



Measurement of the Efficiency Level of Islamic Insurance Firms in Indonesia: DEA and SFA Analysis

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Abstract

This study aims to measure the efficiency level of Islamic insurance companies in Indonesia using DEA and SFA approaches, with secondary data from 13 companies in the 2019-2023 period. The methods used in this study are Data Envelopment Analysis and Stochastic Frontier Analysis. DEA measures the relative technical efficiency of a company compared to other companies in the same group, while SFA measures efficiency by considering stochastic factors that can affect company performance. The results show that there is high variation in efficiency between companies in DEA, while SFA produces efficiency scores above 60%, tending to be higher than DEA. Some companies show consistency in efficiency across both methods, which can be an indicator of good managerial practices, while other companies experience fluctuations, indicating potential improvements in operational management. This research provides practical implications for Islamic insurance companies to improve efficiency through resource optimization, in order to get maximum output, so that the efficiency level of Islamic insurance companies can increase.

Keywords: Efficiency, Islamic Insurance, Resource Optimization, DEA, SFA.

Abstrak

Penelitian ini bertujuan untuk mengukur tingkat efisiensi perusahaan asuransi syariah di Indonesia menggunakan pendekatan DEA dan SFA, dengan data sekunder dari 13 perusahaan pada periode 2019–2023. Metode yang digunakan dalam penelitian ini adalah Data envelopment Analysis dan Stochastic Frontier Analysis. DEA mengukur efisiensi teknis relatif suatu perusahaan dibandingkan dengan perusahaan lain dalam kelompok yang sama, sedangkan SFA mengukur efisiensi dengan mempertimbangkan faktor *stochastic* yang dapat memengaruhi kinerja perusahaan. Hasil penelitian menunjukkan terdapat variasi efisiensi yang tinggi antar perusahaan pada DEA,

sementara SFA menghasilkan skor efisiensi di atas 60%, cenderung lebih tinggi dibandingkan DEA. Beberapa perusahaan menunjukkan konsistensi efisiensi di kedua metode, yang dapat menjadi indikator praktik manajerial yang baik, sementara perusahaan lain mengalami fluktuasi, menunjukkan potensi perbaikan dalam manajemen operasional. Penelitian ini memberikan implikasi praktis bagi perusahaan asuransi syariah untuk meningkatkan efisiensi melalui optimalisasi sumber daya, agar mendapatkan output yang maksimal sehingga tingkat efisiensi perusahaan asuransi syariah dapat meningkat.

Kata kunci: *Efisiensi, Asuransi Syariah, Optimalisasi Sumber Daya, DEA, SFA.*

INTRODUCTION

The insurance industry has an important role in the country's economy, seen from the gross contribution of Islamic insurance, which reached 3.07 trillion in December 2022, this shows that Islamic insurance plays a role in driving the economy through the management of Islamic funds (Indonesian Sharia Insurance Association, 2023). In this era, the insurance industry has a significant role in providing protection against unexpected events. As a country with the largest Muslim population in the world with a total of 86.9% of the total population (Putri et al., 2024), Indonesia is one of the countries with great potential in terms of Islamic financial institutions (Mutmainnah & Yuwana, 2024).

Based on Fatwa DSN-MUI No.21/DSN-MUI/X/2001 Islamic insurance (*Ta'min*, *Takaful*, or *Tadhamun*) is an effort to protect each other and help each other through investments in the form of assets or *tabarru'* with a pattern of return to face certain risks through a contract. With insurance sharia, customers will share risks and bear the burden together (Safika et al., 2024). Islamic insurance has several contracts used in its activities, such as *tabarru'* contracts, *mudharabah musytarakah* contracts, and *wakalah bil ujah* contracts.

The main difference between sharia insurance and conventional insurance lies in the basic concept, sharia insurance is based on the principle of mutual assistance and cooperation among fellow insurance customers through the contribution of *tabarru'* funds (Basri, 2024). In contrast, conventional insurance operates based on an agreement between the insurer and the insured, where the insurer takes responsibility for certain risks in exchange for premiums paid by the insured (Suganda et al., 2024).

The Islamic insurance industry shows a positive trend every year, although the market share of Islamic insurance is only 11% and relatively small, but in the last 5 years, this industry has recorded significant growth when compared to conventional insurance (Anam, 2024). The penetration rate of Islamic insurance in Indonesia is still relatively low, although the market potential is very large (Baihaqi, 2023). One of the policies implemented to support the development of the Islamic insurance industry in Indonesia is the spin-off policy, or the separation of the Islamic insurance business unit from the conventional parent company to become an independent entity (Suryawadi, 2021),

Taking the spin-off step provides an opportunity for Islamic insurance companies to focus more on managing business according to sharia principles, improve operational efficiency, and be more independent in making company policies (Akbar et al., 2022). Although there are many benefits or advantages obtained by Islamic insurance companies

after conducting a spin-off, in reality, there are many challenges and obstacles that must be considered by a company that will carry out a spin-off, including: the readiness of human resources, technology, and capital (Arianty & Ghoni, 2023).

Based on research by Haniyah et al. (2022) which examines the growth of assets and profitability of insurance companies that carry out spin-offs, states that the average growth in total assets and profitability of insurance companies after making spin-offs has decreased. The efficiency of Islamic insurance companies that have made spin-offs has also decreased, this occurs because administrative costs are relatively higher which causes lower profits, or the value of assets used is still not optimal for generating profits (Aziz et al, 2024; Ghoni, 2021).

Although the Islamic insurance industry continues to grow, the literacy and inclusion of Islamic insurance companies in Indonesia is still very low when compared to other financial sectors (Financial Services Authority, 2023). Although the level of ILK in the Islamic insurance industry continues to increase every year, its achievement is still relatively low compared to other financial institutions. The insurance industry only reached a literacy level of 31.7% and inclusion of 16.6%, far behind the banking industry, which reached a literacy level of 49.9% and inclusion of 74.0% (Financial Services Authority, 2023). This shows that more efforts are needed to increase public understanding and access to Islamic insurance (Imtinan et al., 2024; Wartoyo et al, 2024).

Measuring the level of efficiency of Islamic insurance is important because it is an indicator to assess whether the company can compete amid the development of the Islamic insurance industry, which is growing every year (Dwijayanti et al., 2022; Hafif et al, 2025). The concept of efficiency has been mentioned in QS. Al-Isra' verse 27, which reminds humans to avoid wasteful behavior, because wastefulness is an action that Allah SWT does not like (Fauzi, 2023).

This study is different from previous studies in that this study uses two direct approaches, namely a parametric approach (Stochastic Frontier Analysis) and a non-parametric approach (Data Envelopment Analysis). Another difference is that the object of this research is insurance companies listed in AASI. And the year used in this study is from 2019-2023, which is to ensure that the data obtained is the latest and relevant data. This research can fill the research gap related to the measurement of the efficiency level of Islamic insurance companies registered in the Asosiasi Asuransi Syariah Indonesia (AASI), especially in the context of regulatory changes and industry dynamics in 2019-2023. Through the Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA), this research is expected to provide an in-depth understanding of the operational efficiency of Islamic insurance companies.

LITERATURE REVIEW

Debreu (1951) in his work entitled "The Coefficient of Resource Utilization," he explains that an economic system or company can minimize the use of inputs without reducing output. This concept highlights that inefficiency occurs when there is a waste of resources in the production process. If an entity can achieve the same level of output by minimizing the use of inputs, then its efficiency increases. Efficiency is a comparison between output and input. Efficiency in a company is how the company can use the minimum input possible, but can produce the maximum output possible (Hidayat et al., 2021).

The framework in this study is based on the use of input and output variables to analyze the level of efficiency. The input variables used include Total Assets (X1), Claims

Expense (X2), and Tabarru' Fund (X3), while the output variable used is Investment Income (Y). To measure efficiency, this study applies two approaches, namely Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA). Through these two methods, this study aims to obtain an efficiency score that can provide a comparative picture of the performance of each unit analyzed.

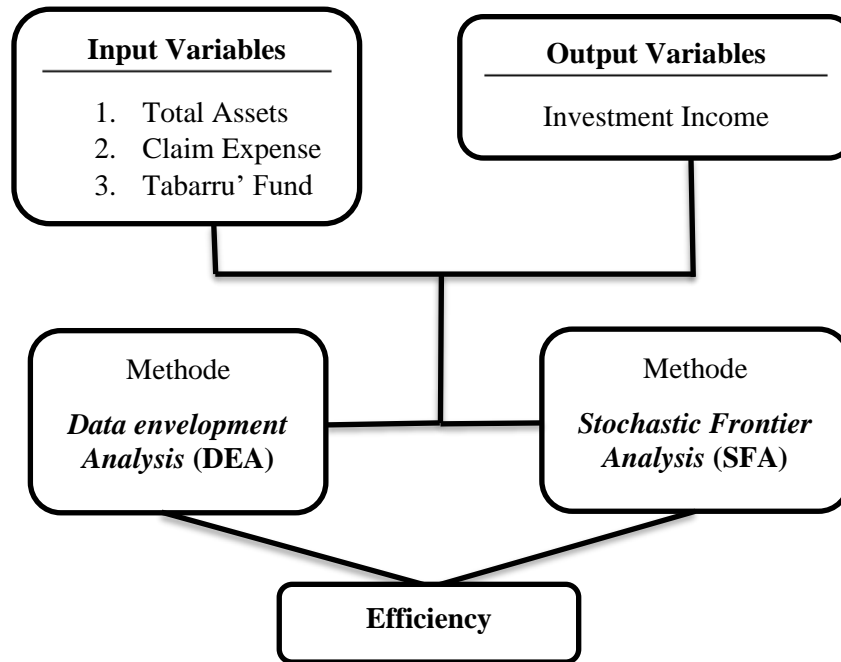


Figure 1. Research Model

According to research by Benyoussef & Hemrit (2019) which examines the efficiency level of the insurance industry in Saudi Arabia, the insurance industry does not operate efficiently. The results of this study are in line with the research of Fauziah et al. (2020) which examines the level of efficiency of insurance companies in Indonesia, states that insurance companies in Indonesia in the research period have not been at an efficient level.

In contrast to previous research, according to Nasution (2021) Those who examined the efficiency level of insurance companies in Malaysia and Indonesia, stated that the efficiency of Islamic companies in Indonesia reached an overall efficiency level of 63.06%. This research is in line with Ulansari & Septiarini (2020)'s research which examines the comparison of the efficiency levels of conventional and Islamic insurance companies, stating that Islamic insurance companies are already at an efficient level.

According to research conducted by Nguyen & Pham (2020) who examined the efficiency level of banking companies in Vietnam using the Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) methods found that, the value of the efficiency level using and Stochastic Frontier Analysis (SFA) has a greater efficiency level than using the Data Envelopment Analysis (DEA) method. This is in line with research conducted by Liu, (2019) which examines the efficiency level of banking companies in America and Canada, the results of his research show that the efficiency level of banking companies using and Stochastic Frontier Analysis (SFA) has a greater efficiency level than using the Data Envelopment Analysis (DEA) method.

METHOD

The population used in this study are Islamic insurance companies registered with the Asosiasi Asuransi Syariah Indonesia (AASI) from 2019-2023. Which then selected 13 sharia insurance companies after being identified and meeting the sample criteria using purposive sampling technique. This type of research is included in the quantitative research category with the data used is secondary data taken from the company's website from 2019-2023. And the variables used in this study are investment income as the output variable (Y), total assets as the input variable (X1), claim expense (X2) and tabarru' funds (X3).

There are two analytical methods used in this research, the first is Data Envelopment Analysis (DEA) which is a linear programming technique used to measure the efficiency level of a Decision Making Unit (DMU) or Decision Making Unit (UPK) in a company, which aims as a benchmark and evaluation in making a decision (Anam, 2021). DEA was first developed by Charnes, Cooper, and Rhodes in 1978 to measure input and output techniques into multi-inputs and outputs, using the framework relative efficiency value as a ratio of input (single virtual input) and output ratio (single virtual output) (Jessica et al., 2022).

The second analysis method is Stochastic Frontier Analysis (SFA). Stochastic Frontier Analysis (SFA) is a parametric analysis method used to determine the inefficiency of a production process without removing the error term from the model (Wafi & Sari, 2021) mathematically the SFA model can be written as follows:

$$Y_{it} = f(X_{it}|\beta) \exp \epsilon_{it}; \epsilon_{it} = v_{it} - u_{it}$$

Stochastic Frontier Analysis (SFA) was developed by Aigner, Lovell, Schmidt (1977) and Meeusen & Van Den Broeck (1977). In the Stochastic Frontier Analysis (SFA) method, the error term consists of two random components, V_i and U_i . V_i is a two-sided error term that describes statistical noise which a random variation in output caused by factors outside the control, such as output measurement errors, environmental variables, and industrial action (Aziz & Budiasih, 2024).

RESULT AND DISCUSSION

Efficiency Level Measurement Using DEA

After analyzing the efficiency level of 13 sharia insurance companies in Indonesia, which were processed using DEA-Frontier software during the period 2019-2023. Then the results of the efficiency score listed in table 1 are obtained.

Table 1
Efficiency Score with DEA-Frontier

NO	COMPANY NAME	SCORE				
		2019	2020	2021	2022	2023
1	PT Asuransi Tugu Pratama Indonesia Tbk	0,31(LE)	0,31(LE)	1,00(E)	0,57(TE)	0,35(LE)
2	PT Asuransi Tri Pakarta	0,48(LE)	0,63(TE)	0,51(TE)	0,39(LE)	0,44(LE)
3	PT Asuransi Staco Mandiri	0,55(TE)	0,45(LE)	0,37(LE)	0,52(TE)	0,31(LE)
4	PT Asuransi Umum Bumiputera Muda 1967	0,24(I)	0,40(LE)	0,40(LE)	0,52(LE)	0,38(LE)
5	PT Asuransi Jiwa Syariah AL AMIN	0,07(I)	0,06(I)	0,08(I)	0,10(I)	0,11(I)

6	PT Asuransi Askrida Syariah	0,20(I)	0,17(I)	0,14(I)	0,18(I)	0,13(I)
7	PT Asuransi Takaful Keluarga	0,09(I)	0,08(I)	0,18(I)	0,23(I)	0,23(I)
8	PT Asuransi Wahana Tata	0,74(TE)	1,00(E)	1,00(E)	1,00(E)	0,90(E)
9	PT Asuransi Sampo Indonesia	1,00(E)	1,00(E)	0,48(LE)	0,94(E)	0,68(TE)
10	PT Asuransi Jasaraharja Putera	0,55(TE)	0,70(TE)	0,80(E)	0,72(TE)	0,97(E)
11	PT Asuransi Reliance Indonesia	0,56(TE)	1,00(E)	0,48(KE)	0,35(LE)	0,20(LE)
12	PT Asuransi Jiwa Tokio Marine Indonesia	1,00(E)	1,00(E)	1,00(E)	1,00(E)	1,00(E)
13	PT Asuransi Sun Life Financial Indonesia	0,52(TE)	0,38(LE)	0,43(LE)	0,35(LE)	0,22(I)

Source: Data Processed, 2025

Description: I = Inefficient
LE = Less Efficient
TE = Towards Efficiency
E = Efficient

PT Asuransi Tugu Pratama Indonesia Tbk experienced fluctuations in efficiency scores, from 0.31 in 2019-2020, increasing sharply to 1.00 in 2021, but falling to 0.57 in 2022 and 0.35 in 2023. PT Asuransi Tri Pakarta recorded an increase from 0.48 in 2019 to 0.63 in 2020, but experienced a gradual decline to 0.44 in 2023. PT Asuransi Staco Mandiri experienced a decline from 0.55 in 2019 to 0.31 in 2023, although it had increased to 0.52 in 2022. PT Asuransi Umum Bumiputera Muda 1967 increased from 0.24 in 2019 to 0.52 in 2022, but fell back to 0.38 in 2023. PT Asuransi Jiwa Syariah AL AMIN and PT Asuransi Askrida Syariah experienced consistently low efficiency, with scores ranging from 0.06-0.11 and 0.13-0.20 during 2019-2023. PT Asuransi Takaful Keluarga also remained inefficient with scores between 0.08-0.23. PT Asuransi Wahana Tata achieved perfect efficiency of 1.00 in 2020-2022, but fell to 0.90 in 2023. PT Asuransi Sampo Indonesia experienced fluctuations from 1.00 in 2019-2020, down to 0.48 in 2021, up to 0.94 in 2022, then down to 0.68 in 2023. PT Asuransi Jasaraharja Putera rose from 0.55 in 2019 to 0.97 in 2023 after fluctuations in between. PT Asuransi Reliance Indonesia reached an efficiency of 1.00 in 2020, but dropped drastically to 0.20 in 2023. PT Asuransi Jiwa Tokio Marine Indonesia remained consistent with a perfect efficiency score of 1.00 throughout 2019-2023. PT Asuransi Sun Life Financial Indonesia dropped from 0.52 in 2019 to 0.22 in 2023, showing a downward trend in efficiency.

Efficiency Level Measurement Using SFA

The following are the results of the measurement of the efficiency level of 13 Islamic insurance companies in Indonesia, which were processed using Stata-MP 17 *software* during the period 2019-2023.

Table 1
Efficiency Level Score with Stata-MP 17

NO	COMPANY NAME	SCORE				
		2019	2020	2021	2022	2023
1	PT Asuransi Tugu Pratama Indonesia Tbk	0,71(TE)	0,68(TE)	0,84(E)	0,60(TE)	0,75(TE)
2	PT Asuransi Tri Pakarta	0,86(E)	0,89(E)	0,83(E)	0,76(E)	0,86(E)
3	PT Asuransi Staco Mandiri	0,75(TE)	0,69(TE)	0,64(TE)	0,74(TE)	0,66(TE)
4	PT Asuransi Umum Bumiputera Muda 1967	0,60(TE)	0,74(TE)	0,70(TE)	0,76(E)	0,75(TE)
5	PT Asuransi Jiwa Syariah AL AMIN	0,65(TE)	0,59(TE)	0,70(TE)	0,71(TE)	0,81(E)
6	PT Asuransi Askrida Syariah	0,86(E)	0,83(E)	0,80(E)	0,83(E)	0,84(E)
7	PT Asuransi Takaful Keluarga	0,78(E)	0,71(TE)	0,85(E)	0,80(E)	0,87(E)
8	PT Asuransi Wahana Tata	0,85(E)	0,88(E)	0,83(E)	0,77(E)	0,84(E)
9	PT Asuransi Sompoo Indonesia	0,86(E)	0,87(E)	0,80(E)	0,85(E)	0,88(E)
10	PT Asuransi Jasaraharja Putera	0,79(E)	0,88(E)	0,88(E)	0,82(E)	0,88(E)
11	PT Asuransi Reliance Indonesia	0,78(E)	0,75(TE)	0,69(TE)	0,57(TE)	0,53(TE)
12	PT Asuransi Jiwa Tokio Marine Indonesia	0,84(E)	0,85(E)	0,74(TE)	0,67(ME)	0,78(E)
13	PT Asuransi Sun Life Financial Indonesia	0,81(E)	0,82(E)	0,69(TE)	0,59(TE)	0,58(TE)

Source: Data Processed, 2025

Description: I = Inefficient
 LE = Less Efficient
 TE = Towards Efficiency
 E = Efficient

Based on the Stochastic Frontier Analysis (SFA), no Islamic insurance company achieved a perfect efficiency score of 1.00, but the average efficiency score was above 0.75. PT Asuransi Tugu Pratama Indonesia Tbk experienced fluctuations from 0.71 in 2019 to 0.75 in 2023, with the highest efficiency of 0.84 in 2021. PT Asuransi Tri Pakarta remains at an efficient level with fluctuations between 0.76-0.89. PT Asuransi Staco Mandiri is at the level towards efficient with scores varying between 0.64-0.75. PT Asuransi Umum Bumiputera Muda 1967 is generally efficient with a score of 0.60-0.76. PT Asuransi Jiwa Syariah AL AMIN increased from 0.65 in 2019 to 0.81 in 2023. PT Asuransi Askrida Syariah is consistently efficient with a score of 0.80-0.86. PT Asuransi Takaful Keluarga fluctuates but remains efficient, with a score of 0.71-0.87. PT Asuransi Wahana Tata, PT Asuransi Sompoo Indonesia, and PT Asuransi Jasaraharja Putera maintain efficient levels despite fluctuations. PT Asuransi Reliance Indonesia tends to decline from 0.78 in 2019 to 0.53 in 2023. PT Asuransi Jiwa Tokio Marine Indonesia drops from 0.84 in 2019 to 0.67 in 2022 before increasing to 0.78 in 2023. PT Asuransi Sun Life Financial Indonesia fell from 0.81 in 2019 to 0.58 in 2023, showing a downward trend in efficiency.

Comparison of DEA and SFA Efficiency Levels

Below is a graph of the results of the comparison of the score of the efficiency level of Islamic insurance companies calculated using two approaches, namely: Data Envelopment Analysis (DEA) with Stochastic Frontier Analysis (SFA). The data in this figure has been averaged based on the measurement results during the research period 2019 - 2023.

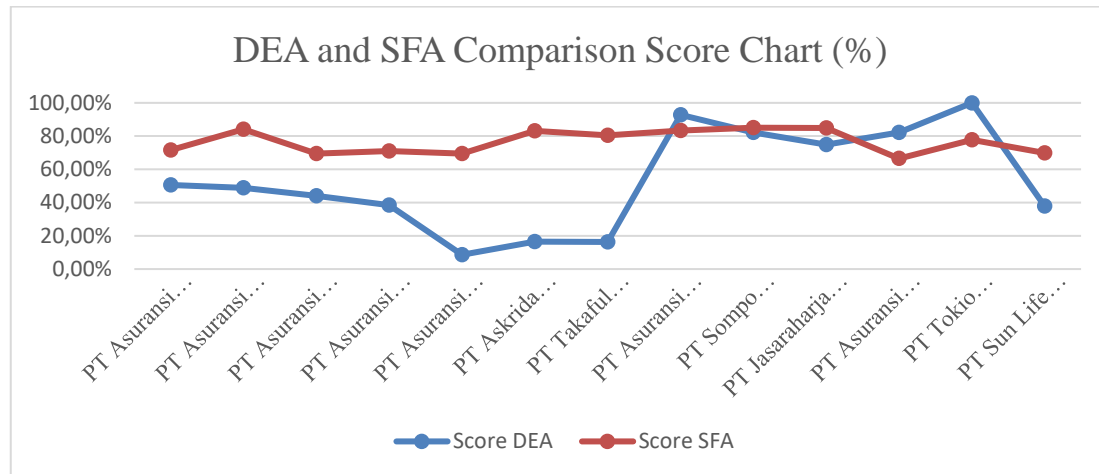


Figure 2
Comparison of DEA and SFA Efficiency Scores

Source: Data Processed, 2025

The figure above shows that the efficiency level of insurance companies based on the Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) methods shows a significant variation. In calculating the efficiency level using Data Envelopment Analysis (DEA), PT Asuransi Jiwa Tokio Indonesia is the company with the highest efficiency score of 100%. In contrast, PT Asuransi Jiwa Syariah AL AMIN recorded the lowest efficiency score of 8.60%, indicating very low technical efficiency.

Implications of DEA and SFA Methodological Differences on Efficiency Results

Based on the measurement of the efficiency level using the Stochastic Frontier Analysis (SFA) method, PT Asuransi Sampo Indonesia was recorded as the company with the highest efficiency score reaching 85.06%. Meanwhile, PT Asuransi Reliance Indonesia became the company that obtained the lowest efficiency score which only reached 66.49%. In general, the efficiency score produced by the Stochastic Frontier Analysis (SFA) method tends to be higher than the Data Envelopment Analysis (DEA) method. As seen in PT Asuransi Tri Pakarta, with an efficiency score generated using the Data Envelopment Analysis (DEA) method of 48.92%. Meanwhile, the efficiency score using the Stochastic Frontier Analysis (SFA) method is 84.06%.

In addition, there is a pattern that shows that companies with efficiency scores using the Data Envelopment Analysis (DEA) method produce higher efficiency scores even though they are still both at the efficient level, such as PT Asuransi Wahana Tata with a score of 92.79%, which also has a high Stochastic Frontier Analysis (SFA) efficiency score of 83.32%. This reflects the consistency in the company's technical efficiency performance, but there are still companies that have a large difference between the efficiency scores using the Data Envelopment Analysis (DEA) and Stochastic Frontier

Analysis (SFA) methods, such as PT Asuransi Reliance Indonesia with a Data Envelopment Analysis (DEA) score of 82.18% and a Stochastic Frontier Analysis (SFA) score of 66.49%.

The difference in efficiency scores is because the Stochastic Frontier Analysis (SFA) takes into account statistical uncertainty or error, which reflects random noise such as external factors or measurement error in the efficiency model. Meanwhile, in the Data Envelopment Analysis (DEA), all discrepancies from the efficiency frontier are considered as inefficiencies, without distinguishing whether the cause comes from random factors or actually comes from inefficiencies in resource management.

In the calculation of the Data Envelopment Analysis (DEA) method, PT Asuransi Jiwa Tokio Indonesia obtained the highest efficiency score of 100%. Meanwhile, in the Stochastic Frontier Analysis (SFA) calculation, PT Asuransi Sampo Indonesia achieved the highest efficiency score of 85.06%. The difference in results is due to the method used in each calculation. SFA still considers statistical errors, which are not taken into account in DEA. One example of the statistical error is the difference in the type of insurance between the two companies, where PT Asuransi Jiwa Tokio Indonesia is engaged in life insurance, while PT Asuransi Sampo Indonesia is a sharia general insurance company (Wartoyo & Haida, 2024).

The differences in insurance types, categorized as random errors or external factors, not only highlight the limitations of efficiency measurement using DEA but also provide new insights into how SFA can account for external factors that were previously overlooked. Data from the Indonesian Sharia Insurance Association (AASI) reveals that the penetration and density of sharia life insurance have decreased by 3.73% each, attributed to the large protection gap and the low public awareness of insurance. In contrast, Islamic general insurance experienced a slight increase, with penetration and density rising by 0.03%. Furthermore, the Covid-19 pandemic in 2020 had a distinct impact on the two sectors, with assets in sharia life insurance declining significantly, while sharia general insurance remained relatively stable. These findings emphasize the importance of considering external factors in efficiency analysis, which could enrich the efficiency measurement models for insurance companies in the future.

CONCLUSION

This study measures the efficiency level of Islamic insurance listed in AASI with two approaches, namely the *Data Envelopment Analysis* (DEA) method as a non-parametric approach and *Stochastic Frontier Analysis* (SFA) as a parametric approach, and compares the results of both. By using data from 13 Islamic insurance companies during the 2019-2023 period, it was found that the efficiency scores varied. The DEA method shows PT Asuransi Jiwa Tokio Marine Indonesia as the most efficient company with a score of 100%, while PT Asuransi Jiwa Syariah AL AMIN has the lowest score of 8.60%. Meanwhile, the SFA method shows an average efficiency above 60%, with PT Asuransi Sampo Indonesia having the highest score of 85.06% and PT Asuransi Reliance Indonesia the lowest score of 66.49%. In general, the SFA method produces higher efficiency scores compared to the DEA method because it considers the uncertainty factor or statistical error, while the DEA method considers all discrepancies as inefficiency.

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