"COVID-19 and market efficiency in ASEAN-5 countries: Stochastic Frontier Analysis"

| AUTHORS | Nur Rizqi Febriandika (iD)
Alifah Shohwatul Islam (iD)
Muhammad Sanusi (iD)
Nurul Latifatul Inayati (iD) |

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
37	1	4

Nur Rizqi Febriandika (Indonesia), **Alifah Shohwatul Islam** (Indonesia), **Muhammad Sanusi** (Indonesia), **Nurul Latifatul Inayati** (Indonesia)

COVID-19 AND MARKET EFFICIENCY IN ASEAN-5 COUNTRIES: STOCHASTIC FRONTIER ANALYSIS

Abstract

This research paper aims to explore the market efficiency of stock exchanges in of ASEAN-5 countries, Indonesia, Malaysia, Singapore, Thailand, and the Philippines, during the COVID-19 pandemic. Stock market efficiency is the degree to which stock prices reflect all available relevant information. In an efficient market, stock prices will immediately rise or fall to reflect new information released by a company. This study uses the Stochastic Frontier Analysis (SFA) method to determine the efficient value over time. Market efficiency generally refers to how well financial markets in these selected countries reflect all available information, particularly in the context of the COVID-19 pandemic. SFA is useful here as it can separate random errors from inefficiencies, allowing us to isolate the impact of COVID-19 on market efficiency levels across these countries. The results show that the stock markets of ASEAN-5 countries (Indonesia, Malaysia, Thailand, Singapore, and Philippines) are efficient during the COVID-19 pandemic. Based on the hypothesis test, for the overall period of 2021 and 2023, the average efficiency ranges from 0.68 to 0.72, and for the time period/per year the average efficiency ranges from 0.66 to 0.74. The efficiency of the Philippine stock market based on time period/per year shows the average maximum efficiency in 2021 (0.74) and 2023 (0.73). While the average efficiency of the Malaysian stock market shows the minimum level of efficiency in 2020 (0.66) and 2021 (0.68).

Keywords	market performance, efficiency, COVID-19, ASEAN, SFA, stock market
JEL Classification	G12, G14, G15, G11

INTRODUCTION

The impact of Coronavirus Disease (COVID-19) is not limited to a particular sector but has affected several sectors, namely tourism, manufacturing, transportation, social, food, and economic sectors. The level of impact also varies from country to country. Stock markets around the world have reacted significantly to the slowdown in economic activity. The policies of each country in responding to COVID-19 have differed, especially in the economic and financial sectors. The stock market reaction to COVID-19 as an event is used to examine its impact on stock market efficiency among the members of the Association of Southeast Asian Nations (ASEAN).

In 2022, the global economy was affected by multiple crises, which weighed on global flows of foreign investment. However, ASEAN and a few developing regions bucked the trend. Foreign investment in ASEAN reached the highest level ever recorded, albeit with growing concentration. Rapid economic and industrial growth and opportunities linked with regional integration were key factors. The main ASEAN stock exchange index was developed in 2021 and 2022. The market capitalization of the Thai stock exchange index grew by 4.61%

Nur Rizqi Febriandika, MSc, Lecturer, Researcher, Faculty of Islamic Studies, Department of Islamic Economic Law, Universitas Muhammadiyah Surakarta [Muhammadiyah Surakarta University], Indonesia. (Corresponding author)

Alifah Shohwatul Islam, Undergraduate, Research Assistant, Faculty of Islamic Studies, Department of Islamic Economic Law, Universitas Muhammadiyah Surakarta [Muhammadiyah Surakarta University], Indonesia.

Muhammad Sanusi, MSc, Lecturer, Researcher, Islamic Banking Department, STEI HAMZAR Lombok Timur, Indonesia.

Nurul Latifatul Inayati, MSc, Lecturer, Researcher, Faculty of Islamic Studies, Department of Islamic Economic Law, Universitas Muhammadiyah Surakarta [Muhammadiyah Surakarta University], Indonesia.

(19.45 and 20.35) and Indonesia grew by 15.06% (8,255.62 and 9,499.14) while the Malaysia stock exchange index (-0.95%), Singapore (-0.80%), and the Philippines (-2.96%) did not experience growth (IFSA, 2022).

Stock market volatility is influenced by several factors such as trading volume, momentum and institutional investors' activities, Initial Public Offering (IPO) issues and information certainty (Dasgupta & Chattopadhyay, 2020), electioneering activities and change in government (Yiadom et al., 2024), the loss-aversion bias and overconfidence (Bouteska & Regaieg, 2020), crude oil price (Agarwalla et al., 2021), exchange rates (Firmansyah & Oktavilia, 2017; Febriandika et al., 2023), and internal financial reports (Setiawan et al., 2021). Available information will quickly cause an increase in transaction volume or stock price fluctuations (Ryandono et al., 2021).

The formulation of the research problem is focused on studying the efficiency of the ASEAN countries' stock markets. In this case, econometric models and statistical tests are applied to obtain accurate and precise empirical results. The ASEAN countries' stock markets are the most important in the country. This index includes sharia and conventional stock indices traded (listed) on the Indonesia, Malaysia, Singapore, Thailand, and Philippines Stock Exchanges.

1. LITERATURE REVIEW

According to the concept of stock market efficiency, the current price of security available information was assumed to imply successive price changes. The forms of stock market efficiency are weak form, semi-strong form, and strong form (Malkiel & Fama, 1970). Stock market efficiency for investment managers is that they try to take advantage of every announcement anomaly (Syed & Bajwa, 2018). Long-term investments can provide investors with the opportunity to obtain optimal returns and short-term investment decisions are supported by psychological or emotional factors of investors, without knowing the market (Zahera & Bansal, 2018).

Market efficiency is a general concept that refers to the difference in output values and input-output values that are observed optimally (Tuyon & Ahmad, 2016). An efficient stock market does not provide investors with the opportunity to earn abnormal profits (Titan, 2015). Technical efficiency describes the ability of a company to achieve maximum production levels using certain input levels (Farrell, 1957).

Literature studies reveal a large number of publications examining the existence of the theory of efficient-market hypothesis in various countries with varying results in developing countries. In previous studies, the stock markets of Indonesia, Malaysia, Philippines, Thailand, and Vietnam were not efficient, while the stock markets in Cambodia, Lao,

and Singapore were weak-form efficient (Shaik & Maheswaran, 2017). In the individual stocks listed on the Bahrain Bourse, it is difficult to conclude the weak form of efficiency of the Bahrain Bourse (Hawaldar et al., 2017). This also happens in developing countries like Serbia and Indonesia, which confirms a weak form of efficient market hypothesis (Tokić et al., 2018; Agustin, 2019; Budiarso & Pontoh, 2022). In other cases, the nonlinear effect significantly impacts the degree of persistence of the Organisation for Economic Co-operation and Development (OECD) stock markets and stock markets of Belgium, Japan, and Hungary, which change from efficient to inefficient (Adekoya, 2021). Similar to that result, the Saudi stock market (SSM) can be considered inefficient (Al-Faryan & Dockery, 2021).

During the pandemic, the stock market sector was also influential, and many studies examined the relationship between COVID-19 and stock market issues. Deviations from market efficiency are seen more in the stock markets of the US and UK (Ozkan, 2021). Capital markets in the ASEAN-5 countries show varying levels of efficiency, with evidence suggesting that Singapore is the only market exhibiting weak-form efficiency (Pontoh & Budiarso, 2023). In other ASEAN stock markets, efficiency fluctuated, particularly during the transition from the pre-pandemic to the pandemic period (Kok & Geetha, 2023). Some markets showed increased efficiency, while others became less efficient as global financial conditions changed.

The COVID-19 pandemic significantly impacted financial markets, leading to a noticeable loss of efficiency, particularly in the US stock indices (Ammy-Driss & Garcin, 2023). However, stock markets in Asia and Australia were less affected by this disruption, with inefficiency being less pronounced compared to their Western counterparts. In some regions, such as Palestine, stock market behavior was found to be nonrandom, further highlighting inefficiency (Mukarker, 2023). The question of stock price fluctuations has long been at the forefront of financial research, as these fluctuations often inform short-term investment decisions (Yaya et al., 2024).

Stock price fluctuations have long been the focus of financial research and are often short-term investment decisions (Zahera & Bansal, 2018). Many studies have attempted to identify the factors that influence stock market behavior across different regions. For instance, in Indonesia, trading volume and market capitalization have been shown to negatively affect stock returns, especially in Islamic stock indices (Hariyanto, 2021). Furthermore, market conditions in Indonesia reveal that factors such as trading volume, book value, and debt-to-equity ratios are significantly correlated with stock prices in volatile environments (Tanheitafino et al., 2023). On a broader scale, the determinants of stock returns in Indonesia's major stock index, the LQ-45, show that trading volume tends to have a positive effect on returns, while market capitalization generally has a negative effect (Chandra & Suhendah, 2023). The stock market volatility experienced during the COVID-19 pandemic, coupled with increased trading activity, had a positive influence on stock returns, while the influence of market capitalization remained negative (Hamidah et al., 2023).

This research aims to measure the market efficiency of stock exchanges in Indonesia, Malaysia, Singapore, Thailand, and the Philippines during the COVID-19 pandemic. Based on previous data, whether information on global COVID-19 issues is sufficient to provide a signal to stock market efficiency, the proposed hypothesis is as follows:

H1: The stock markets of ASEAN-5 countries are efficient during the COVID-19 pandemic.

2. METHODS

This study uses a quantitative approach using the parametric Stochastic Frontiers Analysis (SFA) method. The study uses an analytical tool in the form of Frontier software. The input variables include Trading Volume (TV) and Market Capitalization (MC), and the output variable used is Stock Return (SR). This study uses secondary data in the form of panel data, namely a combination of data between time series data and cross-section data. This research uses a sample of 5 countries in ASEAN, namely Indonesia, Thailand, Malaysia, Philippines, and Singapore. Researchers used monthly stock index data in 5 ASEAN countries from March 2020 – July 2023, which has criteria in the form of stock markets in ASEAN countries that publish financial data reports on each country's website.

Stochastic Frontier Analysis (SFA) is used to determine efficient values over time. The normalized efficiency measure score is between 0 and 1. A score of 0.90 implies that a company is rated at 90 percent. Conversely, a company with a score of 0.70 is rated at 70 percent. Clearly, the market considers the former to be more efficient than the latter (Nguyen & Swanson, 2009). Market efficiency scores in stock market research are measured using a scale from 0 to 1, where 0 indicates inefficiency and 1 represents maximum efficiency. This scoring system can be derived through Stochastic Frontier Analysis (SFA), which compares actual market performance to an ideal efficiency "frontier." Scores close to 1 imply that the market (or firm) operates near optimal efficiency, while lower scores indicate inefficiencies, often influenced by factors like market structure and investor behavior. Berger and Humphrey (1997) surveyed 110 observations using Parametric techniques (SFA, DFA, TFA) and noted that the average predicted efficiency ranged between 61% - 95%, mean of 84%, and median of 85%.

The efficiency value is obtained through the SFA method using U (controllable strander error). To manage data with SFA, you can use Frontier 4.1 software. The standard SFA function with production has a general form, namely:

$$Ln(Q_1) = \beta_0 + \beta_1 ln(P_1) + \beta_2 ln(P_2) + E_n, \quad (1)$$

Therefore, P_1 and P_2 are the input values in this study, namely market capitalization and trading volume. Meanwhile, Q_i is the output in this study, namely stock returns on the stock market. The error term (E_n) consists of two components shown in the following equation:

$$E_n = V_i - U_i, \qquad (2)$$

U_i = controllable random factor (inefficiency), V_i = random factor that cannot be controlled (random noise).

3. RESULTS

The level of inefficiency can increase by modeling inefficiency effects with positive coefficient values, or vice versa. Table 1 shows that the parameter estimate with an inefficiency effect is 0.2026, the market capitalization variable is 0.2811, which is not significant, and the trading volume is 0.5364, which is not significant. Then the sigma-squared is 0.2170, which is different from the number zero, showing good accuracy and suitability. Thus, inefficiency is responsible for 42% of the variation in individual stock returns. When the *Eta coefficient* shows zero, the influence of technical inefficiency tends to be stable over time. Based on the test results using the stochastic frontier analysis approach, the following results were obtained in Table 1.

The efficiency measurements will be carried out using a technical SFA parametric method. This method will produce efficiency values on a scale of zero to one. This study will divide three analyses, namely overall technical efficiency analysis, analysis based on time period, and analysis based on the ASEAN country's stock market. The technical efficient value analysis will be discussed as a whole

(see Figure 1).

The results of calculating the technical efficiency value show that ASEAN countries are approaching efficiency even though they have not yet achieved a perfect efficiency score of one. This shows that no country achieved a perfect efficiency score of one, only almost achieving a score of one. When the stock market in an ASEAN country is doing well, this shows that stock prices reflect all relevant information. The stock market is more efficient if the information is reflected in stock prices more quickly (Rahmayanti et al., 2023). In this context, efficiency definitely means doing all the work that is useful and leaving behind work that is useless and a waste of time.

Overall, the technical efficiency value of the stock market tends to fluctuate towards a negative trend. This is because a country experiences several imbalances in a relatively short time. Since these imbalances are always changing, they are difficult to predict and represent the potential for volatility. Due to market uncertainty, investors find it difficult to predict future profits. If all investors knew all the information and analysis about wrong stock prices, there would be competition between investors, and the market would be more efficient.

Table 2. Descriptive statistics of technical efficiency values

Information	Average Technical Efficiency Value	Country
Maximum	0.9373	Indonesia
Minimum	0.3512	Thailand
Total Average	0.7052	

When viewed as a whole, based on Table 2, the average efficiency scores showed that the value of the five stock exchanges in ASEAN countries is 0.7052 (average efficiency). This shows that stock

Table 1. Maximum likelihood estimation results for SFA models

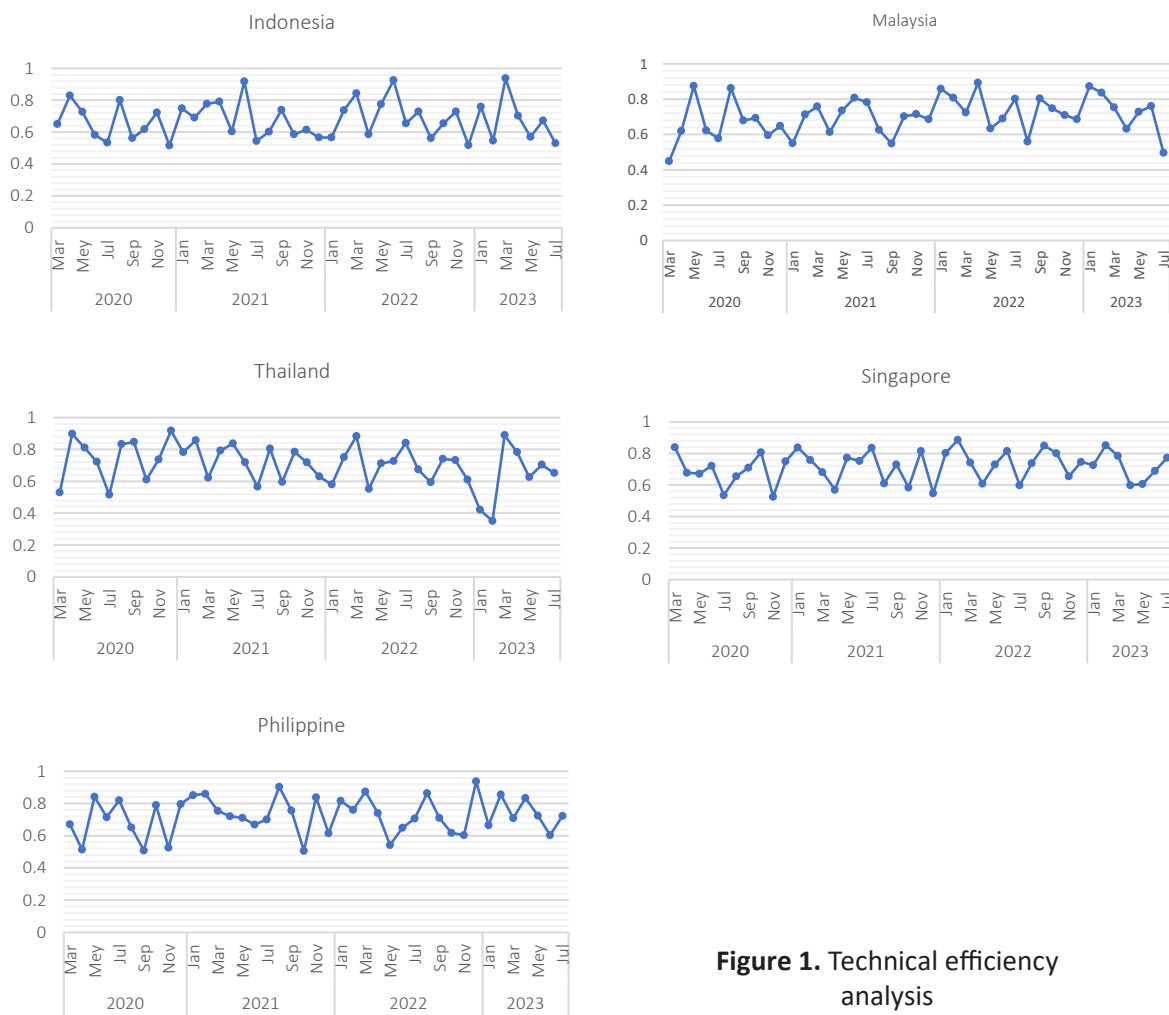| Variable	Parameter	Coefficient	Standard-Error	Risk Value
Constant	β_0	0.5616	0.2026	0.2771
Market Capitalization	β_1	0.2811	0.4764	0.5900
Trading volume	β_2	0.5364	0.4525	0.1185
Sigma-squared	σ^2	0.2170	0.6390	0.3395
Gamma	G	0.7972	0.1364	0.5843
Mu	M	0	0	0
Eta	Y	0	0	0

Figure 1. Technical efficiency analysis

exchanges in countries that provide technical efficiency estimates have produced 70% of potential output. Then, the highest technical efficiency value is in Islamic Stock in Indonesia, namely 0.9373, this value is almost close to the perfect technical efficiency value, namely with a score of one. Meanwhile, the lowest technical efficiency value is in Thailand, 0.3512.

The section explaining the technical efficient value based on the time period can be seen in Table 3.

Table 3 shows that the average technical efficiency in 2020 is 0.6903, and the stock markets of Indonesia, Malaysia, and the Philippines are < 0.6903. The Thai stock market has the highest efficiency level (0.7421), and the Malaysian stock market has the lowest efficiency level (0.6615). In 2021, the average efficiency level will be 0.7101, and the Indonesian, Malaysian, and Singapore stock markets < 0.7101. The Philippine stock market

has the highest efficiency level (0.7404), and the Malaysian stock market has the lowest efficiency level (0.6862).

In 2022, the average stock market efficiency level will be 0.7240, and the Indonesian and Malaysian stock markets < 0.7240. The Singapore stock market has the highest efficiency level (0.7486), and the Indonesian stock market has the lowest efficiency level (0.6896). In 2023, the average stock market efficiency level will be 0.6915, and the Thai and Malaysian stock markets < 0.6915. The Philippine stock market has the highest efficiency level (0.7307), and the Thai stock market has the lowest efficiency level (0.6321). Based on the overall time period per year, the efficiency of the Philippine stock market is more dominant (see the 2021 and 2023 periods), the efficiency of the Indonesian stock market is the highest (see Table 3), and the efficiency of the Malaysian stock market is the lowest (see the 2020 and 2021 periods) and (see Table 3).

Table 3. Average technical efficiency by time period

Country	2020	2021	2022	2023
Indonesia	0.6738	0.6898	0.6896	0.7019
Malaysia	0.6615	0.6862	0.7477	0.6736
Thailand	0.7421	0.7254	0.6993	0.6321
Singapore	0.6907	0.7078	0.7486	0.7191
Philippine	0.6835	0.7404	0.7348	0.7307
Maximum and minimum information for each country				
Maximum	0.7421 (Thailand)	0.7404 (Philippine)	0.7486 (Singapore)	07 (Philippine)
Minimum	0.6615 (Malaysia)	0.6862 (Malaysia)	0.6896 (Indonesia)	0.6321 (Thailand)
Average	0,6903	0,7101	0,7240	0,6915

This section will explain the value of a country's technical efficiency on the Islamic stock exchange. This value is calculated from the average value, highest value, and lowest value of the six countries studied. It can be seen in Table 4:

Based on Table 4, there is one country whose performance is below the average technical efficiency value, namely Malaysia which has a technical efficiency value of 0.6888 (68.88). However, the efficiency value is not too far from the overall technical efficiency value, therefore Malaysia has a chance of 0.04087 (4.087%) to maximize efficient profit returns. Next, Thailand has a technical efficiency value of 0.6997 (69.97%), then Indonesia has a technical efficiency value of 0.6923 (69.23%). Therefore, for countries that have average technical efficiency performance, namely the Philippines has a technical efficiency value of 0.7224 (72.24%), so the opportunity for the Philippines is 0.05688 (5.688%). Then Singapore whose technical efficiency score is 0.7168 (71.68%). So, when the efficiency value is low or decreases during the research period from March 2020 to July 2023, the factors surrounding the stock market in ASEAN countries must be combined. The stock market in ASEAN countries has good efficiency conditions, so this is due to the existence of regulations that support investors.

According to the findings of Berger and Humphrey (1997) from observations using Parametric techniques (SFA) with an average efficiency ranging from 61% - 95%. So, the stock markets of 5 ASEAN countries: Indonesia, Malaysia, Thailand, Philippines, and Singapore are efficient. The average efficiency of the stock markets of 5 ASEAN countries table 3 by time period (0.66 - 0.74) and Table 4. overall period (0.68 - 0.72). Based on the hypothesis formulated, it states that the stock markets of ASEAN-5 countries are efficient during the COVID-19 pandemic. So, the research hypothesis is accepted. This means that the stock markets of ASEAN countries are efficient during the COVID-19 pandemic.

4. DISCUSSIONS

Based on the results of the Stochastic Frontiers Analysis (SFA) method test, the efficiency scores for ASEAN markets overall fell within a moderate range, suggesting that these markets respond effectively to new information but may still have inefficiencies. The annual analysis reveals that ASEAN stock markets, like Singapore's, maintained stability and efficiency, particularly in response to COVID-19, yet some markets fluctuated, showing varying resilience and adaptability (Kok & Geetha, 2023). In general, efficient markets quickly integrate information, so prices reflect actual value. This implies that, for the ASEAN countries in the study, moderate efficiency means that

Table 4. Technical efficiency and inefficiency

Country	Average Technical Efficiency	Average Technical inefficiency
Indonesia	0,6923	0.04311
Malaysia	0,6888	0.04087
Thailand	0,6997	0.04821
Singapore	0,7168	0.05113
Philippine	0,7224	0.05688

while these markets incorporate available information, they might still exhibit some inefficiencies due to structural, informational, or regulatory differences (Pontoh & Budiarso, 2023).

The findings indicate contrasting effects of trading volume and market capitalization on stock returns. While some studies observed a negative impact of these variables on stock returns in Indonesia (Hariyanto, 2021; Hamidah et al., 2023), others found a positive correlation with trading volume (Tanheitafino et al., 2023) and a negative one with the market capitalization (Chandra & Suhendah, 2023). Trading volume, a key market indicator, attracts attention and may drive prices, with volume profiles providing insights into equilibrium and demand-supply dynamics (Li, 2024; Chutka & Rebetak, 2021). Regarding ASEAN market efficiency, the Indonesian stock market (Jakarta Islamic Index) recorded a market efficiency approaching a score of 1 (0.9373) indicating an increasingly efficient stock market, while the Thai stock market had a lower score of (0.3512) indicating a less efficient stock market. The average stock market index of each country showed a moderate level of efficiency ranging from 0.6757 to 0.7233. This means that the stock markets of ASEAN-5 countries have efficient stock markets.

The normalized efficiency measure score is between 0 and 1. A score of 0.90 implies that a company is rated at 90 percent. Conversely, a company with a score of 0.70 is rated at 70 percent. Clearly, the market considers the former to be more efficient than the latter (Nguyen & Swanson, 2009). Berger and Humphrey (1997) surveyed 110 observations using Parametric techniques (SFA, DFA, TFA) and noted that the average predicted efficiency ranged between 61%-95%, mean of 84%, and median of 85%. Market efficiency scores in stock market research are measured using a scale from 0 to 1, where 0 indicates inefficiency and 1 represents maximum efficiency. This scoring system can be derived through Stochastic Frontier Analysis (SFA), which compares actual market performance to an ideal efficiency "frontier." Scores close to 1 imply that the market (or firm) operates near optimal efficiency, while lower scores indicate inefficiencies, often influenced by factors like market structure and investor behavior.

Based on the analysis and observation results of Berger and Humphrey (1997), the mean for the parametric technique (SFA) is 0.84 (84%). This means that Indonesia shows a stock market that has very high efficiency based on the analysis of the entire time period from 2020–2023 with a stock market efficiency level of 0.93 (> 84%) and an average stock market efficiency of 0.70. The inefficient stock market is Thailand (0.35 < 084).

The time period was used to see the stock market efficiency of 5 ASEAN countries (Indonesia, Malaysia, Thailand, Singapore, Philippines) with parametric techniques (SFA) with an average predicted efficiency ranging between 61%-95% (Berger & Humphrey, 1997). All stock markets in 5 ASEAN countries (Indonesia, Malaysia, Thailand, Singapore, Philippines) show efficient stock markets because they are above the average efficiency of 61%.

The time period based on 2020, 2021, 2022, and 2023 shows the same results as all stock markets in 5 ASEAN countries (Indonesia, Malaysia, Thailand, Singapore, Philippines), demonstrating the efficiency of stock markets. However, in that period, there are differences in the level of stock market efficiency of each country. The Philippine stock market showed the maximum level of efficiency in 2021 and 2023. The Malaysian stock market showed the minimum level of efficiency in 2 consecutive years, namely 2020 and 2021.

CONCLUSION

This research aims to measure the market efficiency of stock exchanges in ASEAN-5 countries, Indonesia, Malaysia, Singapore, Thailand, and the Philippines, during the COVID-19 pandemic. This research uses parametric techniques (stochastic frontier approach) to identify deviations from the best performance frontier. Based on the hypothesis formulated, it states that the stock markets of ASEAN-5 countries are efficient during the COVID-19 pandemic. So, the research hypothesis is accepted. This means that the stock markets of ASEAN countries are efficient during the COVID-19 pandemic.

The results of the Stochastic Frontiers Analysis (SFA) method test show that the average stock market efficiency of ASEAN-5 countries (Indonesia, Malaysia, Thailand, Philippines, and Singapore) for the overall period 2021 and 2023 (0.68 - 0.72) and the time period/per year (0.66 - 0.74) is efficient. There are differences in the level of stock market efficiency in each country from the lowest to the highest. Overall, the average period of stock market efficiency in Malaysia (0.68), Indonesia (0.69), Thailand (0.69), Singapore (0.71) and the Philippines (0.72). Based on the time period/per year, the efficiency of the Malaysian stock market shows the minimum average level of efficiency in two consecutive years, namely 2020 (0.66) and 2021 (0.68). Meanwhile, in 2022 (0.68) the average minimum stock market efficiency is Indonesia and in 2023 (0.65) the average minimum stock market efficiency is Thailand. The maximum average efficiency level in 2021 (0.74) and 2023 (0.73) is in the Philippine stock market. Meanwhile, the maximum average efficiency in 2020 is 0.74 (Thailand) and in 2022 is 0.74 (Singapore).

AUTHOR CONTRIBUTIONS

ACKNOWLEDGMENT

REFERENCES

1. Adekoya, O. B. (2021). Persistence and efficiency of OECD stock markets: linear and nonlinear fractional integration approaches. *Empirical Economics, 61*(3), 1415-1433. https://doi.org/10.1007/s00181-020-01913-4

2. Agarwalla, M., Sahu, T. N., & Jana, S. S. (2021). Dynamics of oil price shocks and emerging stock market volatility: a generalized VAR approach. *Vilakshan – XIMB Journal of Management, 18*(2), 106-121. https://doi.org/10.1108/xjm-07-2020-0018

3. Agustin, I. N. (2019). Testing Weak Form of Stock Market Efficiency at The Indonesia Sharia Stock Index. *Muqtasid: Jurnal Ekonomi Dan Perbankan Syariah, 10*(1), 17. https://doi.org/10.18326/muqtasid.v10i1.17-29

4. Al-Faryan, M. A. S., & Dockery, E. (2021). Testing for efficiency in the Saudi stock market: does corporate governance change matter? Review of Quantitative Finance and Accounting, 57*(1), 61-90. https://doi.org/10.1007/s11156-020-00939-0

5. Ammy-Driss, A., & Garcin, M. (2023). Efficiency of the financial markets during the COVID-19 crisis: Time-varying parameters of fractional stable dynamics. *Physica A: Statistical Mechanics and Its Applications, 609*. https://doi.org/10.1016/j.physa.2022.128335

6. Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research, 98*, 175-212. https://doi.org/10.1016/S0377-2217(96)00342-6

7. Bouteska, A., & Regaieg, B. (2020). Loss aversion, overconfidence of investors and their impact on market performance evidence from the US stock markets. *Journal of Economics, Finance and Administrative Science, 25*(50), 451-478. https://doi.org/10.1108/JEFAS-07-2017-0081

8. Budiarso, N. S., & Pontoh, W. (2022). Market efficiency and global issues: A case of Indonesia. *Investment Management and Financial Innovations, 19*(4), 1-13. https://doi.org/10.21511/imfi.19(4).2022.01

9. Chandra, N. A., & Suhendah, R. (2023). The Impact of Covid-19, Trading Volume Activity and Market Capitalization on Stock Return of LQ-45 Companies. *International Journal of Application on Economics and Business, 1*(3), 921-933. https://doi.org/10.24912/ijaeb.v1i3.921-933

10. Chutka, J., & Rebetak, F. (2021). Analysis of trading volume and its use in prediction future price movements in the process of maximizing trading earnings. *SHS Web of Conferences, 92,* 1-7. https://doi.org/10.1051/shsconf/20219202010

11. Dasgupta, R., & Chattopadhyay, S. (2020). Stock market drivers of retail investors' sentiment – facets and new evidences from India. *Rajagiri Management Journal, 14*(2), 133-154. https://doi.org/10.1108/ramj-05-2020-0015

12. Farrell, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society. Series A (General), 120*(3). https://doi.org/10.2307/2343100

13. Febriandika, N. R., Hakimi, F., Awalliyah, M., & Yayuli. (2023). Contagion and spillover effects of global financial markets on the Indonesian Sharia Stock Index post-COVID-19. *Investment Management and Financial Innovations, 20*(3), 35-47. https://doi.org/10.21511/imfi.20(3).2023.04

14. Firmansyah, & Oktavilia, S. (2017). The Stock Market and Exchange Rates in Five South Asian Countries. *Jurnal Ekonomi Pembangunan, 18*(1), 102-117. http://journals.ums.ac.id

15. Hamidah, S., Pahlevi, C., & Aswan, A. (2023). The effect of trading volume, trading frequency, and order imbalance on the stock price volatility of LQ45 company in 2017–2019. *Hasanuddin Journal of Applied Business and Entrepreneurship (HJABE), 5*(2), 1-11. Retrieved from https://journal.unhas.ac.id/index.php/hjabe/article/view/21644

16. Hariyanto, D. (2021). Effect of Trading Volume, Market Capitalization, Firm Size in Explaining Return on Vultures. *Journal of Advanced Research in Economics and Administrative Sciences, 2*(2), 50-64. https://doi.org/10.47631/jareas.v2i2.228

17. Hawaldar, I. T., Rohit, B., & Pinto, P. (2017). Testing of weak form of efficient market hypothesis: Evidence from the Bahrain bourse. *Investment Management and Financial Innovations, 14*(2), 376-385. https://doi.org/10.21511/imfi.14(2-2).2017.09

18. Indonesia Financial Services Authority. (2022). *Capital Market Fact Book.*

19. Kok, S. C., & Geetha, C. (2023). A Comparison of The Weak-Form Efficiency of The ASEAN Stock Markets Before and During the Covid-19 Pandemic. *Malaysian Journal of Business and Economics, 10*(1), 1-7. https://doi.org/10.51200/mjbe.v10i1.4504

20. Li, M. (2024). The Impact of Trading Volume on Stock Price Volatility. *Highlights in Business, Economics and Management, 32,* 117-121. http://dx.doi.org/10.54097/wasnyj47

21. Malkiel, B. G., & Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance, 25*(2), 383-417. https://doi.org/10.1111/j.1540-6261.1970.tb00518.x

22. Mukarker, E. (2023). Assessing market efficiency in Palestine Securities Exchange (PSE) market at weak form: Analysis from 2010–2022. *Investment Management and Financial Innovations, 20*(3), 285-298. https://doi.org/10.21511/imfi.20(3).2023.24

23. Nguyen, G. X., & Swanson, P. E. (2009). Firm characteristics, relative efficiency, and equity return. *Journal of Financial and Quantitative Analysis, 44*(1), 213-236. https://doi.org/10.1017/S0022109009090012

24. Ozkan, O. (2021). Impact of COVID-19 on stock market efficiency: Evidence from developed countries. *Research in International Business and Finance, 58.* https://doi.org/10.1016/j.ribaf.2021.101445

25. Pontoh, W., & Budiarso, N. S. (2023). Efficient market and the COVID-19 pandemic: Case of ASEAN-5. *The Contrarian: Finance, Accounting, and Business Research, 1*(1), 23-29. https://doi.org/10.58784/cfabr.7

26. Rahmayanti, D., Santi, F., Altin, D., Ridwan, M. Q., & Nazdrol, W. M. (2023). Herding B Behavior in The Asean Stock Market During the Covid-19 Pandemic. *Riset Akuntansi Dan Keuangan Indonesia, 8*(3), 228-247. Retrieved from http://journals.ums.ac.id/index.php/reaksi/index

27. Ryandono, M. N. H., Muafi, M., & Guritno, A. (2021). Sharia Stock Reaction Against COVID-19 Pandemic: Evidence from Indonesian Capital Markets. *Journal of Asian Finance, Economics and Business, 8*(2), 697-710. https://doi.org/10.13106/jafeb.2021.vol8.no2.0697

28. Setiawan, D., Asrihapsari, A., Maisaroh, S., & Widawati, M. W. (2021). Determinants of environmental performance: Evidence from the agriculture industry in Indonesian Stock Exchange. *IOP Conference Series: Earth and Environmental Science, 905*(1). https://doi.org/10.1088/1755-1315/905/1/012006

29. Shaik, M., & Maheswaran, S. (2017). Market Efficiency of ASEAN Stock Markets. *Asian Economic and Financial Review, 7*(2), 109-122. https://doi.org/10.18488/journal.aefr/2017.7.2/102.2.109.122

30. Syed, A. M., & Bajwa, I. A. (2018). Earnings announcements, stock price reaction and market ef-

ficiency – the case of Saudi Arabia. *International Journal of Islamic and Middle Eastern Finance and Management, 11*(3), 416-431. https://doi.org/10.1108/IME-FM-02-2017-0044

31. Tanheitafino, C., Helma Malini, Wendy, Giriati, & Ramadania. (2023). The Effect of Market Capitalization, Trading Volume, Book Value, and Capital Structure on Share Prices. *International Journal of Scientific Research and Management, 11*(01), 4418-4428. https://doi.org/10.18535/ijsrm/v11i01.em02

32. Țițan, A. G. (2015). The Efficient Market Hypothesis: Review of Specialized Literature and Empirical Research. *Procedia Economics and Finance, 32*(15), 442-449.

https://doi.org/10.1016/s2212-5671(15)01416-1

33. Tokić, S., Bolfek, B., & Radman Peša, A. (2018). Testing efficient market hypothesis in developing eastern European countries. *Investment Management and Financial Innovations, 15*(2), 281-291. https://doi.org/10.21511/imfi.15(2).2018.25

34. Tuyon, J., & Ahmad, Z. (2016). Behavioural finance perspectives on Malaysian stock market efficiency. *Borsa Istanbul Review, 16*(1), 43-61. https://doi.org/10.1016/j.bir.2016.01.001

35. Yaya, O. O. S., Adekoya, O. B., Vo, X. V., & Al-Faryan, M. A. S. (2024). Stock Market Efficiency in Asia: Evidence from the Narayan–Liu–Westerlund's GARCH-based unit

root test. *International Journal of Finance and Economics, 29*(1), 91-101. https://doi.org/10.1002/ijfe.2676

36. Yiadom, E. B., Tay, V., Sefe, C. E. K., Gbade, V. A., & Osei-Manu, O. (2024). Political change, elections, and stock market indicators: a generalized method of moment analysis. *Journal of Humanities and Applied Social Sciences, 6*(1), 20-37. https://doi.org/10.1108/jhass-09-2023-0111

37. Zahera, S. A., & Bansal, R. (2018). Do investors exhibit behavioral biases in investment decision making? A systematic review. *Qualitative Research in Financial Markets, 10*(2), 210-251. https://doi.org/10.1108/QRFM-04-2017-0028