

Comparative Analysis of Efficient Market for Sharia and Conventional Stocks in ASEAN countries

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Abstract. *This study analyzes and compares the weak forms of Islamic and conventional stock market efficiency in ASEAN countries. The data were taken from BEI Syariah (JKISSI), Jakarta Stock Exchange (JKSE), FTSE Bursa Malaysia EMAS Syariah (FTFBMS), FTSE Malaysia KLCI (KLSE), SET Index (SETI), and FTSE SET Syariah (FTFSTSH) from January 2015 to August 2021. To avoid analytical bias due to the COVID-19 Pandemic, the data is divided into two periods, January 2015 to December 2019 and January 2020 to August 2021. The contribution of this research is to compare the market efficiency of the weak form of Islamic and conventional stocks over two periods with different methods, namely Variance Ratio Test, Run Test, ARIMA Model, and Recurrent Neural Network (RNN). This study shows that Islamic stocks in these countries are more efficient from January 2015 to December 2019. On the other hand, conventional stocks are more efficient from January 2020 to August 2021 (during the COVID-19 Pandemic).*

Keywords: *Sharia and Conventional Stocks, Efficient Market, ASEAN countries*

Abstrak. *Penelitian ini menganalisa dan membandingkan bentuk lemah dari efisiensi pasar saham syariah dan konvensional di negara-negara ASEAN. Data berasal dari BEI Syariah (JKISSI), Bursa Efek Jakarta (JKSE), FTSE Bursa Malaysia EMAS Syariah (FTFBMS), FTSE Malaysia KLCI (KLSE), SET Index (SETI), dan FTSE SET Syariah (FTFSTSH) dari Januari 2015 hingga Agustus 2021. Untuk menghindari bias analisa akibat pandemi COVID-19, data dibagi menjadi dua periode, Januari 2015 hingga Desember 2019 dan Januari 2020 hingga Agustus 2021. Penelitian ini membandingkan bentuk lemah dari efisiensi pasar saham syariah dan konvensional selama dua periode waktu dengan metode berbeda, yaitu Variance Ratio Test, Run Test, Model ARIMA, dan Recurrent Neural Network (RNN). Studi menunjukkan bahwa Saham Syariah di negara-negara tersebut lebih efisien pada periode Januari 2015 hingga Desember 2019. Di sisi lain, saham konvensional lebih efisien pada periode Januari 2020 hingga Agustus 2021 (selama pandemi COVID-19).*

Kata kunci: *Saham Syariah dan Konvensional, Pasar Efisien, Negara ASEAN*

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Introduction

The efficient market hypothesis (EMH), first introduced by Fama (1970), is one of the important hypotheses in the financial sector. This hypothesis argues that if a market is efficient, then all information about the market is fully reflected in stock prices at any point in time, and the prices adjust rapidly to all new information. A consequence of the theory is that an investor can't take advantage only of the available information. There is no room to make abnormal profits by investing in some stocks since everything is fairly priced; hence nobody can constantly beat the market.

Regardless of the controversies, EMH can be used as a benchmark to measure the efficiency of capital markets. Based on what information is reflected in prices, there are three levels of an efficient market: weak form, semi-strong form, and strong form efficient market (Fama, 1970). Weak form efficiency states that current and future stock prices cannot be predicted by only using the past data of stock prices. Semi-strong form efficiency suggests that the current prices reflect all publicly available information, while strong form efficiency claims that stock prices reflect all public and private information. With this hypothesis, investors can have a reference for making decisions in investing (Dupernex, 2007). Therefore, testing of market efficiency is still considered relevant to be carried out.

There are underlying assumptions about EMH. First, investors are rational beings who behave rationally. Therefore every investment decision taken is completely based on consideration of the risks and returns of each invested fund. The second is that information about market conditions is open to everyone, and there is no cost to obtain such information. The assumption about this information disclosure is very important, as Ackert et al. (2003) argued that investors' decisions are strongly influenced by the information circulating and the information received by investors. In the era of digital information as it is today, this assumption is getting closer to the real situation because information circulates quickly through various digital media and can be obtained at almost no cost. Testing the efficient market hypothesis is not only important for conventional capital markets but also sharia capital markets. This is mainly because the sharia capital market has experienced significant growth in recent years (Paltrinieri et al., 2018; Saleem & Ashfaq, 2020). In line with this growth, several conventional financial services companies such as Citibank, Barclays, Morgan Stanley, Merrill Lynch, and HSBC have begun to introduce sharia financial products (Al-Khazali & Mirzaei, 2017). Sharia stocks are also starting to get

attention from many groups, including non-Muslim investors, especially because they can reduce systematic risk (Jawadi et al., 2019). In addition, issues related to ethics, morals, and other social issues, considered an icon of sharia stocks, are considered attractive to several investors as alternative investments (Anas & Mounira, 2009).

Many studies have been conducted to examine the efficiency of capital markets and analyze various phenomena related to anomalies that occur in both conventional and sharia capital markets. However, some of these studies show different results, and thus they seem inconsistent. In the opinion of Senthilnathan (2014), who conducted a literature review on market efficiency in Asia and Pacific countries, it is argued that some studies on capital market efficiency in these countries seem contradictory. The results may also be due to differences in the period and research methods (Semuel & Basana, 2017). This opinion is in line with Mensi et al. (2017), who in their study said that the efficiency of the capital market could vary from time to time. The period used in the study may lead to different results in tests of market efficiency. Therefore, it is essential in the research on market efficiency to pay attention to the period used in the study.

This study aims to examine and compare the weak-form efficiency of conventional and sharia capital markets in Southeast Asia. There are three countries that have sharia and conventional capitals, namely Indonesia, Malaysia, and Thailand. It is interesting to know how far the efficiency of the sharia capital markets is compared to conventional ones. The data used are six stock indices, IDX Shariah (JKISSI), Jakarta Stock Exchange Composite (JKSE), FTSE Bursa Malaysia EMAS Shariah (FTFBMS), FTSE Malaysia KLCI (KLSE), SET Index (SETI), and FTSE SET Shariah (FTFSTSH) from the period of January 2015 to August 2021. To avoid bias in the analysis of market efficiency due to sharp fluctuations during the COVID-19 pandemic, the data is divided into two parts, namely the period January 2015 to December 2019 and the period January 2020 to August 2021. The methods used are run a test, variance ratio test, ARIMA, and Recurrent Neural Network (RNN).

To the best of the author's knowledge, no studies specifically compare the efficiency of the sharia and conventional capital markets in ASEAN. This research is not only academically essential to find out how far the sharia capital market is compared to conventional but can provide input for investors in making investment decisions.

The Previous Studies

Several studies have been conducted to test the efficiency of conventional markets in ASEAN countries. One study by Shaik & Maheswaran (2017) tested eight ASEAN capital market indices over several periods, as presented in Table 1. The methods used to test the efficiency of the eight indices are ADF unit root test, variance ratio test from Lo & Mac Kinlay, Choi, spectral & shape, average exponential, rank & signed based, and power transformed.

Table 1. The List of Indices in the Study of Shaik & Maheswaran (2017)

No	Country	Index	Period
1	The Philippines	PCOMP	1990 – 2016
2	Indonesia	JCI	1990 – 2016
3	Cambodia	CSX	2012 – 2016
4	Laos	LSCX	2011 – 2016
5	Malaysia	FBMKLCI	1994 – 2016
6	Singapore	STI	1999 – 2016
7	Thailand	SET50	1995 – 2016
8	Vietnam	VNIN	2000 – 2016

The results of their study consistently show the efficiency in capital markets in Cambodia, Laos, and Singapore with the Lo & Mac Kinlay, Choi, Spectral & Shape, Average Exponential, and Power transformed test methods. In addition, the capital market in Malaysia has only been proven efficient with the Power transformed test method. The other four ASEAN countries, namely the Philippines, Indonesia, Thailand, and Vietnam, are not classified as efficient markets.

Another study was conducted by Senthilnathan (2014), which tested the efficiency of conventional capital markets in Asia and the Pacific, including four ASEAN countries: Malaysia, Singapore, Thailand, and Vietnam. The results of the study show that of the four capital markets in the ASEAN countries tested, only the capital market in Singapore is included in the efficient market category, while the capital markets in the other three countries are not in line with the efficient market hypothesis. This study is in line with that of Shaik & Maheswaran (2017), which proves that the capital markets in Indonesia, Malaysia, Thailand, and Vietnam are inefficient. They tested the capital markets in eight ASEAN countries, namely

Indonesia, Cambodia, Laos, Malaysia, the Philippines, Singapore, Thailand, and Vietnam, using the particular variance ratio test method from Lo & Mac Kinlay, Choi test, Wright test, and Chen & Deo test. The study results show that only the capital markets in Cambodia, Laos, and Singapore can be said to be efficient markets.

The results of this study are also in line with the survey conducted by Nghia & Blokhina (2020), which tested the capital market in Vietnam from 2015 to 2017 using the unit root test and Kolmogorov Smirnov methods. Tests on the capital market, where most of the issuers are state-owned enterprises, show a discrepancy with the random walk pattern. Thus, it can be categorized as an inefficient market.

Camba & Camba (2020), which conducted tests on the Philippines' capital market, said that its capital market was inefficient. A study conducted using the unit root method and the variance ratio test in the 2015 to 2019 time period shows that the capital market in the Philippines is not in line with the random walk pattern.

Singh & Kumar (2018) analyzed the efficiency of the Malaysian capital market (Composite Index) using a run test from 1998 to 2014. The results show that the Malaysian capital market did not follow the random walk pattern in that period. This result is not different from the study conducted by Soon & Abdul-Rahim (2016). They use ChartNexus, a software for technical analysis that can provide recommendations to investors and traders in choosing stocks that are considered profitable. Of the 547 recommendations, 64% of stocks gave positive returns, and the rest were harmful. The positive recommendations were tested statistically and showed significant results. As a result, the Malaysian capital market can be categorized as inefficient because stock prices can be predicted significantly.

Rahima et al., who tested the LQ45 Index on the capital market in Indonesia, found evidence that the index in the period 2011 to 2016 was inefficient. In this analysis, they used the run test method (the Phillips Perron test), the ADF unit root test, and the autocorrelation function test.

Kartika et al., examined the capital markets in several ASEAN countries, namely Indonesia, the Philippines, Malaysia, Singapore, and Vietnam, in the period 2012 to 2016. This study, which was conducted using the run test and Kolmogorov Smirnov methods, shows that the capital market in the Philippines has the highest efficiency level, followed by Indonesia.

Yaya & OlaOluwa et al., (2021) conducted a study of 19 countries in Asia, including six ASEAN countries, namely Indonesia, the Philippines, Malaysia,

Singapore, Thailand, and Vietnam, in the period 28 July 2000 to 18 May 2020. The study was conducted using the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) based unit root test, which was recently introduced by Narayan et al. This shows that the index of the six ASEAN countries is not in line with the efficient market hypothesis.

Phanrattinon et al. (2020), who tested the Asia Pacific capital market including six ASEAN countries, namely Indonesia, the Philippines, Malaysia, Singapore, Thailand, and Vietnam during the period 2008 to 2018, obtained different results from the other studies. The study's results using the unit root test method show that the six ASEAN capital markets are inefficient. However, conflicting results were obtained from testing using the Durbin Watson test, where all indices followed a random walk pattern. On the other hand, the run and variance ratio test results prove that only Indonesia and Thailand are efficient.

Furthermore, studies conducted to analyze the efficiency of the weak form of the sharia capital markets in ASEAN were conducted by Agustin (2019), who analyzed the Indonesian Sharia Stock Index (ISSI) for the period 2017 to 2019 using the run test, autocorrelation test, and the ARIMA model. The study results show that the ARIMA model used can predict stock prices with an accuracy rate of 78% and is significantly based on the paired sample t-test, so it can be concluded that the ISSI index is inefficient. However, different results were obtained in research conducted by Andrianto & Mirza, which analyzed the Jakarta Islamic Index, LQ45 Index, and Kompas 100 Index between 2013 and 2014. According to the study, the three indices follow a random walk pattern. Therefore, it can be said as an efficient market.

Methods

The Market Efficiency Testing Method

In this study, the methods used to test the market efficiency of the weak form of sharia and conventional stock indices in ASEAN are run test, variance ratio test, ARIMA model, and Recurrent Neural Network. Run and variance ratio tests are used to test whether the index follows a random walk pattern, while the ARIMA model and Recurrent Neural Network are used to predict the price for each index.

1. The Run Test

The run test is used to test whether the return index is independent in a time range or not. Run can be defined as a sequence of returns with the same sign,

namely the positive (+) run, which is obtained when the index experienced a price increase compared to the previous day, and the negative (-) run that is obtained when the index decreased compared to the previous day, and zero (0) that is executed if there is no index change. Suppose the index return change is positively correlated. In that case, there will be a slight change in sign, and conversely, if the index is negatively correlated, there will be a lot of significant change between (+), (-), and (0). If the order of returns is random, the observed number of runs will be close to the expected number.

The equation used to calculate the expected number of runs is as follows:

$$m = \frac{N(N+1) - \sum_{i=1}^3 n_i^2}{N} \tag{1}$$

Where m is the number of expected runs, n_i is the number of price changes for each category (+), (-), and (0) and N is the total number of price changes. If the number of observations is large enough, the expected number of runs is normally distributed with a standard deviation of σ_m which has the equation:

$$\sigma_m = \sqrt{\frac{\sum_{i=1}^3 (n_i^2 + N(N+1)) - 2N \sum_{i=1}^3 (n_i^3 + N^3)}{N^2(N-1)}} \tag{2}$$

The equations used to perform the Z-test on the run test are as follows:

$$Z = \frac{R - m \pm 0.5}{\sigma_m} \tag{3}$$

Where R is the total number of expected runs and 0.5 is a continuous adjustment based on W. Allen & Harry V. (1956).

2. The Variance Ratio Test

The variance ratio test is a method that is also commonly used to test the random walk hypothesis, which was first introduced by Lo & MacKinlay. The variance ratio test is defined as follows:

$$VR(q) = \frac{\sigma^2(q)}{\sigma^2(1)} \tag{4}$$

In time series data that follows a random walk pattern, the variance of the q-difference is q times the variance of the first difference, as in the following equation:

$$\text{Var}(p_t - p_{t-q}) = q\text{Var}(p_t - p_{t-1}) \quad (5)$$

Where q is a positive integer. The variance ratio test as in equation 1 can be formulated as follows:

$$VR(q) = \frac{\frac{1}{q}\text{Var}(p_t - p_{t-q})}{\text{Var}(p_t - p_{t-1})} \quad (6)$$

The variance ratio test assumes that the test is based on asymptotic estimates and requires a large number of samples (Lo and MacKinlay, 1988), so the data commonly used to test price index data is daily data.

For statistical testing, Lo & MacKinlay propose two normal test statistics, namely tests for homoscedastic data, $Z(q)$ and heteroscedastic $Z^*(q)$ as follows:

$$Z(q) = \frac{VR(q)-1}{\sqrt{\theta(q)}} \sim N(0,1) \quad (7)$$

$$Z^*(q) = \frac{VR(q)-1}{\sqrt{\theta^*(q)}} \sim N(0,1) \quad (8)$$

Where $\theta(q)$ is the asymptotic variance of the variance ratio assuming homoscedastic data, and $\theta^*(q)$ for heteroscedastic data.

$$\theta(q) = \frac{2(2q-1)(q-1)}{3q(nq)} \quad (9)$$

$$\theta^*(q) = \sum_{j=1}^{q-1} \left(\frac{2(q-j)}{q}\right)^2 \delta(j) \quad (10)$$

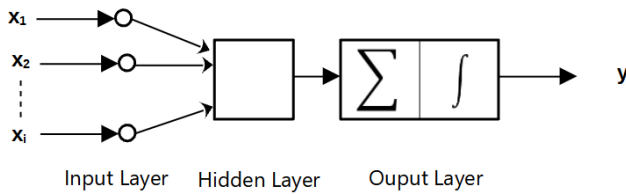
Where $\delta(j)$ is a heteroscedasticity consistent estimator which is formulated as follows:

$$\delta(j) = \frac{\sum_{t=1}^{nq} (p_t - p_{t-1-u})^2 (p_t - p_{t-j-1-u})^2}{\left(\sum_{t=1}^{nq} (p_t - p_{t-1-u})^2\right)^2} \quad (11)$$

3. Recurrent Neural Network

Neural networks consist of several layers connected to each other, namely the input layer, the output layer, and one or more hidden layers. The minimal architecture of neural networks which only consists of an input layer and an input layer without hidden is known as Rosenblatt's Perceptron, while those that have at least one hidden layer are known as Multilayer Perceptrons. Connectors between neurons from each layer have their respective weights which as a whole will affect the magnitude of the output value.

Figure 1: Neural Network's Basic Structure



Modeling using a neural network is carried out by finding the optimal weight of each link between neuron cells from the input layer to the hidden layer and from the hidden layer to the output layer. This is for the output to match the desired target. The process of finding the optimal weights is referred to as network training. Training is carried out until the desired output target is achieved. The accuracy between the output value of the training results and the actual value is measured by how much error there is between the two. Finding the optimum value is similar to the statistical model for the search for minimal risk (Härdle & Simar, 2014).

Although the principle of neural networks is quite easy to understand, namely finding the optimal weight of the connectors between neurons, the use of neural networks can be unique when compared to statistical methods or other methods whose characteristics can be well recognized (Greff et al., 2017). The relationship between neuron connections and their weights is often not easy to explain, in contrast to statistical models where the relationship between input and output can be understood and analyzed mathematically (Petnehazi, 2019).

There are several commonly used neural network models or architectures. One of the best models to use for sequential or time-series data is the recurrent neural network. As the name implies, it is called an RNN because each cell uses information from the previous cell to calculate the output value. The output of the previous cell is entered as information on the hidden layer so that it resembles a chain (Dautel et al., 2020). In this study, the RNN model is the Short-Term Long Memory (LSTM) type.

An LSTM cell consists of an input gate, a forget gate, and an output gate. The input gate takes the output of the last cell and the new input as the input of the sigmoid function. The forget gate is part of cell that takes output at time $t - 1$ and input at time t , which is then used as input for the sigmoid activation function. The output gate controls how many states pass to the output and works in the same way as any other gate, generating a new state cell (ht).

The formal notation of input, forget, and output gates is as follows:

$$i_t = \sigma(W_i h_{t-1} + W_t x_t) \tag{12}$$

$$f_t = \sigma(W_f h_{t-1} + W_f x_t) \tag{13}$$

$$o_t = \sigma(W_o h_{t-1} + W_o x_t) \tag{14}$$

Where:

i_t, f_t, o_t : Input gate, forget gate, and output gate at time t

W_i : Weight of input gate

W_f : Weight of forget gate

W_o : Weight of output gate

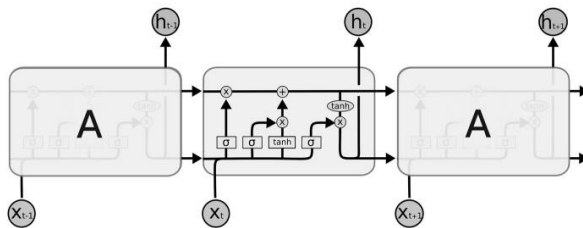
x_t : Input at time t

h_t : Status at time t

h_{t-1} : Status at time $t-1$

σ : sigmoid function

Figure 2. The Structure of an LSTM Network



With these attributes, LSTM is very appropriate to be used in forecasting time series data, although it is not limited to only that type of data.

4. ARIMA Model

ARIMA is a model for forecasting based on the synthesis of historical data patterns. This method fully uses past and present data as independent variables without paying attention to other independent variables that may affect the movement of the time series data. ARIMA has two components, namely the Autoregressive (AR) component and the Moving Average (MA) component.

The equations of the AR components can be denoted as follows:

$$Y_t = \varphi_0 + \varphi_0 \cdot Y_{t-1} + \dots + \varphi_p \cdot Y_{t-p} + \varepsilon_t \quad (15)$$

Where:

Y_t : Dependent variable at time t

Y_{t-p} : Independent variable or past data at time t-p

Φ_0 : intercept

Φ_p : The coefficient of the AR component

ε_t : Residual at time t

While the equation of the MA component can be denoted as follows:

$$Y_t = \omega_0 + \varepsilon_t - \omega_1 \cdot \varepsilon_{t-1} - \dots - \omega_q \cdot \varepsilon_{t-q} \quad (16)$$

Where:

Y_t : Dependent variable at time t

ω_0 : intercept

ω_{t-p} : MA component coefficient

ε_{t-p} : Previous residual value (lag)

ε_t : Residual at time t

Therefore, the general equation of the ARIMA model is as follows:

$$Y_t = Y_{t-1} + \varphi_0 + \varphi_1(Y_{t-1} - Y_{t-2}) + \dots + \varphi_p(Y_{t-p} - Y_{t-p-1}) - \omega_1 \cdot \varepsilon_{t-1} - \dots - \omega_q \cdot \varepsilon_{t-q} + \varepsilon_t \quad (15)$$

5. The Research data

The data used in this study are sharia and conventional indices from three Southeast Asian countries namely Indonesia, Malaysia, and Thailand which are downloaded from www.investing.com for the period January 2015 to August 2021. In order to avoid bias in market efficiency analysis due to sharp fluctuations at the beginning of the COVID-19 pandemic, the data is divided into two parts, namely Period I and Period II (Table 2). Index data for both periods are analyzed using the same method, namely run test, variance ratio test, ARIMA and Elman-type Recurrent Neural Network (Elman RNN).

6. The Research Hypothesis

The Run Test

The hypothesis used in the run test is:

H_0 : The data is random, following the random walk pattern

H_1 : The data is not random, does not follow the pattern of random walk

Confidence interval is 95%. If the run test score is $> 5\%$, the alternative hypothesis H_1 is rejected, which means the data is random and follows a random walk pattern.

Table 2. The List of Sharia and Conventional Stock Indices of three ASEAN countries

No	Index	Country	Description
1	FTFBMS	Malaysia	Sharia
2	FTFSTSH	Thailand	Sharia
3	JKISSI	Indonesia	Sharia
4	JKSE	Indonesia	Conventional
5	KLSE	Malaysia	Conventional
6	SETI	Thailand	Conventional

Table 3. The Division of Index Testing Period

The Data Period	
Period I	January 2015 – December 2019
Period II	January 2020 – August 2021

The Variance Ratio Test

The hypothesis used in the variance ratio test is:

H_0 : The data is random, following the random walk pattern

H_2 : The data is not random, does not follow the pattern of random walk

Confidence interval is 95%. If the variance ratio test score is $> 5\%$, the alternative hypothesis H_1 is rejected, which means the data is random and follows a random walk pattern.

The ARIMA and RNN Models

To determine the significance of the stock index forecasting results using the ARIMA and RNN models, it is necessary to perform a statistical test that compares the forecasting results with the actual index. Two methods commonly used to test the results of a time series data forecast are the paired t-test and the Wilcoxon test. In this study, the statistical test method used was the Wilcoxon test.

The Wilcoxon test is a nonparametric test method to measure the significance of the difference between two groups of paired data that are not normally distributed. The Wilcoxon method is commonly used as an alternative method of testing using a t-test if the data does not meet the normality assumption.

The test hypothesis from the index forecasting results using ARIMA and RNN is as follows:

H_0 : The mean of the difference between the predicted data and the actual data is equal to 0

H_3 : The mean of the difference between the predicted data and the actual data is not equal to 0

The confidence interval used is 95%. If H_0 is rejected, the actual stock index is significantly different from the stock index predicted using the ARIMA and RNN models. And conversely, if H_0 is accepted, there is no significant difference between the actual stock price and the stock price predicted using the RNN model. This means the market is inefficient in its weak form because the index price is predictable.

To analyze the data using the run test method, variance ratio test and forecasting using ARIMA and RNN, R-Programming Language was used in this study, which is a free programming language that is widely used for statistical computing and data science.

Results and Discussion

The presentation of data in the form of important descriptive statistics is presented to help understand the characteristics of each index. The descriptive statistical information can be seen in Table 4.

It can be seen that the index that has the highest difference between minimum maximum return is FTFSTSH, which is 20.693%. This highest difference occurred in Period II, which was at the beginning of the COVID-19 pandemic. Meanwhile,

the index with the lowest difference is the KLSE index, which is 5.432% in the period before the COVID-19 pandemic. The lowest return value was -10.779% experienced by the SETI index and the highest of 10.181% experienced by the JKSE index. Both are in Period II. In Period I the FTFSTSH, JKISSI, and JKSE indices had the highest variance of 0.008%, indicating that the risk of the three indices was higher than the other indices. Meanwhile, the index with the lowest variance in Period I was FTFBMS and KLSE at 0.003%.

In Period II the index with the highest variance was FTFSTSH at 0.029% and the lowest was KLSE at 0.011%. It can also be seen that the volatility of all indices is higher during Period II. This finding is not surprising, as information spread during a pandemic causes increased volatility. This condition could be due to high volatility in the market caused by the pandemic or financial crisis, as shown by various studies that health and financial crises caused an increase in volatility in the capital market (Zhang et al.,2020; Albulescu, 2021; Baker et al., 2020).

The results of testing the return index on six indices in Asia using the run test and variance-ratio test are listed in Table 5. While the results of testing using the ARIMA and RNN models are presented in Table 6 and Table 7.

Table 4. The Descriptive Statistics of ASEAN Stock Index

Index	Period	N	Mean	Variance	Max	Min
FTFBMS	Period I	1220	-0.00001	0.00003	0.02404	-0.03365
	Period II	430	0.00019	0.00012	0.05961	-0.05195
FTFSTSH	Period I	1220	0.00005	0.00008	0.04610	-0.05946
	Period II	390	0.00021	0.00029	0.10185	-0.10508
JKISSI	Period I	1220	0.00013	0.00008	0.04579	-0.04333
	Period II	390	-0.00005	0.00020	0.09073	-0.06347
JKSE	Period I	1220	0.00019	0.00008	0.04552	-0.04006
	Period II	390	0.00003	0.00021	0.10191	-0.06579
KLSE	Period I	1220	-0.00005	0.00003	0.02247	-0.03185
	Period II	390	-0.00013	0.00011	0.06851	-0.05261
SETI	Period I	1220	0.00008	0.00005	0.04586	-0.04727
	Period II	390	0.00007	0.00025	0.07954	-0.10799

Table 5. Test Results Using Run Test and Variance Ratio Test

Index	Period	The Run Test			The Variance Ratio Test		
		Stat	P-value	Annotation	Stat	P-value	Description
FTFBMS	Period I	-1.1457	0.2519	H ₀ accepted	4.3591	0.0368	H ₀ accepted
	Period II	-0.9914	0.3215	H ₀ accepted	0.0299	0.8626	H ₀ accepted
FTFSTSH	Period I	-1.4894	0.1364	H ₀ accepted	0.1415	0.7068	H ₀ accepted
	Period II	-0.5499	0.5824	H ₀ accepted	2.0361	0.1536	H ₀ accepted
JKISSI	Period I	-0.8046	0.4210	H ₀ accepted	0.0436	0.8346	H ₀ accepted
	Period II	1.3016	0.1930	H ₀ accepted	0.1393	0.7090	H ₀ accepted
JKSE	Period I	-0.8046	0.4210	H ₀ accepted	1.0318	0.3097	H ₀ accepted
	Period II	0.2996	0.7645	H ₀ accepted	0.3710	0.5424	H ₀ accepted
KLSE	Period I	-0.3434	0.7313	H ₀ accepted	1.4157	0.2341	H ₀ accepted
	Period II	1.1896	0.2342	H ₀ accepted	0.1713	0.6789	H ₀ accepted
SETI	Period I	-1.0884	0.2764	H ₀ accepted	1.2147	0.2704	H ₀ accepted
	Period II	0.5993	0.5490	H ₀ accepted	1.2439	0.2647	H ₀ accepted

Table 6. Test Results using ARIMA

Index	Period	ARIMA Model	Wilcoxon Test		
			V	P-value	Description
FTFBMS	Period I	ARIMA(2,1,3)	188.0	0.0010	H ₀ rejected
	Period II	ARIMA(0,1,0)	146.0	0.1327	H ₀ accepted
FTFSTSH	Period I	ARIMA(0,1,0)	187.0	0.0012	H ₀ rejected
	Period II	ARIMA(1,1,2)	21.0	0.0009	H ₀ rejected
JKISSI	Period I	ARIMA(0,1,0)	5.0	0.0002	H ₀ rejected
	Period II	ARIMA(1,2,2)	205.0	0.0000	H ₀ rejected
JKSE	Period I	ARIMA(0,1,0)	7.0	0.0000	H ₀ rejected
	Period II	ARIMA(2,1,2)	209.0	0.0000	H ₀ rejected
KLSE	Period I	ARIMA(1,1,0)	208.0	0.0000	H ₀ rejected
	Period II	ARIMA(0,1,0)	192.0	0.0005	H ₀ rejected
SETI	Period I	ARIMA(0,1,0)	181.0	0.0032	H ₀ rejected
	Period II	ARIMA(3,1,2)	188.0	0.0010	H ₀ rejected

Table 7. Test Results Using RNN

Index	Period	Wilcoxon Test		
		V	P-value	Description
FTFBMS	Period I	15.0	0.0003	H ₀ rejected
	Period II	9,0	0.0000	H ₀ rejected
FTFSTSH	Period I	52.0	0.0484	H ₀ rejected
	Period II	0.0	0.0000	H ₀ rejected
JKISSI	Period I	174.0	0.0016	H ₀ rejected
	Period II	1.0	0.0000	H ₀ rejected
JKSE	Period I	202.0	0.0000	H ₀ rejected
	Period II	1.0	0.0000	H ₀ rejected
KLSE	Period I	32.0	0.0049	H ₀ rejected
	Period II	0.0	0.0000	H ₀ rejected
SETI	Period I	82.0	0.4091	H ₀ accepted
	Period II	33.0	0.0056	H ₀ rejected

Based on the test using the run test and the variance ratio test, it is found that all indices followed a random walk pattern in both periods. This result is in line with the study from Phanrattinon et al. (2020), which was conducted using Durbin Watson, variance ratio, unit root, and run test. Their test using Durbin Watson showed that all indices are efficient, while the test using variance ratio and the run test revealed that only the market in Indonesia and Thailand is in line with the Random Walk pattern. However, the study conducted by Yaya (2021) showed a different result. According to his study, which used the data from 28 July 2000 to 18 May 2020, indices from Indonesia, Malaysia, and Thailand were not in line with the Random Walk pattern. Senthilnathan (2014) who tested markets in four ASEAN countries found that the market in Malaysia and Thailand were not random. Shaik & Maheswaran (2017) also proved that the capital markets in Indonesia, Malaysia, and Thailand were not efficient.

A similar finding also occurred for the Indonesian Sharia Stock Index JKISSI. The result of this study is in line with Andrianto & Mirza (2016) who found that the JKISSI follows a random walk pattern. However, Agustin (2019) - who tested the efficiency of the Indonesian Sharia Stock Index (JKISSI) - obtained different results and argued that the JKISSI index was not efficient.

These differences in results can be caused by differences in the period and research methods used in the studies (Semuel & Basana, 2017). This opinion is in line with Mensi et al. (2017), who said that the efficiency of the Sharia capital market differs from time to time. The period used in the study may lead to different results in weak-form market efficiency tests. As stated by Senthilnathan (2015) who conducted a literature review on market efficiency in Asian and Pacific countries, found that some studies on capital market efficiency in these countries seem contradictory to one another.

The result in this study also reveals that Sharia stocks have better efficiency compared to their counterparts during period I. All methods used in this study show that Sharia stocks in Indonesia, Malaysia and Thailand follow random walk pattern, so that future indices cannot be predicted properly and nobody can consistently beat the market in this period. This Finding is in line with the study conducted by Ben Rejeb & Arfaoui (2019). They conducted a study on ten shariah indices in the period January 1996 to 2016 using a state-space modeling approach and found that in general, the Shariah indices are more efficient than their counterparts. While study by Al- Khazali & Mirzaei (2017), and Alam et al. (2016) showed different results. According to their study, conventional stocks are more efficient compared to Sharia stocks. However, they found that Shariah indices appear to have significantly improved in their efficiency.

On the other hand, the test results in period II or during the COVID-19 pandemic using the run test, variance ratio test, ARIMA and RNN model show that all indices except the Malaysian Sharia Index FTFBMS follow the random walk pattern. The ARIMA model used in this study can predict the index FTFBMS in period II significantly, hence FTFBMS is during the pandemic not efficient. Interestingly, compared to other Sharia indices, the Index FTFBMS has less volatility during the COVID-19 pandemic. As shown in Table 4, the other Sharia indices, JKISSI and FTFSTSH have greater variance compared to FTFBMS during the COVID-19 Pandemic. In terms of return, the Index FTFSTSH has a better return compared to other indices during the COVID-19 Pandemic. However, the index FTFSTSH is also the most volatile stock among other indices. This finding is in line with the study from Ben Rejeb & Arfaoui (2019), which showed that the indices with less volatility tended to be more efficient. However, there is no strong evidence showing a correlation between return, volatility, and efficiency. As Malkiel (2003) argues, a market with high volatility can be efficient or inefficient.

The result of this study is also not in line with the study conducted by Tuna (2021). He showed that conventional, as well as Sharia stock markets in the period from 19 March 200 to 27 July 2020, were not efficient. In this short period at which time COVID-19 cases were significantly increased, the investors could predict the stock prices using the news related to the COVID-19 pandemic. However, his study did not reveal how the stock markets behave during another period during the pandemic. As Yu et al. (2022) show in their study that in the second half of the year 2020, the anxiety indices in some countries are decreased even though the number of daily cases still arises. Investors' decisions are strongly influenced by the information circulating and the information received by investors, so the decline in anxiety indices may cause different efficiency. To get more robust evidence for market efficiency during the COVID-19 pandemic, it is suggested to divide the research data into more than one period, such as the study conducted by Liu et al. (2022) that divided the data into three phases.

Conclusion

This study aims to analyze whether Sharia and conventional capital markets in Indonesia, Malaysia, and Thailand follow the weak-form of the efficient market hypothesis and whether current and future indices can be predicted only based on past information. It is interesting to find out the performance of the stock market in these countries in the normal and extreme conditions. Based on the test results, the sharia Index in Malaysia in Period II did not indicate an efficient market. In contrast, the conventional stock index in the country was consistent with the efficient market hypothesis. The opposite situation occurred in Thailand. The sharia stock index in Thailand was in the efficient category in both test periods, while the conventional index was only efficient in Period II. Meanwhile, in Indonesia, the two stock indices showed conditions as efficient markets in both Period I and Period II. The results also show that using the Run Test, Variance Ratio Test, ARIMA, and RNN Model in Period I, the Sharia stocks follow a random walk pattern. There is strong evidence that nobody can consistently get abnormal returns from Sharia stocks in this period. In contrast, their counterpart is less efficient during this period. The RNN model used in this study can significantly predict the Index SETI's future price in Period I.

On the other hand, in Period II or during the COVID-19 Pandemic, the Sharia stocks were less efficient compared to their counterparts. The ARIMA

model used in this study can significantly predict Malaysia Shariah Index (FTFBMS). However, a deeper study is needed to get a more robust result of the weak-form of the efficient market during the COVID-19 Pandemic. In future research, it is suggested to divide research data into three periods: the initial phase when the first wave occurs, the second phase when the second wave occurs, and the third phase when many countries have vaccinated their citizens. The use of Recurrent Neural Network and ARIMA to test market efficiency and predict current and future prices or indices is also relatively good. However, RNN is not necessarily appropriate to be used in every situation. A suggestion for subsequent research is to add other methods to see the consistency of the various methods.

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