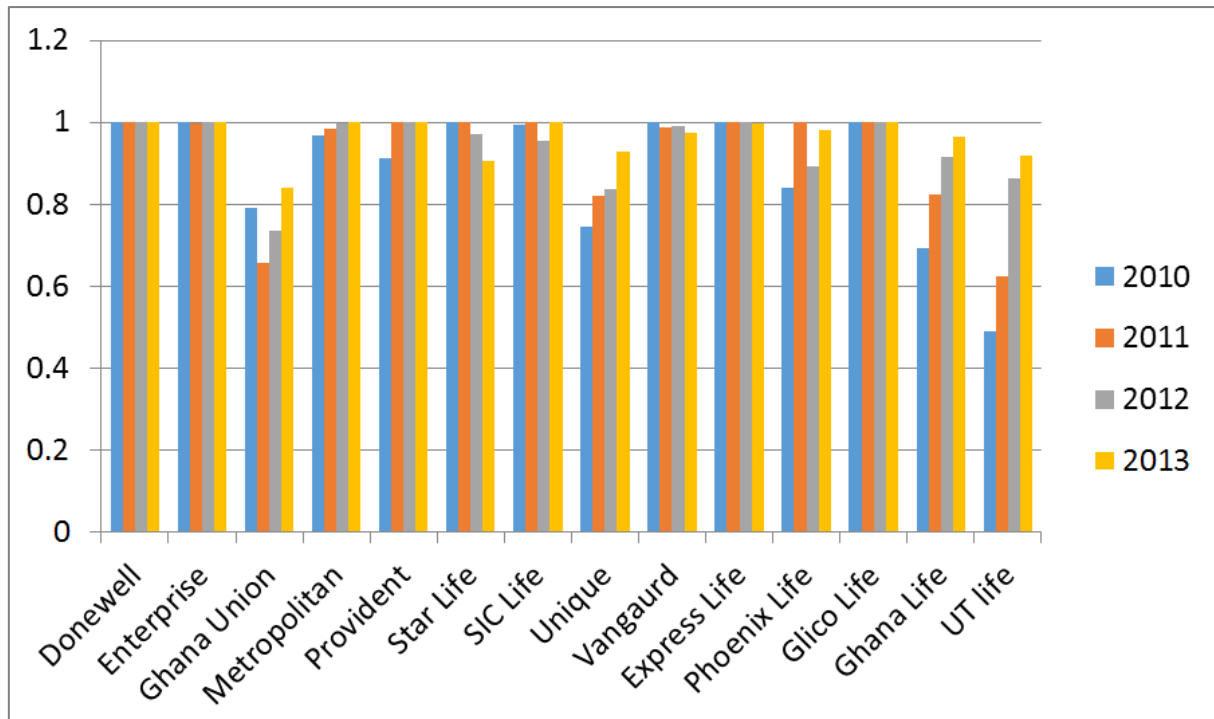


Figure 3. Scale Efficiencies of Ghanaian Life Insurers for the period

From table 4 and figure 3 we observed these:

- 1) The minimum scale efficiency was recorded by UT Life in 2010 which was at 49% (0.490166).
- 2) The Life Insurance firms showed more scale efficiencies than for technical efficiencies. This implies that various firms could increase their efficiency by among other things altering their size towards optimal scale.
- 3) Within the span of the study, mean scale efficiency of the life insurance firms was at 93%. This shows that, on the average, life insurance firms functioned at increasing returns to scale.

3.5. Average Technical, Scale and Global/Overall Efficiencies of Ghanaian Life Insurance Firms

For the period of the study we have shown in table 5 and in figure 4 the average technical, scale and overall efficiencies of the life insurers. Apart from Ghana Life, all the other Insurance companies performed above average. There is still the need for improvement since they all operated below 100%.

- 1) The scale efficiency outcomes are higher than the technical and overall efficiency outcomes. This implies that inefficiencies of life insurance firms are largely due to inefficient management operations.
- (i). Donewell Life and Glico Life outperformed the other companies. The inefficient companies can improve their performances by observing the mode of operations of these efficient ones and implementing those things contributing to the efficiency of the two companies.

Table 5. Technical, Scale and Overall Efficiencies of Ghanaian Life Insurers

Company	Overall efficiencies	Scale efficiencies	Technical efficiencies
Donewell	1	1	1
Enterprise	0.987483358	0.999719517	0.987750098
Ghana Union	0.689892705	0.7559499	0.913553862
Metropolitan	0.820613371	0.987764817	0.820613371
Provident	0.942585001	0.978292913	0.960896824
Star Life	0.881490206	0.969817269	0.906186515
SIC Life	0.960693609	0.98711566	0.973449322
Unique	0.737172857	0.83277208	0.888167523
Vanguard	0.849755321	0.988365046	0.858823847
Express Life	0.87843979	0.999029343	0.878940418
Phoenix Life	0.759945413	0.928995163	0.820733624
Glico Life	1.000000001	1.000000001	1
Ghana Life	0.464487498	0.849126495	0.551471996
UT life	0.53832789	0.724465077	0.77574085
Average	0.822206216	0.928672377	0.881166304

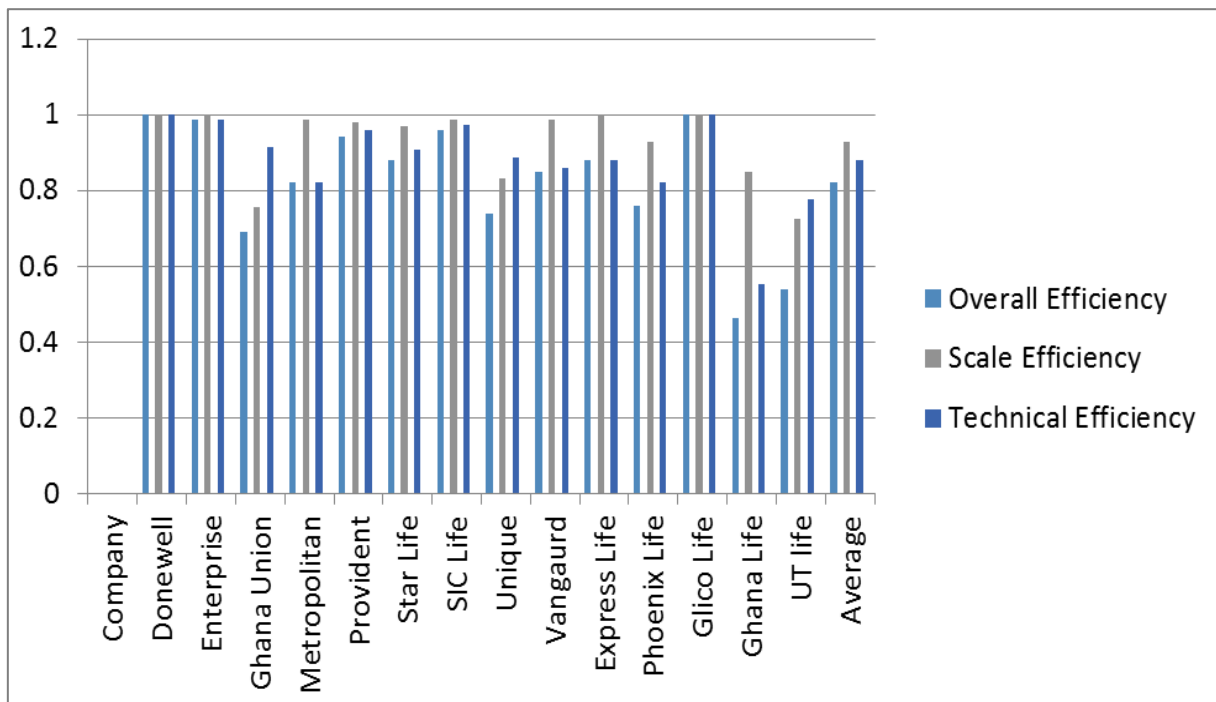


Figure 5. Average Technical, Scale and Overall Efficiencies of Ghanaian Life Insurers

3.6. Effects of Dimension and Market Share on Life Insurance Efficiency

We seek to test hypotheses in relation to efficiency results of insurance firms gotten. The Mann Whitney U test is able to test whether two samples are from the same population and it is recommended for use in DEA since results from efficiency studies fail to fit in a standard normal distribution. The overall efficiency scores were used in the hypothesis testing.

3.6.1. Outcome of Dimension on Life Insurance Efficiency

In order to test the hypothesis, we group the life insurance firms by capital and further divide the sample into two subsets.

- (ii). H0: Large life insurance firms are not more efficient than small life insurance firms.
H1: Large life insurance firms are more efficient than small life insurance.
- (iii). Significance level: $\alpha = 0.05$
- (iv). Rejection Region: This is a two-tailed test with $n_1 = 7, n_2 = 7$.
Reject the null hypothesis if $p\text{-value} < 0.05$
- (v). The test statistic, $p\text{-value} = \text{Asymp Sig (2-tailed)} = 0.142$

Table 6. Mann Whitney U test on differences in Life Insurers based on Dimension

Ranks				
	Dimension	N	Mean Rank	Sum of Ranks
Overall Efficiencies	Large	7	9.14	64.00
	Small	7	5.86	41.00
	Total	14		

Test Statistics	
	Overall Efficiencies
Mann-Whitney U	13.000
Wilcoxon W	41.000
Z	-1.469
Asymp. Sig. (2-tailed)	.142
Exact Sig. [2*(1-tailed Sig.)]	.165 ^b

- (vi). Decision: Since the $p\text{-value} > 0.05 = \alpha$ the null hypothesis is retained.
- (vii). Conclusion: At the $\alpha = 0.05$ level of significance, there is enough evidence to show that large life insurance firms in terms of capital are not more efficient than small life Insurance firms.

3.6.2. Outcome of Market share on Life Insurance Efficiency

In order test the hypothesis, the life insurance firms are grouped by net premiums to find the expected market share. The sample is further divided into two constituting large and small insurers.

- (i) H₀: Life insurance firms with higher market shares are not more efficient than firms with lower market shares.
- (ii) H₁: Life insurance firms with higher market shares are more efficient than those with lower shares.
- (iii) Significance level: $\alpha = 0.05$
- (iv) Rejection region: This is a two-tailed test with $n_1 = 7, n_2 = 7$. The null hypothesis is rejected if the $p\text{-value} < 0.05$.
- (v) $p\text{-value} = \text{Asymp Sig (2-tailed)} = 0.035$ is the test statistic

Table 7. Mann Whitney U test on differences in Life Insurers based on Market share

Ranks				
	Market share	N	Mean Rank	Sum of Ranks
Overall efficiencies	Large	7	9.86	69.00
	Small	7	5.14	36.00
	Total	14		

Test Statistics	
	Overall efficiencies
Mann-Whitney U	8.000
Wilcoxon W	36.000
Z	-2.108
Asymp. Sig. (2-tailed)	.035
Exact Sig. [2*(1-tailed Sig.)]	.038 ^b

- (i). Decision: Since the $p\text{-value} = 0.035 < 0.05 = \alpha$, null hypothesis is rejected.
- (ii). Conclusion: At the $\alpha = 0.05$ level of significance, there is enough evidence to show that life insurers that have big market shares are considered efficient than life insurers that have small market shares.

Thus, from the above hypotheses carried out at 5% significance level, we indicate this:

1. Big life insurers do not necessarily appear to have higher efficiency than small life insurers in terms of capital. In conclusion, size efficiency could be significantly affected by methodological choice.
2. Life insurers that are more efficient are those with higher market shares. This result is consistent with previous studies in the insurance industry [1, 2].

4. Conclusions

In this research, we sought to evaluate efficiencies of Ghanaian life insurance firms. Data envelopment analysis was used and it permits for the integration of numerous inputs and outputs in ascertaining the efficiencies of life insurance firms. We conclude that a good number of the life insurers operated with relatively high managerial skills and higher scale efficiency. Also, size-efficiency of

Ghanaian life insurance firms was significantly affected by choice of classification and efficiency and size are statistically unrelated.

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