

Analysis of the Jakarta Islamic Index (JII) Using the Autoregressive Integrated Moving Average (ARIMA) Method During and After the COVID-19 Pandemic

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ABSTRACT

This study aims to identify the best Autoregressive Integrated Moving Average (ARIMA) model for analysing movements of the Jakarta Islamic Index (JII) during the COVID-19 pandemic (2020-2022) and after the pandemic (2023-2025), and to compare the resulting models. Daily JII closing prices from Investing.com were analysed using stationarity tests, model identification, parameter estimation, and residual diagnostic tests. The results indicate that ARIMA([2,3],1,[9]) is the best model for the pandemic period, while ARIMA([1],1,[13]) is the best model for the post-pandemic period. The post-pandemic model has lower AIC and SIC values (6,265914 and 6,291549) than the pandemic model (6,946495 and 6,977820), indicating better model fit. These differences suggest that the pandemic altered JII movement patterns and provide references for Sharia-compliant investment decisions.

INTRODUCTION

The capital market plays a crucial role in the economy-as a means of raising capital, an investment alternative, and an indicator of macroeconomic stability (Prasetyo, 2022). The Indonesia Stock Exchange (IDX), as the capital market in Indonesia, serves as an efficient means of distributing funds between investors and companies (Tambunan, 2020), as well as providing opportunities for the public to participate in the economy (Nurmalia and Thoyib, 2022). To help investors select stocks from among the many listed companies, the IDX provides several indices, including the Jakarta Islamic Index (JII), which is the focus of this study.

The JII was officially launched on July 3, 2000, with 30 sharia-compliant stocks that have the highest liquidity on the Indonesia Stock Exchange, selected based on listing duration, market capitalization, and daily trading frequency, and reviewed twice a year (Rifqi, 2021). The selection of the JII as the subject of this study is closely related to the growth of the Islamic economy and the increasing interest among investors in instruments based on Islamic principles in Indonesia.

Figure 1 illustrates that during the COVID-19 pandemic (2020-2022), the JII underwent significant changes, beginning with a drastic decline in early 2020, which was then followed by a fairly rapid recovery. The JII's performance generally aligned with that of the Composite Stock Price Index (IHSG), although it appeared more stable over several quarters. Entering the post-pandemic phase (2023-2025), the JII's movements show calm, with lower volatility and a significant positive increase at the end of the period. This pattern reflects that sharia-compliant stocks tend to be defensive and are able to recover well after experiencing a crisis.

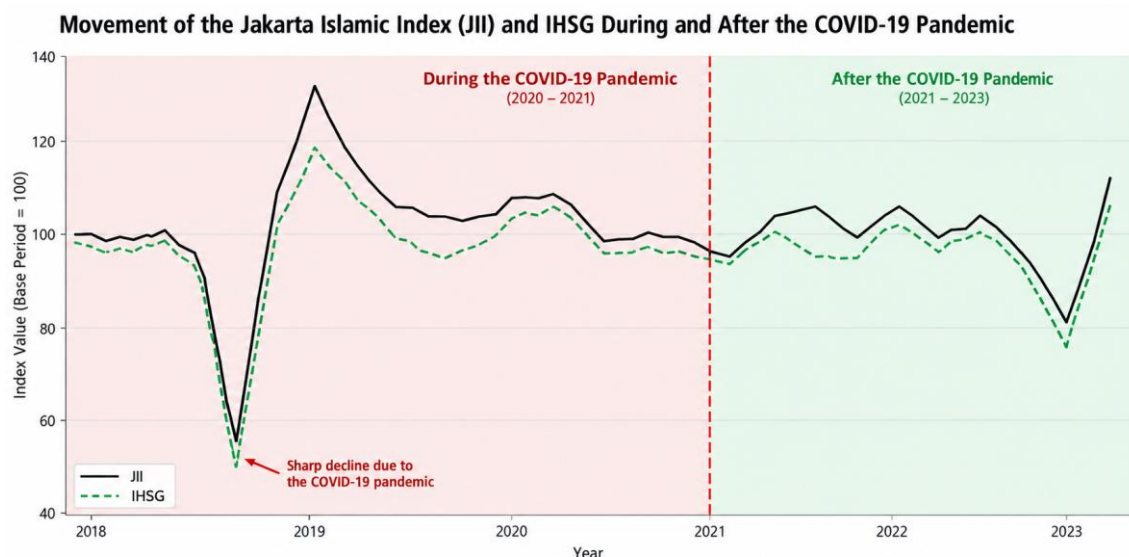


Figure 1. Performance of the Jakarta Islamic Index (JII) and the Composite Stock Price Index (IHSG) for the 2019-2025 Period

Source: Data compiled by the researcher from investing.com (2020-2025)

The trend in recent years showing a decline in the JII makes it important to analyse this index quantitatively using the ARIMA (Autoregressive Integrated Moving Average) method. This method was chosen because of its ability to handle non-stationary time series data, such as stock prices, and has proven successful in various empirical studies in the financial sector (Fauzani and Rahmi, 2023; Panjaitan et al., 2018; Safitri et al., 2021; Prabuningrat et al., 2023; Susilawati and Sunendiari, 2022, in Nisardi et al., 2024). Several previous studies have also utilized ARIMA to model the price movements of individual stocks. For example, Wulandari and Yurinanda (2021) analysed the stock of PT Bank Central Asia Tbk and developed an ARIMA(0,2,1) model; Rezaldi and Sugiman (2021) examined the stock of PT Telekomunikasi Indonesia Tbk using an ARIMA(0,2,1) model, and Nailufar et al. (2023), who examined Alphabet Inc. stock using an ARIMA(0,1,0) model.

Based on the above discussion, this study aims to identify the best ARIMA model for analysing movements in the JII during and after the COVID-19 pandemic, as well as to compare the two models, thereby providing insight into how the global health crisis has affected the movement patterns of the sharia stock index in Indonesia.

LITERATURE REVIEW

Asset Pricing

Asset pricing is a theory in the field of finance that describes how the prices of financial assets are determined in the market based on predictions of return and risk. The Capital Asset Pricing Model (CAPM) indicates that the higher the beta coefficient of a stock, the higher the rate of return and risk accepted by investors (Kholishoh et al., 2018; Aunillah and Wahyudi, 2022). Fama and French (1993) expanded the CAPM by adding the size premium and the book-to-market premium (Hermawan and Anwar, 2025), while Ross's (1976) Arbitrage Pricing Theory (APT) emphasizes that expected returns are influenced by macroeconomic factors, not just firm-specific risks (Gea and Silalahi, 2022). These asset pricing theories serve as a foundation for understanding how market uncertainty during and after the pandemic is reflected in the JII's price movement patterns.

Time Series Analysis and ARIMA Models

Time series data refers to a set of data collected in chronological order at consistent intervals, which generally reveals stable patterns, trends, seasonal variations, or cyclical patterns (Arini et al., 2021). Time series analysis methods can be divided into two types: univariate, which focuses on a single variable and relies on the previous values of that variable; and multivariate, which involves multiple variables simultaneously to detect interactions among them (Iftikhar et al., 2025; Audibert et al., 2021).

In its application, the ARIMA model uses only one variable in the time series (univariate), with the caveat that the AR and MA components are relevant only for stationary series; thus, for non-stationary series, transformation via differencing is required (Junaid et al., 2020). ARIMA is

recognized as an effective method for handling non-stationary data that exhibit trends or seasonal patterns; it excels at modeling historical patterns to predict future values in a structured manner and has proven successful in various studies in the field of finance (Nisardi et al., 2024). This model is expressed in the form $ARIMA(p,d,q)$, where p represents the order of the autoregressive process, d indicates the order of differencing, and q describes the order of the moving average process.

Capital Markets, Stocks, and Stock Indices

According to Law No. 8 of 1995, capital market activities include public offerings and the trading of securities, public companies involved in the securities they issue, as well as institutions and professionals related to those securities. The capital market serves as a venue that connects individuals or entities with excess funds (investors) with those in need of funds (issuers) through securities transactions such as stocks, bonds, and mutual funds (Patrianto and Hartono, 2021). A stock itself is a token of ownership in a company, with a price that is volatile and random (Putri and Aghsilni, 2019), while a stock index is a statistical measure that reflects the price movements of a specific group of stocks and serves as an indicator of market conditions for investors (Indonesia Stock Exchange, 2022).

Jakarta Islamic Index (JII)

The Jakarta Sharia Stock Index (JII) is the first index to track sharia-compliant stocks in the Indonesian capital market. This index was introduced on July 3, 2000, and consists of the 30 most liquid Sharia-compliant stocks on the Indonesia Stock Exchange (IDX). The JII is reviewed twice a year in accordance with the review schedule for the Sharia Securities List issued by the Financial Services Authority (OJK). The criteria for liquidity include a minimum listing period of six months; selection of the 60 stocks with the highest market capitalization; and further screening to identify the 30 stocks based on the highest average daily trading value (Indonesia Stock Exchange, 2022).

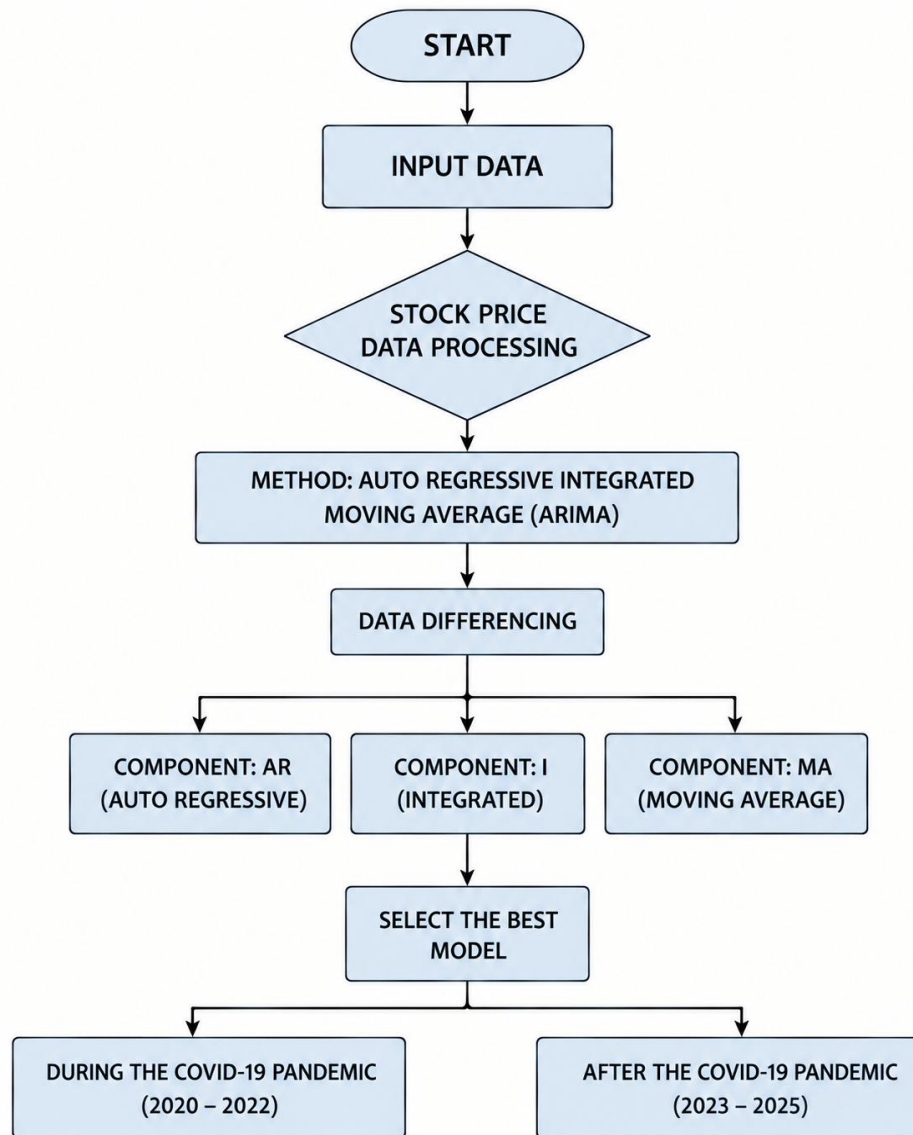


Figure 2. Conceptual Framework of the Study

METHODOLOGY

This research is a quantitative study using a descriptive-comparative approach that aims to describe the price movement patterns of the JII Index during the COVID-19 pandemic (2020-2022) and post-pandemic (2023-2025) periods, as well as to compare the performance of the ARIMA forecasting model across these two periods. The research was conducted from May 1 to July 30, 2025.

The data used consists of daily closing prices of the JII from 2020 to 2025, obtained from the website www.investing.com, downloaded in CSV format, and processed using Microsoft Excel and EViews 12. Prior to analysis, the data underwent a cleaning process that included removing outliers, checking for duplicates, and handling missing values and inconsistent date formats. The study population comprised all historical daily closing price data for the JII from 2020 to 2025, with a purposive sample divided into two groups: (1) the

COVID-19 pandemic period (2020-2022) with a total of 735 trading days, and (2) the post-COVID-19 pandemic period (2023-2025) with a total of 714 trading days.

Data analysis was conducted in stages using EViews 12, including: (1) descriptive analysis to characterize the data; (2) model suitability tests, consisting of tests for stationarity in the mean and variance (including the Augmented Dickey-Fuller/ADF unit root test, with the null hypothesis of the presence of a unit root/non-stationary data), as well as model identification through the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF); (3) estimation of the ARIMA(p,d,q) model, which combines autoregressive (AR), differencing (I), and moving average (MA) processes; and (4) a white noise test on the residuals to ensure there is no significant residual autocorrelation and that the model has captured all patterns in the data (Sujarwo, 2025). Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) values are used to determine the best model over time.

RESEARCH RESULT

Descriptive Statistics

Descriptive statistics for the JII for both observation periods are shown in Table 1. During the COVID-19 pandemic, which lasted from January 2, 2020, to December 30, 2022, the mean JII was 579.64, with a median of 574.56, a maximum value of 699.45, a minimum of 393.86, and a standard deviation of 44.22, indicating a relatively symmetrical distribution with fluctuations still within reasonable limits.

Table 1. Descriptive Statistics for the Jakarta Islamic Index (JII)

Statistics	During the COVID-19 Pandemic (2020-2022)	After the COVID-19 Pandemic (2023-2025)
Mean	579,64	525,81
Median	574,56	526,63
Maximum	699,45	591,84
Minimum	393,86	373,94
Std. Dev.	44,22	40,52

Source: EViews 12 output (processed data, 2025)

Stationarity Tests and Model Identification

The results of the Augmented Dickey-Fuller unit root test indicate that the JII data for both periods are non-stationary at the level (before differencing). Therefore, to ensure that the data achieve stationarity, first-order differencing ($d = 1$) is required. After differencing, the ACF and PACF patterns were examined to identify the AR and MA orders. Subsequently, several potential

models were evaluated and compared based on parameter significance, AIC and SIC values, and the results of the white noise test on the residuals.

Best ARIMA Model

The ARIMA([2,3],1,[9]) model was considered the best fit during the COVID-19 pandemic, with an AIC of 6,946495 and an SIC of 6,977820. The AR(2) component (coefficient -0,090345; p-value 0,0001), AR(3) component (coefficient 0,154537; p-value 0,0000), and MA(9) component (coefficient -0,090416; probability 0,0001) are statistically significant, while the constant (-0,144693; probability 0,6207) is not significant. With an AIC of 6,265914 and a SIC of 6,291549, the ARIMA([1],1,[13]) model is considered the best fit for the post-pandemic period. The AR(1) component (coefficient -0,092907; probability 0,0052) and the MA(13) component (coefficient 0,095429; probability 0,0048) are statistically significant, while the constant is not significant. With Durbin-Watson values of 2,017388 and 2,004782, respectively-which are nearly identical-the residuals of both models satisfy the white noise assumption, indicating that no significant autocorrelation remains.

Table 2. Comparison of the Best ARIMA Models for the Period During and After the COVID-19 Pandemic

Description	During the COVID-19 Pandemic (2020-2022)	After the COVID-19 Pandemic (2023-2025)
The best model	ARIMA([2,3],1,[9])	ARIMA([1],1,[13])
AR Components	AR(2) dan AR(3)	AR(1)
MA Components	MA(9)	MA(13)
Order of differencing	1	1
AIC	6,946495	6,265914
SIC	6,977820	6,291549
Durbin-Watson	2,017388	2,004782
Residual white noise	Fulfilled	Fulfilled

Source: EViews 12 output (processed data, 2025)

In Table 2, the pandemic-period model has two AR components (lags 2 and 3), while the post-pandemic-period model has only one AR component (lag 1). This indicates that more complex historical values influenced the JII's movements during the pandemic due to high market uncertainty. Conversely, the effects of shocks in the post-pandemic period last longer (up to lag 13) than in the pandemic period (up to lag 9). Better goodness of fit is indicated by lower AIC and SIC values for the post-pandemic model compared to the pandemic model.

DISCUSSION

The ARIMA([2,3],1,[9]) model during the COVID-19 pandemic shows that fluctuations in the JII do not depend solely on past index data but are also influenced by shocks or prediction errors from previous periods. This finding is consistent with asset pricing theory, which states that in situations of high uncertainty, investors tend to periodically adjust their expectations regarding risk and return-as evidenced by how the JII is influenced by the AR and MA components. This is also in line with a study conducted by Diharjo and Arief (2021), which produced an ARIMA([0],1,[1]) model for the IDX30 index throughout the COVID-19 pandemic, and supports the findings of Zhang et al. (2022), which showed that stock market movements before and after the emergence of COVID-19 exhibited distinct patterns and could be identified using the ARIMA method.

After the pandemic, the ARIMA([1],1,[13]) model indicates that movements in the JII are still influenced by values from previous periods and past impacts, albeit in a simpler structure within the AR component. This suggests that price adjustment processes and investor expectations do not entirely erase the historical patterns found in the JII daily data, consistent with the findings reported by Wulandari and Yurinanda (2021) and Rezaldi and Sugiman (2021), who also successfully identified patterns in stock price time series using ARIMA, and supporting the study by Ahmed et al. (2023), which states that ARIMA is effective in predicting index movements during periods of uncertainty.

The difference in model structure between the two periods-two AR and MA components at lag 9 during the pandemic, which changed to one AR and MA component at lag 13 after the pandemic-shows that external factors such as a global health crisis can influence the dynamics of stock market time series. Therefore, a model relevant for one period cannot be directly applied to another period. In the context of asset pricing, these differences indicate changes in risk conditions and investor expectations: increased uncertainty during the pandemic caused index movement patterns to become more complex, whereas as the economy entered the recovery phase, these patterns began to simplify, although they have not yet completely disappeared. These results are consistent with the research by Zhang et al. (2022) and Chia and Liew (2022), which showed that volatility in the stock market increased significantly during the pandemic and then gradually declined, confirming that no single ARIMA model applies to all market conditions.

CONCLUSIONS AND RECOMMENDATIONS

The JII data for both observation periods are not stationary at the level, so first-order differencing is required. The best ARIMA model for the COVID-19 pandemic period is ARIMA([2,3],1,[9]), which has statistically significant AR(2), AR(3), and MA(9) components, while the best model for the post-pandemic period is ARIMA([1],1,[13]), with AR(1) and MA(13) components that are also significant. Both models satisfy the white noise residual criterion; however, the model for the post-pandemic period exhibits lower AIC and SIC

values (6,265914 and 6,291549) compared to the model for the pandemic period (6,946495 and 6,977820), indicating a higher level of model fit. The differences in model characteristics and structure between the two periods suggest that the COVID-19 pandemic has influenced the movement patterns of the Jakarta Islamic Index (JII); therefore, the determination of the optimal ARIMA model must be based on the data characteristics and market conditions in each period.

Researchers analysing stock index movements during a crisis such as a pandemic should consider methods better suited to capturing high volatility, such as the GARCH model or the hybrid ARIMA-GARCH model. Researchers analysing the post-pandemic period should proceed to the forecasting stage and evaluate the accuracy of their forecasts using error metrics such as MAPE, RMSE, or MAE. A broader comparison with other methods, such as Long Short-Term Memory (LSTM) or machine learning-based models, is also recommended for future research. For investors and market participants, the results of this study indicate that the ideal model for analysing JII movements may vary depending on market conditions; therefore, periodic model evaluation is recommended over the continuous use of the same model. For policymakers, the differences in model structure between the pandemic and post-pandemic periods may serve as evidence that economic crises significantly alter capital market dynamics, necessitating flexible and responsive market stabilization policies.

ADVANCED RESEARCH

Based on daily closing prices, the univariate ARIMA approach used in this study has not yet reached the forecasting stage or the evaluation of forecasting accuracy. Future research should expand the analysis to the forecasting stage using accuracy metrics (MAPE, RMSE, MAE), consider models that capture volatility such as GARCH during crisis periods, and compare the performance of ARIMA with machine learning-based approaches such as LSTM to gain a more comprehensive understanding of the dynamics of the Islamic stock market in Indonesia.

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