Macroeconomic Factor Analysis of Composite Stock Price Index (IHSG) Returns Period (2020-2025) Using Multiple Linear Regression

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ABSTRACT

The Jakarta Composite Index (JCI) is the main indicator used to describe the performance of the Indonesian capital market. JCI movements are influenced by various macroeconomic factors that can influence investment decisions and financial market stability. This study aims to analyze the influence of macroeconomic factors consisting of the USD/IDR exchange rate, the BI Rate, gold prices, and inflation on JCI returns for the 2020–2025 period. The data used are monthly data obtained from Yahoo Finance, Bank Indonesia, and the Central Bureau of Statistics. The research method used is Python-based multiple linear regression with analysis stages including return transformation, stationarity test using Augmented Dickey-Fuller (ADF), multicollinearity test using Variance Inflation Factor (VIF), and classical assumption testing using Durbin-Watson, BreuschPagan, and Jarque-Bera. The results show that changes in the USD/IDR exchange rate have a negative and significant effect on JCI returns. Conversely, changes in the BI Rate, gold prices, and inflation do not show a significant effect at the 5% significance level. The developed model explains 43.6% of the variation in JCI returns and meets the required statistical assumptions. These findings demonstrate that the exchange rate is the most dominant macroeconomic factor influencing JCI returns during the study period. These results are expected to serve as a reference for investors and researchers in understanding the relationship between macroeconomic conditions and the Indonesian capital market.

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1. INTRODUCTION

The capital market is an important component in the modern economic system because it functions as a means of raising funds for companies and as an investment medium for the public. (K et al., 2024) . The existence of capital markets provides companies with the opportunity to obtain long-term funding to support business development, while investors obtain investment alternatives with the potential to generate profits. Furthermore, capital market development is often used as an indicator of a country's economic condition because it reflects the level of investor confidence in economic stability and business prospects.

In Indonesia, one of the indicators used to describe the condition of the capital market is the Composite Stock Price Index (IHSG). (Wibowo et al., 2021) . The Jakarta Composite Index (JCI) is an index that reflects the movement of all stocks listed on the Indonesia Stock Exchange (IDX), and is therefore often used as a benchmark for assessing the performance of the national capital market. Changes in the JCI's value are influenced not only by internal company conditions but also by various external factors originating from the macroeconomic environment. Therefore, analyzing the factors influencing JCI movements is crucial for investors, academics, and policymakers in understanding the dynamics of the Indonesian capital market.

In practice, investors not only consider a company's financial information when making investment decisions but also consider economic conditions that can affect the level of risk and return on investment. Some macroeconomic indicators frequently associated with capital market movements are the US dollar exchange rate against the rupiah (USD/IDR), the BI Rate, gold prices, and inflation. These variables are linked to national and global economic activity, which can ultimately influence investor sentiment and stock price movements.

The USD/IDR exchange rate is an economic indicator closely monitored by investors because it is related to international trade activity, corporate production costs, and foreign capital flows. A weakening rupiah against the US dollar can increase import costs and burden companies with foreign currency obligations. This situation has the potential to reduce corporate profitability and discourage investors from investing in the stock market. Conversely, a strengthening rupiah can increase investor optimism regarding the national economy.

In addition to the exchange rate, the BI Rate, Bank Indonesia's benchmark interest rate, also influences investment activity in the capital market. Changes in interest rates can influence investors' decisions when selecting investment instruments. When interest rates rise, investors tend to shift funds to lower-risk instruments such as deposits or bonds. Conversely, when interest rates fall, the stock market becomes more attractive due to lower corporate capital costs and greater profit opportunities.

The gold price is also often used as an economic indicator related to investment behavior. Gold is known as a safe haven asset that tends to be sought after during times of economic and financial market uncertainty. Rising gold prices may encourage some investors to shift their investments from the stock

market to the commodity market. This shift in investment preferences has the potential to impact stock trading activity and the movement of the Jakarta Composite Index (JCI).

Another equally important macroeconomic factor is inflation. High inflation can reduce people's purchasing power, increase companies' production costs, and reduce their profits. This can lead to declining company performance and ultimately affect stock prices on the capital market. Therefore, inflation is often used as a key variable in research examining the relationship between economic conditions and the stock market.

The relationship between macroeconomic factors and the Jakarta Composite Index (JCI) has been extensively studied. Research by Sutandi et al. (2021) showed that inflation, the rupiah exchange rate, and interest rates had no significant effect on the JCI. Meanwhile, Asriani and Hapsari (2022) found that inflation had no significant effect on the JCI, while the BI7DRR had a significant effect on stock index movements. On the other hand, Ansyori (2025) concluded that the exchange rate and gold prices had a significant influence on the JCI in the long term using the Autoregressive Distributed Lag (ARDL) approach. These differing findings indicate that the relationship between macroeconomic variables and JCI movements remains inconsistent and requires further study.

The research period was set for 2020–2025 because it encompasses various significant economic events impacting Indonesia's financial markets, ranging from the COVID-19 pandemic, the postpandemic economic recovery process, to changes in monetary policy at both the national and global levels. These conditions led to fluctuations in various economic indicators, providing a relevant context for analyzing the relationship between macroeconomic factors and the JCI movement.

Although extensive research has been conducted on the influence of macroeconomic factors on the Jakarta Composite Index (JCI), most previous studies have used level-based data on economic variables and stock indices. Using level-based data in time series data can potentially lead to nonstationarity issues, which can result in spurious regression. Furthermore, previous research has shown inconsistencies regarding the macroeconomic variables that most influence the JCI. Therefore, a more appropriate approach for time series data is needed to more accurately explain the relationships between variables.

Unlike previous research, this study uses return transformations on the Jakarta Composite Index (JCI), the USD/IDR exchange rate, and gold prices, as well as changes in the BI Rate and inflation variables before conducting regression modeling. Furthermore, the analysis is complemented by stationarity testing using Augmented Dickey-Fuller (ADF), multicollinearity testing using the Variance Inflation Factor (VIF), and model diagnostic testing using Durbin-Watson, Breusch-Pagan, and Jarque-Bera. This approach is used to ensure the model meets the necessary statistical assumptions, thus ensuring more valid and scientifically interpretable analysis results.

In addition to providing empirical contributions to the study of Indonesian capital markets, this research is also expected to enrich the use of the Python programming language in economics and finance.

Python provides various libraries that support data processing, statistical analysis, and data visualization, enabling research processes to be more efficient, transparent , and easily replicated by other researchers.

Based on this description, the research focuses on analyzing the influence of the USD/IDR exchange rate, BI Rate, gold price, and inflation on the return of the Jakarta Composite Index (JCI) for the 2020–2025 period using the Python-based Multiple Linear Regression method. The research results are expected to contribute to the development of Indonesian capital market studies and serve as a reference for investors, academics, and policymakers in understanding the macroeconomic factors that influence JCI returns.

2. LITERATURE REVIEW

2.1. Capital Market

The capital market is a crucial instrument in the economic system, serving as a means of raising longterm funds for companies and as an investment alternative for the public. Through the capital market, companies can obtain funding for business expansion, while investors have the opportunity to profit through ownership of financial instruments such as stocks, bonds, and mutual funds. Capital market activity is often used as an indicator of a country's economic development because it reflects the level of investor confidence in economic conditions and future business prospects. (Amin, 2012) .

Capital market development is influenced by various economic factors, both domestic and global. Changes in macroeconomic indicators such as inflation, interest rates, exchange rates, and commodity prices can influence investor behavior in making investment decisions. Therefore, analyzing the relationship between macroeconomic factors and capital markets is crucial for understanding the dynamics of stock price movements. (Listrino & Nuraina, 2015) .

2.2 Return of the Composite Stock Price Index (IHSG)

The Composite Stock Price Index (IHSG) is an index that describes the movement of all shares listed on the Indonesia Stock Exchange (IDX). (K et al., 2024) . The JCI is used as a primary indicator to assess the condition of the Indonesian capital market and is often used as a reference by investors in evaluating stock investment performance.

In modern capital market research, analysis is often performed on the JCI return compared to the index value directly. Returns describe the rate of change in the index value from one period to the next, thus better representing the profits or losses experienced by investors. Using returns also helps mitigate the non-stationarity problem that often arises in financial time series data.

Mathematically, returns can be calculated using the formula:

$$Return_t = \frac{IHSG_t - IHSG_{t-1}}{IHSG_{t-1}}$$

Where:

- Return = IHSG return for the t period
- IHSGt = IHSG value for period t
- IHSGt−1 =IHSG value of the previous period

2.3 USD/IDR Exchange Rate and IHSG Return

An exchange rate is the price of one currency against another. In the Indonesian context, the USD/IDR exchange rate indicates the number of rupiah needed to purchase one US dollar. The exchange rate is a crucial indicator because it directly impacts international trade, foreign investment, and corporate business activities. (Asriani & Hapsari, 2022) .

A weakening rupiah exchange rate can increase import costs, especially for companies dependent on foreign raw materials. This can reduce corporate profitability and impact stock prices. Conversely, a strengthening rupiah exchange rate can increase investor confidence in national economic stability, potentially boosting the JCI's returns.

esearch by Amin and Herawati (2012) shows that the USD/IDR exchange rate negatively impacts the JCI. Research by Ansyori (2025) also found that the rupiah exchange rate significantly impacts the JCI in the long term.

2.4 BI Rate and IHSG Return

The BI Rate is the policy interest rate set by Bank Indonesia as a monetary control instrument. Changes in the BI Rate affect bank interest rates, borrowing costs, and public investment activity. (Parulian & Suartini, 2013) .

When the BI Rate rises, investors tend to shift funds from the stock market to safer instruments like deposits and bonds. Conversely, when the BI Rate falls, the stock market becomes more attractive because companies' cost of capital is lower and potential investment returns increase.

Research by Listriono and Nuraina (2015) showed that the BI Rate had a significant impact on the JCI. Contrary results were found by Sutandi et al. (2021), who stated that interest rates had no significant effect on the JCI.

The difference in results shows that the relationship between the BI Rate and the IHSG is still an interesting topic for further study.

2.5 Gold Prices and IHSG Returns

Gold is an investment instrument often used as a safe haven. When economic conditions experience uncertainty, investors tend to shift some of their funds to gold because it is perceived as having lower risk.

Rising gold prices are often associated with a shift of funds from the stock market to the commodity market. Consequently, rising gold prices have the potential to reduce investment activity in the stock market and impact the JCI's returns.

Ansyori's (2025) research found that gold prices have a significant influence on the Jakarta Composite Index (JCI) in the long term. This finding suggests that gold prices are a macroeconomic variable that requires attention in capital market analysis.

2.6 Inflation and IHSG Returns

Inflation is a general and persistent increase in the prices of goods and services over a period of time. High inflation can reduce people's purchasing power and increase companies' production costs.

From a capital market perspective, high inflation can reduce corporate profits, leading to lower stock prices. However, under certain conditions, stable inflation can reflect good economic growth and therefore doesn't always have a negative impact on the capital market.

Research by Sutandi et al. (2021) shows that inflation has no significant effect on the JCI. Similar results were found by Asriani and Hapsari (2022), who stated that inflation had no significant effect on the JCI.

2.7 Multiple Linear Regression

Multiple Linear Regression is a statistical method used to analyze the relationship between one dependent variable and more than one independent variable simultaneously.
The general model of multiple linear regression is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Information:

- Y = Return of the Composite Stock Price Index
- X1 = USD/IDR exchange rate
- X2 = BI Rate
- X3 = Gold Price
- X4 = Inflation
- β0 = constant
- β1–β4 = regression coefficient
- ε = error

This method was chosen because it is able to measure the influence of each macroeconomic variable on the IHSG return partially and simultaneously.

2.9 Python in Data Analysis

Python is a programming language widely used in data science, machine learning, statistics, and financial analysis due to its simple syntax and support for a comprehensive range of data analysis libraries. In economic and capital market research, Python is used for efficient data processing, visualization, statistical testing, and predictive model development.

One of Python's strengths is its ability to process time series data, which is widely used in economics and financial research. Furthermore, Python is open source, allowing researchers to conduct transparent and easily replicable analyses.

The analysis utilized several key Python libraries: Pandas for data management and manipulation, NumPy for numerical computation, Statsmodels for statistical analysis and multiple linear regression, and Matplotlib and Seaborn for data visualization. The use of Python is expected to improve the efficiency of the analysis process and produce more accurate models that are easily reproducible by other researchers.

2.10 Previous Research

Previous research serves as a foundation for understanding the development of research related to the influence of macroeconomic factors on the movement of the Jakarta Composite Index (JCI). By reviewing previous research, we can identify frequently used variables, applied methods, and obtained research results, which can help identify research gaps.

Table 2.1 Previous Research

No	Researchers	Method	Variables	Research result
1	Amin and Herawati (2012)	Linear Regression	Exchange rate, IHSG	The exchange rate has a negative impact on the JCI.
2	Jeremiah et al. (2013)	Multiple Linear Regression	Macroeconomic variables and the Composite Stock Price Index (IHSG)	Macroeconomic factors influence the movement of the JCI.
3	Listriono and Nuraina (2015)	Multiple Linear Regression	Inflation, BI Rate, Exchange Rate, IHSG	BI Rate and exchange rate influence the JCI.
4	Sutandi et al. (2021)	Multiple Linear Regression	Inflation, Exchange Rate, Interest Rate, IHSG	The variables tested did not have a significant effect on the JCI.
5	Rupaidah, Syarif, and Enri (2021)	Linear Regression	IHSG historical data	The regression model is able to model the movement of the JCI well.
6	Asriani and Hapsari (2022)	Linear Regression	Inflation, BI7DRR, IHSG	Inflation is not significant, BI7DRR is significant to IHSG.
7	Aryani and Pardistya (2024)	Multiple Linear Regression	Gold Price, Exchange Rate, IHSG	Gold prices and exchange rates affect the JCI.
8	Ansyori (2025)	ARDL	Inflation, Exchange Rate, Gold Price, IHSG	The exchange rate and gold price have a significant impact on the JCI in the long term.

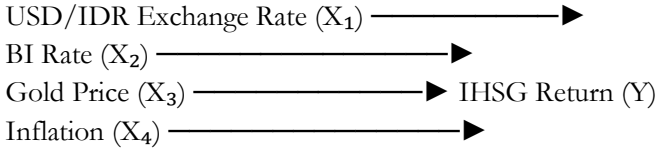
2.11 Research Gap

Previous research has found mixed results regarding the influence of the USD/IDR exchange rate, the BI Rate, gold prices, and inflation on the Jakarta Composite Index (JCI). Some studies indicate that the exchange rate and gold prices significantly influence the JCI, while others find that inflation and interest rates have no significant effect. These discrepancies indicate that the relationship between macroeconomic factors and the JCI remains inconsistent, requiring further research.

Furthermore, most previous studies used level data for economic variables and stock indices. Using level data for time series data can potentially lead to non-stationarity issues, which can result in spurious regression. Therefore, this study utilized return transformations for the Jakarta Composite Index (JCI), the USD/IDR exchange rate, and gold prices, as well as changes in the BI Rate and inflation before modeling.

This study also integrates stationarity testing using Augmented Dickey-Fuller (ADF), multicollinearity testing using Variance Inflation Factor (VIF), and Python-based Multiple Linear Regression analysis for the 2020–2025 period covering the COVID-19 pandemic and post-pandemic economic recovery.

2.12 Conceptual Framework



2.13 Research Hypothesis

H_1 : The USD/IDR exchange rate has a significant effect on the IHSG return.
H_2: BI Rate has a significant effect on IHSG Return.
H_3 : Gold prices have a significant effect on IHSG returns.
H_4: Inflation has a significant effect on the IHSG return.
H_5: USD/IDR exchange rate, BI Rate, gold price, and inflation simultaneously have a significant effect on the IHSG Return.

3. METHOD, DATA, AND ANALYSIS

3.1 Research Design

This study employed a quantitative research approach using **Multiple Linear Regression (MLR)** to examine the relationship between selected macroeconomic variables and the monthly return of the Indonesian Composite Stock Price Index (IHSG) during the period **January 2020 to December 2025**. Multiple Linear Regression was selected because it enables the simultaneous evaluation of several independent variables in explaining variations in a single dependent variable **(Ansyori, 2025)**.

The dependent variable in this study is the **IHSG monthly return**, while the independent variables consist of the **USD/IDR exchange rate return, gold price return, BI Rate change, and inflation change**. Prior to model estimation, the variables were transformed according to their characteristics to improve the suitability of the time-series analysis. Return transformations were applied to the IHSG, USD/IDR exchange rate, and gold price, whereas first-difference transformations were applied to the BI Rate and inflation.

The regression model was estimated using the **Ordinary Least Squares (OLS)** method implemented in the **Statsmodels** library in Python. To evaluate the robustness of the empirical findings, additional analyses were conducted using **heteroskedasticity-consistent (HC3) standard errors**, a **lagged dependent variable model**, and a **pandemic-period control model**. These additional analyses were performed to assess whether the principal findings remained stable under alternative model specifications.

3.2 Population, Sample, and Unit of Analysis

The population of this study consists of macroeconomic and capital market data related to the movement of the Indonesian Composite Stock Price Index (IHSG). The variables observed include the IHSG, the USD/IDR exchange rate, the BI Rate, gold prices, and inflation over the study period.

The sample was selected using a purposive sampling approach based on the availability, completeness, and consistency of monthly data required for the analysis. The initial dataset consisted of **72 monthly observations**, covering the period from **January 2020 to December 2025**.

Before regression analysis, the variables were transformed according to their characteristics. Monthly return transformations were applied to the IHSG, USD/IDR exchange rate, and gold price, while first-difference transformations were applied to the BI Rate and inflation. Because these transformations require observations from the previous period, the first observation (January 2020) could not be used in the

transformed dataset. Consequently, the regression analysis was conducted using **71 effective observations**, covering the period from **February 2020 to December 2025**.

The unit of analysis in this study is each monthly observation representing the macroeconomic conditions and capital market performance in Indonesia during the observation period.

3.3 Data Collection

This study used secondary data obtained from various official and reliable sources. Data on the Jakarta Composite Index (JCI), the USD/IDR exchange rate, and gold prices were obtained from Yahoo Finance, while BI Rate data was obtained from Bank Indonesia (BI) publications, and inflation data was obtained from the Central Statistics Agency (BPS).

The data collection process began by retrieving monthly data for each variable according to the predetermined observation period. Subsequently, all datasets were standardized using a consistent monthly date format and integrated into a single research dataset. This integration ensured that each observation represented the same time period across all variables.

Before conducting the statistical analysis, the dataset underwent a data preparation stage, including verification of missing values, duplicate observations, and consistency among variables. After the data quality had been confirmed, the variables were transformed according to the analytical requirements and prepared for subsequent statistical analysis.

3.4 Variable Measurement

This study employed one dependent variable and four independent variables. The dependent variable is the **monthly return of the Jakarta Composite Index (JCI)**, which represents the performance of the Indonesian stock market. The independent variables consist of the **monthly return of the USD/IDR exchange rate**, **monthly return of gold prices**, **monthly change in the BI Rate**, and **monthly change in the inflation rate**. These variables were selected because they represent major macroeconomic factors that are commonly associated with stock market movements.

Prior to the regression analysis, the variables were transformed according to their characteristics. Market price variables, including the JCI, USD/IDR exchange rate, and gold prices, were converted into monthly returns to measure the percentage change between two consecutive months. Meanwhile, the BI Rate and inflation were transformed using the first-difference method to capture monthly changes in these macroeconomic indicators.

The monthly return was calculated using the following equation:

$$Return_t = \frac{X_t - X_{t-1}}{X_{t-1}}$$

- $Return_t$ = monthly return at period t
- X_t = value of the variable at period t
- X_{t-1} = value of the variable at period $t-1$

This transformation was applied to the following variables:

- Jakarta Composite Index (JCI)

- USD/IDR Exchange Rate
- Gold Price

The first-difference transformation was calculated using:

$$\Delta X_t = X_t - X_{t-1}$$

where:

- ΔX_t = change in the variable between two consecutive periods
- X_t =value of the variable at period t
- X_{t-1} = value of the variable at period $t-1$

This transformation was applied to:

- BI Rate
- Inflation

The application of these transformations aimed to produce variables that are more appropriate for time-series regression analysis and to improve the statistical properties of the data before model estimation.

Variable	Symbol	Unit	Transformation	Role
JCI Return	Y	%	Monthly Return	Dependent
USD/IDR Return	X_1	%	Monthly Return	Independent
BI Rate Change	X_2	Percentage Point	First Difference	Independent
Gold Return	X_3	%	Monthly Return	Independent
Inflation Change	X_4	Percentage Point	First Difference	Independent

3.5 Data Analysis Procedure

The data analysis in this study was conducted sequentially to ensure that the regression model satisfied the statistical assumptions and produced reliable results. The analysis was performed using Python with the Pandas, NumPy, Statsmodels, and SciPy libraries.

First, descriptive statistical analysis was conducted to summarize the characteristics of each variable, including the mean, standard deviation, minimum value, maximum value, and quartiles.

Second, the stationarity of each transformed variable was examined using the **Augmented Dickey–Fuller (ADF) test**. This test was performed to determine whether each time-series variable was stationary before regression analysis.

Third, multicollinearity among the independent variables was evaluated using the **Variance Inflation Factor (VIF)**. Variables with VIF values below the commonly accepted threshold indicate that multicollinearity is not a serious concern.

Fourth, the relationship between macroeconomic variables and the monthly return of the Jakarta Composite Index (JCI) was estimated using **Ordinary Least Squares (OLS) multiple linear regression**.

Fifth, several diagnostic tests were performed to evaluate whether the regression model satisfied the classical assumptions. These included the **Durbin–Watson test** for autocorrelation, the **Breusch–Pagan test** for heteroskedasticity, and the **Jarque–Bera test** for residual normality.

Finally, robustness analyses were conducted to evaluate the stability of the regression results. These analyses consisted of estimating the model using **HC3 robust standard errors**, incorporating a **lagged dependent variable**, and including a **pandemic-period dummy variable**. The robustness tests were intended to examine whether the main findings remained consistent under alternative model specifications.

3.6 Multiple Linear Regression Analysis

This study employed **Ordinary Least Squares (OLS) multiple linear regression** to examine the effect of macroeconomic variables on the monthly return of the Jakarta Composite Index (JCI). Multiple linear regression was selected because it enables the simultaneous estimation of the effects of several independent variables on a single dependent variable while controlling for the influence of the other explanatory variables.

The estimated regression model is expressed as follows:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \varepsilon_t$$

- Y_t = Monthly Return of the Jakarta Composite Index (JCI)
- β_0 = Intercept (constant)
- β_1 = Coefficient of USD/IDR Return
- β_2 = Coefficient of BI Rate Change
- β_3 = Coefficient of Gold Return
- β_4 = Coefficient of Inflation Change
- X_{1t} = USD/IDR Return
- X_{2t} = BI Rate Change
- X_{3t} = Gold Return
- X_{4t} = Inflation Change
- ε_t = Random error term

The significance of each regression coefficient was evaluated using the **t-test**, while the overall significance of the regression model was assessed using the **F-test**. The explanatory power of the model was measured using the **coefficient of determination (R^2)** and the **adjusted coefficient of determination ($\overline{R^2}$)**. Statistical significance was evaluated at the **5% significance level ($\alpha = 0.05$)**.

3.7 Diagnostic Test

Before interpreting the regression results, **diagnostic tests** were conducted to evaluate potential violations of the statistical assumptions underlying the baseline Ordinary Least Squares (OLS) model. The diagnostic results are interpreted as statistical evidence regarding potential assumption violations rather than absolute proof that an assumption is perfectly satisfied.

The diagnostic tests included the **Variance Inflation Factor**

$$VIF_i = \frac{1}{1-R_i^2}$$

to assess multicollinearity among the independent variables, the **Durbin–Watson**

$$DW = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2}$$

test to detect autocorrelation, the **Breusch–Pagan (BP) test** to examine heteroskedasticity, and the **Jarque–Bera (JB) test** to evaluate the normality of the regression residuals.

To further examine the stability of the estimated coefficients, **robustness tests** were also performed. These consisted of estimating the regression model using **HC3 heteroskedasticity-robust standard errors**, incorporating a **one-period lag of the dependent variable**, and including a **pandemic-period**

dummy variable. The robustness analyses were conducted to determine whether the estimated relationships remained consistent under alternative model specifications.

3.7.1 Stationarity Test

Stationarity was examined using the **Augmented Dickey–Fuller (ADF) test** to determine whether each transformed time-series variable contained a unit root. The null hypothesis of the ADF test states that the variable is non-stationary. A variable was considered stationary at the **5% significance level** when the ADF p-value was below **0.05**. The ADF test was applied to all transformed variables before estimating the regression model.

3.7.2 Multicollinearity Test

Multicollinearity among the independent variables was evaluated using the **Variance Inflation Factor (VIF)**. Higher VIF values indicate stronger linear relationships among the explanatory variables and potentially greater instability in the estimated regression coefficients. In this study, **VIF values below 10** indicate that multicollinearity is not considered a serious problem in the regression model.

3.7.3 Autocorrelation Test

Residual autocorrelation was evaluated using the **Durbin–Watson (DW) statistic**. A Durbin–Watson value close to **2** indicates limited evidence of first-order autocorrelation, whereas values substantially below or above 2 may indicate positive or negative autocorrelation, respectively.

3.7.4 Heteroscedasticity Test

Potential heteroskedasticity was evaluated using the **Breusch–Pagan (BP) test**. The null hypothesis assumes constant residual variance (homoskedasticity). A p-value greater than **0.05** indicates that the null hypothesis cannot be rejected, suggesting that the residual variance is approximately constant.

To ensure robust statistical inference, the regression model was also estimated using **HC3 heteroskedasticity-robust standard errors**. This robustness analysis was conducted to determine whether the statistical significance of the regression coefficients remained consistent after accounting for potential heteroskedasticity.

3.7.5 Normality Test

Residual normality was evaluated using the Jarque-Bera test. The null hypothesis indicates that the residual distribution is consistent with normality. The result was interpreted based on whether sufficient statistical evidence existed to reject the null hypothesis.

3.7.6 Robustness Test

To further assess the stability of the estimated relationships, additional robustness analyses were performed using alternative model specifications. Besides the estimation using **HC3 heteroskedasticity-robust standard errors**, the regression model was re-estimated by incorporating a **one-period lag of the dependent variable** and a **pandemic-period dummy variable**. These robustness tests were conducted to evaluate whether the estimated coefficients remained consistent under different model specifications.

3.8 Software and Research Tools

All data processing and statistical analyses were performed using the **Python** programming language within the **Google Colaboratory** environment. Google Colaboratory provides a cloud-based platform that enables efficient data processing and statistical analysis without requiring additional software installation on the user's computer.

Several Python libraries were utilized according to their respective functions. **Pandas** was used for data collection, merging, cleaning, and manipulation, while **NumPy** supported numerical computations. **Statsmodels** was employed to estimate the multiple linear regression model and perform statistical tests, including the Augmented Dickey–Fuller, Breusch–Pagan, Durbin–Watson, and Jarque–Bera tests. **SciPy** was used to support additional statistical computations, whereas **Matplotlib** and **Seaborn** were used to visualize the data and analytical results.

The use of Python in this study provides a transparent, efficient, and reproducible analytical workflow, enabling future researchers to replicate the analysis using the same procedures and dataset.

4. RESULT AND DISCUSSION

4.1. Descriptive Analysis

This study uses monthly data covering the period from **January 2020 to December 2025**, including the **Jakarta Composite Index (JCI)**, the **USD/IDR exchange rate**, **gold prices**, the **BI Rate**, and **inflation**. After collecting and combining data from various sources, the variables were transformed by calculating **monthly returns** for the JCI, USD/IDR exchange rate, and gold prices, while **first differences** were applied to the BI Rate and inflation. Following the transformation process, the final dataset used in the regression analysis consisted of **71 observations**.

	N	Mean	Std. Dev.	Minimum	Q1	Median	Q3	Maximum
IHSG_Return	71.000000	0.006200	0.042400	-0.167600	-0.008400	0.007500	0.032300	0.094400
USD_Return	71.000000	0.003200	0.027000	-0.068000	-0.006600	0.001600	0.013700	0.141900
Gold_Return	71.000000	0.015100	0.041400	-0.069200	-0.016200	0.011900	0.042300	0.105700
BI_Rate_Change	71.000000	-0.003500	0.160900	-0.250000	0.000000	0.000000	0.000000	0.500000
Inflasi_Change	71.000000	0.003400	0.416800	-0.990000	-0.250000	-0.010000	0.195000	1.260000

Figure 1. Results of the Augmented Dickey-Fuller (ADF) Stationarity Test
Source: Processed by the Authors using Python (2026).

Based on **Figure 1**, all variables exhibit different levels of variation. **Gold_Return** has the highest average return among the return variables, while **Inflasi_Change** shows the largest standard deviation, indicating greater variability than the other variables. Overall, the descriptive analysis provides an initial overview of the distribution of the transformed variables before proceeding to the stationarity test and regression analysis.

4.2 Stationarity Test

The Augmented Dickey–Fuller (ADF) test was performed to examine the stationarity of the transformed variables before estimating the regression model. The results are presented in **Figure 2**.

Based on **Figure 2**, **IHSG_Return, USD_Return, Gold_Return, and Inflasi_Change** are stationary at the 5% significance level, as indicated by their p-values below 0.05. In contrast, **BI_Rate_Change** has a p-value of **0.0603**, indicating that it is not stationary at the 5% significance level. Overall, most transformed variables satisfy the stationarity assumption required for regression analysis.

	Variable	ADF Statistic	p-value	Lag	Observations	Critical Value 1%	Critical Value 5%	Critical Value 10%	Decision (5%)
0	IHSG_Return	-7.823200	0.000000	0	70	-3.527400	-2.903800	-2.589300	Stationary
1	USD_Return	-4.205900	0.000600	5	65	-3.535200	-2.907200	-2.591100	Stationary
2	Gold_Return	-7.633000	0.000000	0	70	-3.527400	-2.903800	-2.589300	Stationary
3	BI_Rate_Change	-2.786300	0.060300	5	65	-3.535200	-2.907200	-2.591100	Non-stationary
4	Inflasi_Change	-2.976000	0.037200	2	68	-3.530400	-2.905100	-2.590000	Stationary

Figure 2. Results of the Augmented Dickey-Fuller (ADF) Stationarity Test
Source: Processed by the Authors using Python (2026).

4.3 Multicollinearity Test

The Variance Inflation Factor (VIF) test was conducted to examine the presence of multicollinearity among the independent variables. The results of the VIF test are presented in **Figure 3**.

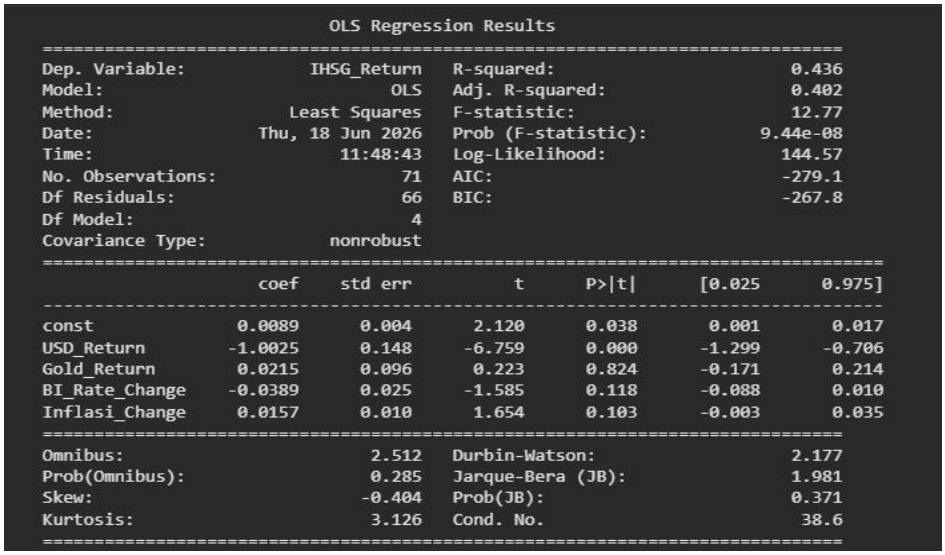
	Variable	VIF
0	const	1.171200
1	USD_Return	1.044100
2	Gold_Return	1.036800
3	BI_Rate_Change	1.017000
4	Inflasi_Change	1.025400

Figure 3. Results of the Variance Inflation Factor (VIF) Test
Source: Processed by the Authors using Python (2026).

Based on **Figure 3**, all independent variables have VIF values ranging from **1.0170** to **1.0441**, while the constant term has a VIF value of **1.1712**. Since all VIF values are substantially below the commonly accepted threshold of **10**, there is no evidence of multicollinearity among the independent variables. Therefore, all explanatory variables are considered suitable for inclusion in the multiple linear regression model.

4.4 Regression Analysis

Multiple linear regression analysis was conducted to examine the effects of the USD/IDR exchange rate, gold prices, the BI Rate, and inflation on IHSG returns. The regression results are presented in **Figure4**.



OLS Regression Results

Dep. Variable:	IHSG_Return	R-squared:	0.436
Model:	OLS	Adj. R-squared:	0.402
Method:	Least Squares	F-statistic:	12.77
Date:	Thu, 18 Jun 2026	Prob (F-statistic):	9.44e-08
Time:	11:48:43	Log-Likelihood:	144.57
No. Observations:	71	AIC:	-279.1
Df Residuals:	66	BIC:	-267.8
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0089	0.004	2.120	0.038	0.001	0.017
USD_Return	-1.0025	0.148	-6.759	0.000	-1.299	-0.706
Gold_Return	0.0215	0.096	0.223	0.824	-0.171	0.214
BI_Rate_Change	-0.0389	0.025	-1.585	0.118	-0.088	0.010
Inflasi_Change	0.0157	0.010	1.654	0.103	-0.003	0.035

Omnibus:	2.512	Durbin-Watson:	2.177
Prob(Omnibus):	0.285	Jarque-Bera (JB):	1.981
Skew:	-0.404	Prob(JB):	0.371
Kurtosis:	3.126	Cond. No.	38.6

Figure 4. Results of the Multiple Linear Regression (OLS) Analysis

Source: Processed by the Authors using Python (2026).

Model Evaluation

The regression model is statistically significant, as indicated by the **Prob (F-statistic)** of $\mathbf{9.44 \times 10^{-8}}$, which is well below the 5% significance level. This result indicates that the independent variables jointly have a statistically significant relationship with **IHSG_Return**.

The model produces an **R-squared value of 0.436** and an **Adjusted R-squared value of 0.402**. These values indicate that approximately **43.6%** of the variation in **IHSG_Return** can be explained by **USD_Return**, **Gold_Return**, **BI_Rate_Change**, and **Inflasi_Change**, while the remaining **56.4%** is explained by other variables that are not included in the regression model.

Overall, the regression model demonstrates acceptable explanatory power and provides an appropriate basis for evaluating the effects of the selected macroeconomic variables on IHSG returns.

Effect of USD_Return

The regression results show that **USD_Return** has a coefficient of **−1.0025** with a **p-value below 0.001**, indicating a statistically significant negative effect on **IHSG_Return**. This finding suggests that increases in the return of the USD/IDR exchange rate are associated with decreases in IHSG returns during the observation period.

The negative coefficient indicates an inverse relationship between exchange rate movements and stock market returns. A depreciation of the Indonesian Rupiah against the US Dollar may increase uncertainty in the financial market and reduce investor confidence, thereby exerting downward pressure on the Indonesian stock market.

Effect of Gold_Return

The estimated coefficient for **Gold_Return** is **0.0215**, indicating a positive relationship with **IHSG_Return**. However, the corresponding **p-value of 0.824** is substantially higher than the 5% significance level, indicating that the relationship is not statistically significant.

This result suggests that changes in gold returns did not significantly influence IHSG returns during the observation period. Although gold is often considered a safe-haven asset, the empirical results of this study indicate that its monthly return movements were not sufficient to explain variations in the Indonesian stock market.

Effect of BI_Rate_Change

The coefficient of **BI_Rate_Change** is **−0.0389**, indicating a negative relationship with **IHSG_Return**. However, the variable is not statistically significant, with a **p-value of 0.118**.

These findings indicate that changes in the BI Rate did not have a statistically significant impact on IHSG returns during the study period. Although interest rate changes may theoretically influence investment decisions and capital flows, the evidence from this regression model does not support a significant effect at the 5% significance level.

ffect of Inflasi_Change

The estimated coefficient for **Inflasi_Change** is **0.0157**, indicating a positive relationship with **IHSG_Return**. Nevertheless, the corresponding **p-value of 0.103** exceeds the 5% significance threshold, indicating that the relationship is not statistically significant.

This result suggests that monthly changes in inflation did not significantly explain movements in IHSG returns during the observation period. Therefore, inflation changes cannot be considered a significant predictor of IHSG returns within the regression model used in this study.

Summary of Regression Results

Overall, the multiple linear regression results indicate that the model is statistically significant and explains **43.6%** of the variation in **IHSG_Return**. Among the four independent variables examined, only **USD_Return** has a statistically significant effect on IHSG returns. In contrast, **Gold_Return**, **BI_Rate_Change**, and **Inflasi_Change** do not show statistically significant effects at the 5% significance level. These findings suggest that exchange rate movements play a more important role in explaining changes in IHSG returns than the other macroeconomic variables included in the model.

4.5 Diagnostic Test

To evaluate the validity of the regression model, several diagnostic tests were conducted, including the **Durbin–Watson test** for autocorrelation, the **Breusch–Pagan test** for heteroscedasticity, and the **Jarque–Bera test** for normality. The results are presented in **Figure 5**.

	Test	Statistic	p-value
0	Durbin-Watson	2.177500	NaN
1	Breusch-Pagan LM	6.908200	0.140800
2	Breusch-Pagan F	1.778500	0.143700
3	Jarque-Bera	1.981100	0.371400

Figure 5. Results of the Regression Diagnostic Tests

Source: Processed by the Authors using Python (2026).

Autocorrelation Test

The Durbin–Watson statistic is **2.1775**, which is close to the benchmark value of **2.0**. This result indicates that there is no evidence of autocorrelation in the residuals. Therefore, the independence assumption of the regression model is considered to be satisfied.

Heteroscedasticity Test

The Breusch–Pagan test produces an **LM statistic of 6.9082** with a **p-value of 0.1408**. In addition, the **F-statistic is 1.7785** with a corresponding **p-value of 0.1437**. Since both p-values are greater than the 5% significance level, the null hypothesis of homoscedasticity cannot be rejected.

These results indicate that the regression residuals exhibit constant variance, suggesting that heteroscedasticity is not a concern in the estimated model.

Normality Test

The Jarque–Bera test yields a statistic of **1.9811** with a **p-value of 0.3714**. Because the p-value exceeds the 5% significance level, the null hypothesis of normally distributed residuals cannot be rejected.

This finding suggests that the residuals are approximately normally distributed, supporting the validity of statistical inference based on the regression model.

Overall Assessment

Overall, the diagnostic test results indicate that the estimated regression model satisfies the major classical regression assumptions. The residuals show no evidence of autocorrelation or heteroscedasticity and are approximately normally distributed. Therefore, the regression model is considered statistically reliable and suitable for further analysis and interpretation.

4.6 Robustness Test

To evaluate the stability of the baseline regression results, robustness analyses were performed using three alternative model specifications, namely the **HC3 robust standard error model**, the **lagged regression model**, and the **pandemic-period dummy model**. The results of these robustness tests are presented in **Figures 6–8**.

	Variable	Coefficient	HC3 Std. Error	HC3 t-statistic	HC3 p-value	CI 95% Lower	CI 95% Upper
0	const	0.008900	0.004300	2.067900	0.042600	0.000300	0.017500
1	USD_Return	-1.002500	0.253600	-3.953400	0.000200	-1.508700	-0.496200
2	Gold_Return	0.021500	0.100100	0.214200	0.831000	-0.178500	0.221400
3	BI_Rate_Change	-0.038900	0.031900	-1.220800	0.226500	-0.102500	0.024700
4	Inflasi_Change	0.015700	0.010900	1.448800	0.152100	-0.005900	0.037400

Figure 6. HC3 Robust Regression Results

Source: Processed by the Authors using Python (2026).

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LAG-1 REGRESSION RESULTS

OLS Regression Results

Dep. Variable:	IHSG_Return	R-squared:	0.429
Model:	OLS	Adj. R-squared:	0.385
Method:	Least Squares	F-statistic:	9.629
Date:	Tue, 28 Jul 2026	Prob (F-statistic):	6.90e-07
Time:	04:22:36	Log-Likelihood:	143.89
No. Observations:	70	AIC:	-275.8
Df Residuals:	64	BIC:	-262.3
Df Model:	5		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0094	0.004	2.224	0.030	0.001	0.018
IHSG_Return_Lag1	0.0397	0.092	0.431	0.668	-0.144	0.224
USD_Return	-0.9471	0.150	-6.328	0.000	-1.246	-0.648
Gold_Return	0.0154	0.096	0.161	0.873	-0.176	0.206
BI_Rate_Change	-0.0470	0.025	-1.888	0.064	-0.097	0.003
Inflasi_Change	0.0173	0.009	1.833	0.071	-0.002	0.036

Omnibus:	3.410	Durbin-Watson:	2.356
Prob(Omnibus):	0.182	Jarque-Bera (JB):	2.636
Skew:	-0.447	Prob(JB):	0.268
Kurtosis:	3.324	Cond. No.	39.1

Figure 7. Lagged Regression Results

Source: Processed by the Authors using Python (2026).

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PANDEMIC-PERIOD ROBUSTNESS RESULTS

OLS Regression Results

Dep. Variable:	IHSG_Return	R-squared:	0.436
Model:	OLS	Adj. R-squared:	0.393
Method:	Least Squares	F-statistic:	10.06
Date:	Tue, 28 Jul 2026	Prob (F-statistic):	3.67e-07
Time:	04:24:45	Log-Likelihood:	144.57
No. Observations:	71	AIC:	-277.1
Df Residuals:	65	BIC:	-263.6
Df Model:	5		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0088	0.005	1.708	0.092	-0.001	0.019
USD_Return	-1.0020	0.150	-6.680	0.000	-1.302	-0.702
Gold_Return	0.0219	0.098	0.223	0.824	-0.174	0.217
BI_Rate_Change	-0.0387	0.025	-1.527	0.132	-0.089	0.012
Inflasi_Change	0.0158	0.010	1.641	0.106	-0.003	0.035
Pandemic_Period	0.0003	0.009	0.032	0.975	-0.017	0.018

Omnibus:	2.489	Durbin-Watson:	2.178
Prob(Omnibus):	0.288	Jarque-Bera (JB):	1.966
Skew:	-0.403	Prob(JB):	0.374
Kurtosis:	3.121	Cond. No.	41.1

Figure 8. Pandemic-Period Dummy Regression Results

Source: Processed by the Authors using Python (2026).

The HC3 robust regression produced results that were highly consistent with the baseline model. The explanatory power of the model remained unchanged (**R^2 = 0.436**; **Adjusted R^2 = 0.402**), while **USD_Return** continued to exhibit a statistically significant negative effect on **IHSG_Return** (**$\beta = -1.0025$**, **$p < 0.001$**). Meanwhile, **Gold_Return**, **BI_Rate_Change**, and **Inflasi_Change** remained statistically insignificant. These findings indicate that correcting the standard errors for potential heteroscedasticity does not alter the principal conclusions of the study.

The lagged regression model was estimated to examine whether the previous month's stock market return influences the current month's return. The model achieved an **R^2 of 0.429**, which is only slightly lower than the baseline model. The lagged dependent variable (**IHSG_Return_Lag1**) was not statistically

significant (**p = 0.668**), indicating that the previous month's return does not significantly explain the current month's return. Consistent with the baseline regression, **USD_Return** remained significantly negative (**β = −0.9471**, **p < 0.001**), whereas **Gold_Return**, **BI_Rate_Change**, and **Inflasi_Change** remained statistically insignificant.

To account for possible structural changes during the COVID-19 pandemic, a dummy variable representing the pandemic period was included in the regression model. The inclusion of this variable did not materially change the model performance, with the **R^2 remaining at 0.436**. Furthermore, the **Pandemic_Period** variable was not statistically significant (**β = 0.0003**, **p = 0.975**), suggesting that after controlling for the selected macroeconomic variables, the pandemic period did not exert an additional significant effect on **IHSG_Return**. The significance and direction of **USD_Return** also remained unchanged, while the remaining explanatory variables continued to show statistically insignificant effects.

Overall, the robustness analyses demonstrate that the principal findings of this study remain stable across alternative model specifications. Regardless of whether the regression model is estimated using HC3 robust standard errors, incorporates a lagged dependent variable, or includes a pandemic-period dummy variable, **USD_Return** consistently exhibits a statistically significant negative effect on **IHSG_Return**. In contrast, **Gold_Return**, **BI_Rate_Change**, and **Inflasi_Change** remain statistically insignificant in all robustness specifications. These results strengthen the reliability of the baseline regression model and provide additional evidence that the main conclusions of this study are robust under different estimation approaches.

5. CONCLUSION AND SUGGESTION

5.1 Conclusion

The analysis focuses on the influence of macroeconomic factors, including the USD/IDR exchange rate, the BI rate, gold prices, and inflation, on the Jakarta Composite Index (JCI) return for the 2020– 2025 period using the Python-based Multiple Linear Regression method. Prior to modeling, the data was transformed into returns and changes, then tested using the Augmented Dickey-Fuller (ADF) to ensure data stationarity.

The results showed that the constructed regression model was able to explain 43.6% of the variation in JCI returns with a Prob(F-statistic) value of 9.44×10^{-8}, indicating that the model was simultaneously significant. Based on partial testing, only the USD_Return variable was proven to have a significant effect on JCI returns at the 5% significance level. The negative coefficient obtained indicates that the weakening of the rupiah exchange rate against the US dollar tends to be followed by a decrease in JCI returns.

Meanwhile, the Gold_Return, BI_Rate_Change, and Inflation_Change variables did not significantly influence JCI returns during the study period. This finding suggests that the exchange rate played a more dominant role than other macroeconomic variables in influencing JCI returns in the 2020–2025 period.

Furthermore, the diagnostic test results indicate that the model meets the required statistical assumptions. No signs of multicollinearity, autocorrelation, heteroscedasticity, or deviations from normality of residuals were found. Therefore, the resulting model can be used as a valid basis for explaining the relationship between macroeconomic factors and JCI returns.

5.2 Suggestion

This study still has several limitations, particularly the number of variables used and the model's ability to only partially explain variations in JCI returns. Therefore, future research is recommended to add other macroeconomic variables such as Gross Domestic Product (GDP), money supply, world oil prices, unemployment rates, and global stock indices to improve the model's ability to explain JCI movements.

Furthermore, future research could utilize a longer observation period to capture economic dynamics over a broader timeframe. The use of more complex econometric methods such as Vector Autoregression (VAR), Vector Error Correction Model (VECM), or Autoregressive Distributed Lag (ARDL) could also be considered to gain a deeper understanding of the short- and long-term relationships between macroeconomic factors and the Indonesian capital market.

For investors, the results of this study indicate that USD/IDR exchange rate movements should be a key indicator when making investment decisions in the Indonesian stock market. Meanwhile, for researchers and academics, this study can serve as a reference for developing more comprehensive capital market analysis models utilizing Python-based data science and econometric approaches.

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Declaration of AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used AI-assisted technologies, including ChatGPT and Google Translate, to support language editing, translation, and improvement of clarity and readability. The authors take full responsibility for the content of the manuscript and confirm that the use of these tools did not affect the originality, validity, or integrity of the research.

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