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ARCH AND GARCH MODELS ON THE INDONESIAN SHARIA STOCK INDEX

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ABSTRACT

Investments in Islamic stocks are in demand because of the profit-sharing system so that the company is more stable in facing uncertain global economic conditions. This study aims to analyze the volatility of the Indonesian Sharia Stock Index and the Indonesian Sharia Stock Index's potential in the future. We use daily data from 2012 to 2020 and the Autoregressive Conditionally Heteroscedasticity-Generalized Autoregressive Conditional Heteroskedasticity (ARCH-GARCH) method. The results show that the Indonesian Sharia Stock Index's volatility is influenced by the risk of the two previous periods and the return volatility in the previous period. Potential Indonesian Sharia Stock Index tends to fluctuate in return by an average of 3 percent.

Keywords*: Indonesian Sharia Stock Inde; ARCH; GARCH; Investment; Forecasting*

ABSTRAK

Investasi pada saham syariah diminati karena sistem bagi hasilnya sehingga perusahaan lebih stabil dalam menghadapi kondisi ekonomi global yang tidak menentu. Penelitian ini bertujuan untuk menganalisis volatilitas Indeks Saham Syariah Indonesia dan potensi Indeks Saham Syariah Indonesia di masa yang akan datang. Kami menggunakan data harian dari 2012 hingga 2020, dan metode Autoregressive Conditionally Heteroscedasticity-Generalized Autoregressive Conditional Heteroskedasticity (ARCH-GARCH). Hasil penelitian menunjukkan bahwa volatilitas Indeks Saham Syariah Indonesia dipengaruhi oleh risiko dua periode sebelumnya dan volatilitas return pada periode sebelumnya. Potensi Indeks Saham Syariah Indonesia cenderung mengalami fluktuasi return dengan rata-rata sebesar 3 persen.

Kata kunci: Indeks Saham Syariah Indonesia; ARCH; GARCH; Investasi; Peramalan

1. INTRODUCTION

The development of a country's economy is inseparable from the investment conditions therein (Alfaro & Chauvin, 2017). The more developed a country, the more significant the role of investment (Were, 2015). In developed countries, the capital market's purpose is more significant than banking institutions in channeling funds to the productive sector (Sufian, Kamarudin,

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& Nassir, 2016; Torres & Zeidan, 2016). Today the development of the capital market continues to follow the existing financial system (De la Torre & Schmukler, 2006). One of the updates is the sharia-based capital market that supports the Islamic finance industry (Syarif, 2019). The Indonesian Sharia Stock Index (ISSI) is one of the stock indexes listed on the Indonesia Stock Exchange in which all companies can be categorized into sharia shares. Sharia shares are developing in line with the allure of the halal lifestyle or sharia lifestyle, which has recently become a global trend; no exception is also in the capital market's realm (Adinugraha & Sartika, 2019; Sukardani, Setianingrum, & Wibisono, 2020).

Islamic stock's business activities are not contrary to Islamic principles, namely gambling, exploitation, and buying and selling that contain elements of uncertainty (gharar) (Md Akhter, 2015). Besides, companies are prohibited from producing, distributing, trading, and providing illicit goods or services, as well as damaging morale (Hashim, 2012). Islamic stocks have an essential role in the national economy, so that the domestic investment climate needs to be maintained so that investors feel safe in investing in Islamic stocks (Chen & Imam, 2013). Currently, the sharia industry is growing and has the potential for shares to be sought after by market participants (Boukhatem & Moussa, 2018). The majority of market participants who buy shares focus on the profit potential, and only a few pay attention to stocks from the Islamic index or not (A. Ng & Ariff, 2019). Islamic stocks index has trading characteristics where market participants can benefit greatly, and this index is predicted to go down or go up with a widespread (Alam et al., 2017).

Research related to Islamic stock indexes has been conducted by Ahmed and Elsayed (2019) on the stock market in Malaysia concluded that the conventional stock market influences one-third of the risk of the Islamic stock index, Mishra et al. (2019) on the Dow Jones Islamic index concluded the influence of global crude oil prices on Islamic stocks Index, Shahzad et al. (2018) on the Islamic Market World Index, Islamic indices of the USA, UK, Japan, and the Islamic Financial sector index concluded that there is an asymmetric risk in the time variation between world oil prices and the Islamic stock index.

Trabelsi and Naifar (2017) in Gulf countries concluded that systemic risk harms the Islamic stock index with the Islamic stock index in Asia considered a useful hedging asset, Abounoori, Mila, and Nademi (2016) on the Islamic stock index in Iran concluded Autoregressive (AR) (2) -Markov Regime Switching ARCH (MRSARCH) model-Generalized Error Distribution (GED) the model outperformed the other models within one day, Naifar (2016) on the Islamic stock index in Saudi Arabia concluded that the yield of sukuk shows a significant dependence on the volatility of the Islamic stock index, and Charles et al. (2015) on the Dow Jones Islamic Indexes concluded the Islamic stock index is riskier than conventional stocks.

This study focuses on the volatility of the Indonesian Sharia Stock Index (ISSI), which contains the Jakarta Islamic Index (JII) and the potential

future shares of ISSI. For information, ISSI is an index that contains all Islamic stocks listed on the IDX, namely 451 shares. While JII contains 30 of the most liquid and most capitalized Islamic stocks and JII 70, the number of members is more comprehensive, namely 70 shares. This study aims to determine whether to assess stock returns' level of volatility at ISSI and determine stock returns' characteristics and the model of stock return volatility in the future. This research contributes to knowing the characteristics of ISSI stocks, and investors can know the prediction of ISSI's future movement and add to the literature for academics.

2. LITERATURE REVIEW

Stock price volatility is the fluctuation of shares, the returns of a security or a portfolio in a certain period (Wang & Ma, 2014). Market volatility can occur due to new information entering the market or stock exchange (Chakraborty & Kakani, 2016). As a result, market players re-evaluate the assets traded by the company. The price level in an efficient market will adjust quickly so that the price formed reflects new information.

Islamic stock investment is growing from time to time. The number of shares categorized as Islamic stocks has continued to increase in recent years. Based on data collected from Exchange Members who provide Shariah Online Trading System services, the number of sharia investors has also increased rapidly. In the last five years, Islamic investors have increased by 1,500%, from 4,908 investors in 2015 to 80,152 investors as of September 2020, with a functional level of 25.2%. Islamic stock investing has several differences from conventional stocks. Islamic stocks are stocks whose principles are not against the principles of sharia in the capital market (Wahyudi & Sani, 2014).

Sharia shares are shares of companies that do not carry out many business activities such as gambling, trading that is not accompanied by the delivery of goods or services, interest-based banking, conventional insurance, producing or selling goods, or haram in substance (Soemitra, 2016). Moreover, for Muslims, Islamic stocks are considered capable of accommodating their shares following their religious values.

Research related to stock volatility has been conducted by Ng, Chin, & Chong (2020), investigates the transmission of realized volatility between the Malaysian Islamic stock market and various global sectoral Islamic stock markets. The results show that the volatility of the Malaysian Islamic stock market equities depends significantly on its equity in the short, medium, and long term. The study results provide useful insights for understanding the risk of a Sharia-compliant portfolio so that it can make a more informed portfolio allocation.

Ahmed and Elsayed (2019) examined the Islamic and conventional capital markets in Malaysia from 2007 to 2017 by analyzing the dynamic interdependence between conventional stock markets, Islamic stocks market,

bonds, and sukuk. The empirical findings show that the total one-third of the total estimate is associated with the impact of spillovers in the four markets, thus suggesting that the conventional stock market and the Islamic stock market are closely related.

Mishra et al. (2019) analyzed the relationship between global crude oil price fluctuations and the Dow Jones Islamic Stock Index using daily data from January 1, 1996, to April 13, 2018. The results showed heterogeneity regarding the positive influence of global crude oil prices on the Islamic Stock Index. Oil price fluctuations positively affect the Islamic stock index in the short term, but oil prices hurt the Islamic stock index to achieve stability.

Shahzad et al. (2018) discuss the relationship between five Islamic stock markets (the World Islamic Market index, the US, UK, Japan Islamic index, and the Islamic Finance sector index) in the oil market. The results underscore the varying dependence on oil and Islamic stock markets. Furthermore, there is an asymmetric risk from the oil market to the Islamic stock market. As a result, this asymmetric risk has a significant effect after the global financial crisis.

Trabelsi and Naifar (2017) assess the exposure of the Islamic stock index to systemic events. The samples used are Islamic and conventional stock indices from various markets of developed and developing countries from September 2005 to March 2015. The results reveal that systemic risk has a moderate detrimental effect on the Islamic stock index and, to a lesser extent, in the Cooperation Council countries. Bay. Other results also show that the Asian stock index can be a useful hedge asset after the global financial crisis. Furthermore, empirical results reveal that portfolios, including the Islamic stock index, perform better than reference portfolios in periods of turmoil. This finding has several implications for financial decisions, including stability strategies and asset allocation.

Naifar (2016) investigated the dependency structure between yields on Sukuk (Islamic bonds) and the stock market (yields and volatility) in Saudi Arabia. The results show that the yield on Sukuk shows a significant dependence only on stock market volatility. The dependence structure between Sukuk yields and stock market volatility is symmetrical and related to the same intensity.

Charles et al. (2015) analyzed the impact of Islamic filtering criteria on the Dow Jones Islamic index's risk relative to conventional spare parts. The results show that the Islamic and conventional indices are affected by the same extreme events that can bias risk estimates, especially the global financial crisis 2007-2008 and after that, which was characterized by a very high level of volatility. Overall, the Islamic index appears to be riskier than conventional spare parts and shows higher performance (1996-2013). Other results show that both indices have been affected by changes in invariance. Most Islamic indices have a higher level of risk than conventional indexes, regardless of the sub-period.

3. RESEARCH METHOD

This study uses monthly data from 2012 to 2020. The data used is sourced from financial services authorities by taking the Indonesian Sharia Stock Index data. This study uses the Autoregressive Conditionally Heteroscedasticity-Generalized Autoregressive Conditional Heteroskedasticity (ARCH-GARCH) method to answer the research objectives. ARCH-GARCH is a method of measuring volatility for time series data (Engle, 1982). Time series data usually contain heteroscedasticity where there is the same variant of the residuals for all observations in the linear regression model so that the ARCH-GARCH method serves to solve the same variant problem (Bollerslev, 1986).

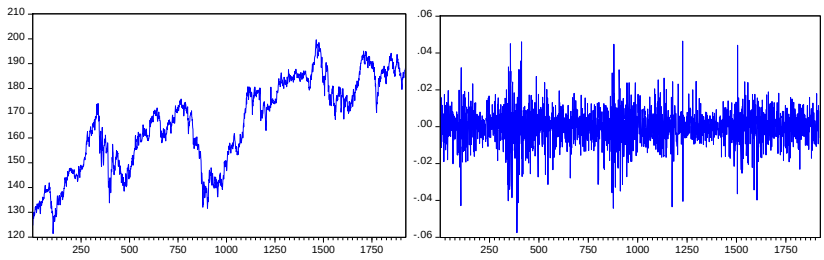
The processing process to answer the objectives begins with the model's specification by detecting the ARCH effect of stock data using the autocorrelation test and ARCH test, followed by the average equation's appropriate specification. The next step is estimating the parameters and selecting the best variance model by simulating several variance models based on the Akaike Information Criterion (AIC) value. Furthermore, the variance model diagnostic test with error analysis includes the ARCH test and normality test. The last stage is forecasting where $ISSI_t$ = daily return, $\alpha_1 e^2_{t-1}$ = random error, h_{t-1} = conditional variance using the following model.

$$\text{ISSI}_t = \delta + \alpha_1 e_{t-1}^2 + \cdots + \beta_1 h_{t-1}$$

4. DATA ANALYSIS AND DISCUSSION

Figure 1 shows the monthly price movement (left) and the observed object's daily return movement, the Indonesian Syariah Stock Index (ISSI), from 2012 to 2020. Based on Figure 1, the ISSI return object of observation has a volatile level of high volatility. In general, ISSI stock movements show a large return change followed by a more considerable return change and a small return change followed by a smaller return change in the next period or what is commonly called time-varying volatility. For example, the volatility of ISSI returns in 2015 was more significant than in 2016.

Figure 1. Daily Data Chart and Daily Return



From Table 1, the descriptive statistic is a measure of data concentration from the data used where the mean is the average of the observation period, the median is the middle value of the observation period, the maximum is the highest value of the observation period, the minimum is the lowest value of the observation period, and the standard deviation is a variation of data distribution. The period used obtained a mean of 0.02%, a median of 0.07%, a maximum value of 4.6%, a minimum value of -5.8%, and a standard deviation of 0.01.

Table 1. Descriptive Statistic Table

Indicator	**ISSI**
Mean	0.000213
Median	0.000707
Maximum	0.046461
Minimum	-0.057538
Std. Dev	0.010010

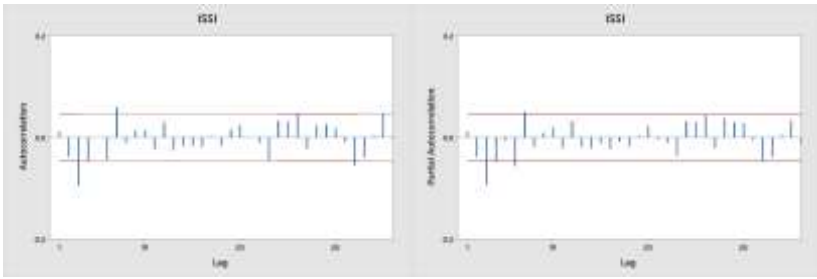
The stationary test serves to analyze so that the time series data is at the mean and variance. Useful data is stationary data. The stationary test of this study used the Augmented Dickey-Fuller test (ADF-test). The ADF-test results in Table 2 show the probability value is smaller than the critical value (0.0000 <0.05), which means that the data in this study are stationary.

Table 2. Unit Root Testing using Augmented Dickey-Fuller

Variable	Level	
	Augmented Dickey-Fuller test statistic	Prob*
ISSI	-28.41335	0.0000

To ensure that the data is stationary or not, other tests are carried out, namely the correlogram test using the autocorrelation function (ACF) and the partial autocorrelation function (PACF). The correlogram test in Figure 2 shows the Autocorrelation graph (left) and the Partial Autocorrelation chart (right), forming a similar pattern in the form of a cutoff pattern in the data used. Based on the pattern that has been formed, it can be concluded that the data is stationary so that the residual value is random and has an adequate model. From the results of ACF and PACF, it is also concluded that some models have negative autocorrelation values at the initial lag (<10), which indicates that the data does not need to be differencing again so that the possibility of order d is 0.

Figure 2. Autocorrelation Function Graph (Left) and Partial Autocorrelation Function Graph (Right)



After the data is stationary, the next step is to check the data, whether the data contains heteroscedasticity effects or not. In this study, testing the heteroscedasticity effect used the ARCH-LM test. Based on Table 3, the test results found that the data contained a heteroscedasticity effect because the probability value was smaller than the critical value (0.0000 <0.05), so that the data could be continued with the ARCH-GARCH model. The ARCH-GARCH model solves problems in time-series data that have a heteroscedasticity effect of continuing the forecasting process.

Table 3. ARCH-LM Heteroscedasticity Test

Variable	Prob.
ISSI	0.0000

The next step is to determine the best Integrated Moving Average (ARIMA) Autoregressive Model. Determination of the best model in this study using the smallest Akaike Info Criterion (AIC) value with a significant variable probability value (<0.05). Table 4 shows the results of selecting the best ARIMA model where p is the ARCH value, d is the stationary data position, and q is the GARCH value with the smallest AIC value and a significant probability.

Table 4. Best ARIMA model (p, d, q)

Variable	ARIMA (*p,d,q*)	Akaike Info Criterion	Prob.
ISSI	ARIMA (4,0,3)	-6.378587	(0,0)

The next step is selecting the best GARCH model based on the smallest AIC value, and the probability is smaller than the critical value (<0.05). Table 5 is the result of selecting the best GARCH model.

Table 5. Overfitting Model GARCH (p,q)

(*p,q*)	C	ARCH (*t-1*)	ARCH (*t-2*)	GARCH (t-1)	Prob	AIC
(1,0)	0.0000728	0.273262	-	0	0	-6.448910
(0,1)	0.0000722	0	-	0.270035	0	-6.378336

(*p*,*q*)	C	ARCH (*t-1*)	ARCH (*t-2*)	GARCH (t-1)	Prob	AIC
(1,1)	0.0000015	0.061555	-	0.923148	0	-6.532889
(2,1)	0.0000011	0.153249	-0.108101	0.942861	0	-6.540342

The below model provides information that the ISSI index's risk level is influenced by the amount of the return value of the two previous days and the magnitude of the standard deviation of the return for the last day.

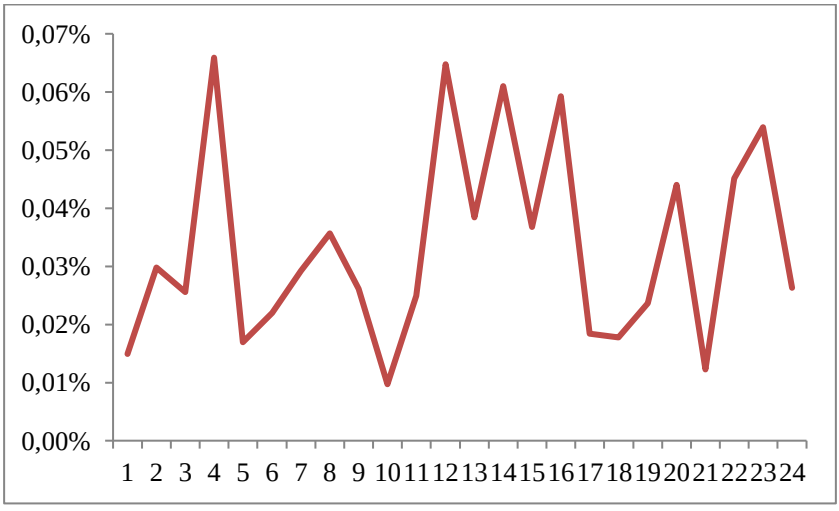
$$\text{ISSIh}_t = 1.14\text{E-}6 + 0.153249\ \varepsilon_{t-1^2} - 0.108101\ \varepsilon_{t-2^2} + 0.942861\text{h}_{t-1}$$

Testing the accuracy of the model for capturing errors was tested with three test equipment, namely the ARCH-LM Test, to examine whether there is still a heteroscedasticity effect on errors. Correlogram Q Statistics test checks whether the data is autocorrelated or not and the Kurtosis test to see the distribution of errors. ARCH-LM test results found that the information does not contain a heteroscedasticity effect after GARCH modeling. Correlogram Q Statistics test results found that the error was random, or the residual value was random.

Table 6. Diagnostic Models

Heteroskedastisitas	Autocorrelation
0.5715	0.381

Figure 3. Forecasting Results using the GARCH model (2,1)



Forecasting results show fluctuating movements. However, the balance sheets of the companies that are members of the Islamic index are generally healthier than other companies. The Jakarta Islamist Index (JII) was recorded up 1.88%, the Indonesia Sharia Stock Index (ISSI) rise 2.03%, and the Jakarta Islamic Index 70 (JII70) rise 2.56%. Meanwhile, the Composite

Stock Price Index (IHSG) throughout 2019 only grew by 1.70%. Thus, the growth of Islamic stocks looks better. The company's performance can be maintained due to Islamic stocks' characteristics required to have low-interest debt (Razak, Saiti, & Dinç, 2019). One of the requirements for entering into Islamic stocks is total debt based on interest compared to total assets of not more than 45% (Mahfooz & Ahmed, 2014). With this unstable macroeconomic condition, investors tend to look for defensive stocks with strong balance sheets and low debt levels (Ammer, Claessens, Tabova, & Wroblewski, 2019; Driver, Grosman, & Scaramozzino, 2020).

Sharia-based investment has a large enough market in Indonesia. Given, Indonesia is a country with the largest Muslim population in the world. Indonesia also has quite good Islamic financial literacy because, based on a Bank Indonesia survey, the Indonesian Islamic financial literacy index is classified as well literate, so that Islamic stocks still have a pretty good prospect. The Financial Services Authority (OJK) noted, in October 2020 the value of Islamic stock market capitalization reached 3,061 trillion rupiahs. This amount is equivalent to 51.4% of Indonesia's total capital market capitalization, which is 5,957 trillion rupiahs.

When viewed from the index, the Islamic index may lose compared to the Composite Stock Price Index (IHSG) because banking stocks mostly support the IHSG with large market capitalization. The increase in the Islamic index was also boosted by the healthy balance sheet conditions of index members. Indeed, the prospect depends on each issuer and the industry. Nevertheless, most shares in the Islamic index have low debt, so they are not too burdened by interest costs and are healthier on their balance sheet.

The Islamic capital market has grown up fast and is increasingly attractive. The Islamic capital market has also become a popular investment choice for Indonesians. It can be seen from the number of Islamic stocks listed on the stock exchange. Based on data on the Indonesia Stock Exchange (IDX), from 2011 to October 2020, the number of Islamic shares increased by 90.3%, from 237 shares to 451 shares. This amount is equivalent to 63.6% of the total shares listed on the IDX. Based on the amount of market capitalization, Islamic stocks account for 51.4% of the total market capitalization. The total market capitalization of Islamic stocks is IDR 3.061.6 trillion, of the total market capitalization of IDR 5,956.7 trillion.

5. CONCLUSION

This study aims to examine the characteristics of the ISSI Index return volatility during the observation period. During an observation, the ISSI data has an average of 0.02%, with the lowest value of -5.75% and the highest of 4.46%. The estimation results show that the ISSI volatility is influenced by the risk of the previous two days and the return volatility on the previous day. The forecast results show that the ISSI volatility fluctuates with an average of 0.03%, a maximum value of 0.07%, and a minimum value of 0.01%.

The results of this study can be used by investors and securities analysis to assess and predict the ISSI volatility. Investors can also observe Islamic stocks that tend to print an increase in income and good performance, so they are suitable for investing.

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