

TECHNOLOGY AND MACROECONOMIC TURBULENCE: A PANEL ARDL ANALYSIS OF STOCKS ON THE INDONESIA STOCK EXCHANGE

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Abstract

This study investigates the impact of macroeconomic factors—namely inflation, Bank Indonesia's benchmark interest rate (BI Rate), and the Price to Book Value (PBV)—on the stock prices of technology sector companies listed on the Indonesia Stock Exchange (IDX) using a Panel Autoregressive Distributed Lag (ARDL) approach. The analysis covers 12 technology firms during the quarterly period from 2021 to 2024. Unit root tests confirm that all variables are stationary, allowing for the estimation of both short-term and long-term dynamics. The findings indicate that in the short term, only changes in the BI Rate significantly affect stock prices with a negative direction. In contrast, all variables exhibit significant positive effects on stock prices in the long term. The PBV emerges as the most influential factor, reflecting investor confidence in firm valuation. Diagnostic tests support the model's robustness and validity. These results offer empirical insights for investors and policymakers in understanding market behavior amid macroeconomic volatility, particularly within Indonesia's growing tech sector.

Keywords: Panel ARDL, Stock Price, Macroeconomy, PBV, Technology Sector

INTRODUCTION

The Indonesia Stock Exchange (IDX) plays a pivotal role in the national economy by serving as a platform for capital formation, supporting investment flows, and reflecting broader macroeconomic conditions. As the primary institution facilitating equity trading in Indonesia, the IDX is not only influenced by domestic economic fundamentals but is also highly responsive to global external factors such as inflation, interest rate movements, exchange rate volatility, and technological advancements. In particular, structural changes driven by digital transformation and global monetary shifts have increasingly shaped investor sentiment and market performance, especially in sectors that rely heavily on growth expectations like technology.

The development of the technology sector in Indonesia has become increasingly prominent since the COVID-19 pandemic, especially following the acceleration of digital transformation during the social restriction period in 2020–2021. Technology companies listed on the Indonesia Stock Exchange (IDX), such as PT DCI Indonesia Tbk. (DCII), PT Elang Mahkota Teknologi Tbk. (EMTK), and Kioson Komersial Indonesia (KIOS), have begun to attract the attention of both local and global investors.



Figure 1. Technology Stock Price Trend

However, from the first quarter of 2021 to the second quarter of 2024, the technology sector has not been immune to pressures triggered by both domestic and global macroeconomic turbulence. Similar findings are reflected in studies of emerging markets, where infrastructure and technology sectors exhibit high sensitivity to inflation and global interest rates (Magweva & Sibanda, 2020). The trend of the Indonesia Composite Index (IHSG) reflects volatility that has also impacted the technology sector in Indonesia. From Q1 2021 to Q4 2024, the IHSG experienced fluctuations driven by global economic uncertainty in the post-pandemic period and tight monetary policy, particularly in Q2 2024. As the global economy recovers, the IHSG has shown an upward trend, but external factors such as inflation and interest rates continue to exert pressure on the technology sector, which is heavily reliant on valuations and growth expectations. Therefore, despite the significant growth of the technology sector, the fluctuations in the IHSG also reflect investor uncertainty, especially amid ongoing macroeconomic volatility.

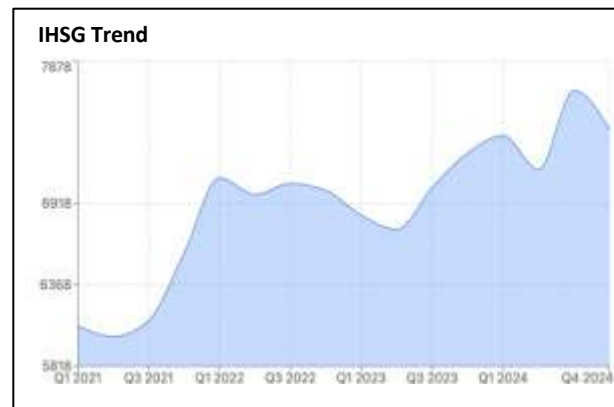


Figure 2. IHSG Trend

The surge in global inflation in the post-pandemic period, supply chain disruptions, Russia's invasion of Ukraine in early 2022, and aggressive monetary policies by the Federal Reserve—which triggered benchmark interest rate hikes in various countries, including Indonesia—have created significant market uncertainty (World Bank, 2023). Similar findings are also observed in other developing countries, such as the GCC nations, where inflation has shown long-term effects on stock prices in the financial and technology sectors (Bengana et al., 2024).



Figure 3. BI Rate and Inflation Trend

Bank Indonesia raised the BI 7-Day Reverse Repo Rate from 3.50% (early 2022) to 6.25% in Q2 2024 in response to inflationary pressures and currency depreciation (Bank Indonesia, 2025). This interest rate hike affected the cost of capital and valuations of growth-oriented stocks, including technology stocks. On the other hand, Indonesia's inflation rate, which spiked to 5.95% in September 2022, placed pressure on consumer spending and purchasing power, and influenced

investor expectations in the capital market (BPS, 2022). In addition, the Price to Book Value (PBV) as a valuation indicator reflects market perception of the fundamentals of technology issuers. Although several technology companies posted high valuations, the extreme fluctuations in PBV during the period indicate investor uncertainty regarding the sector's long-term prospects (Tandelilin, 2010).

Several previous studies have found that variables such as inflation, the BI Rate, and PBV significantly affect stock prices in both the short and long term. Cross-country studies have shown that inflation and interest rates have a negative long-term impact on technology stock prices, using the Panel ARDL method (Gümüş & Mustapha Baba, 2024). In Indonesia, studies by Suhendra (2023) and Nugroho et al. (2025) also confirm the strong influence of macroeconomic variables on stock prices in strategic sectors.

However, there remains a limited number of studies in Indonesia that specifically apply the Panel ARDL approach to evaluate the dynamic relationship between macroeconomic factors and valuation on the stock prices of technology companies—especially within the context of the high-pressure global economic environment from 2021 to 2024.

Therefore, this study aims to analyze the effects of inflation, interest rates, and PBV valuation on the stock prices of technology companies listed on the Indonesia Stock Exchange (IDX), both in the short and long term, using the Panel Autoregressive Distributed Lag (ARDL) method. The findings of this research are expected to provide empirical insights for investors and policymakers in navigating volatility in the technology-driven market.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

The dynamic behavior of stock prices can be examined through several theoretical perspectives. The Efficient Market Hypothesis (EMH) posits that stock prices fully reflect all publicly available information, including macroeconomic variables such as inflation and interest rates (Fama, 1970). This implies that any change in macroeconomic indicators should be immediately incorporated into asset prices. From a macroeconomic standpoint, inflation and interest rates are crucial determinants of firm performance and investor behavior. High inflation reduces purchasing power and increases operational costs, while rising interest rates increase the cost of capital, making equity investments less attractive—particularly in growth-oriented sectors such as technology. Meanwhile, firm valuation theory emphasizes the importance of metrics like Price-to-Book Value (PBV), which reflect investor confidence in a firm's fundamentals and growth prospects (Damodaran, 2012).

Several empirical studies support these theoretical insights. Afifah et al. (2018) found that inflation reduces consumer demand and corporate earnings, leading to lower returns in technology firms. Jarallah et al. (2024) observed a similar trend in GCC countries, where long-term inflation significantly affected sectoral indices. Chee and Shiok (2015) demonstrated that inflation had a negative influence on Malaysian stock prices, while interest rates and money supply showed long-run positive effects.

Interest rate changes, particularly through the BI Rate, also demonstrate significant effects on stock prices. Febrianti et al. (2023) noted that an increase in the BI Rate dampens investment appeal in growth stocks. Alzoubi (2022) found that a 1% increase in interest rates reduced stock values by up to 5%. Sun and Wong (2019) further confirmed that short-term interest rate fluctuations are key drivers of long-term stock performance in Malaysia. Evidence from the Amman stock market also reinforces the dual impact of inflation and interest rates on equity prices.

PBV is widely recognized as a leading indicator of stock price movements in the technology sector. Studies by Purwanto & Pranyoto (2019) found that PBV positively influenced stock prices in

Indonesian firms. Al-Hajj et al. (2020) provided supporting evidence from the Malaysian stock exchange, showing that PBV is a major determinant of technology stock performance, especially under inflationary and high-interest conditions.

The ARDL method, especially in a panel data setting, is suitable for analyzing such dynamics. Gümüş & Mustapha Baba (2024) used the Panel ARDL model to examine relationships between stock prices and macroeconomic variables in 19 emerging markets. Their results showed significant long-term impacts from inflation, interest rates, and exchange rates.

Based on the above theoretical and empirical review, the following hypotheses are formulated:

H1: Inflation negatively affects the stock prices of technology companies listed on the IDX.

H2: The BI Rate negatively affects the stock prices of technology companies listed on the IDX.

H3: PBV positively affects the stock prices of technology companies listed on the IDX.

H4: The interaction of inflation, BI Rate, and PBV has a significant effect on stock prices in the technology sector during 2021–2024.

RESEARCH METHODS

Design Research

This study employs a quantitative approach using the Panel Autoregressive Distributed Lag (ARDL) method. The ARDL model is chosen for its ability to estimate dynamic relationships between independent and dependent variables in both the short and long term simultaneously. The objective of this study is to identify the influence of macroeconomic variables and firm valuation on the stock prices of technology companies listed on the Indonesia Stock Exchange (IDX).

Panel ARDL Model

This study adopts the Panel Autoregressive Distributed Lag (ARDL) model to estimate the short-run and long-run effects of macroeconomic variables—namely the BI Rate, inflation, and PBV—on the stock prices of technology companies listed on the Indonesia Stock Exchange (IDX). The selection of the ARDL model is appropriate given the mixture of stationary variables at levels $I(0)$ and first differences $I(1)$, without any $I(2)$ variable.

To determine the optimal lag length for the ARDL model, the Akaike Information Criterion (AIC) was used. The results suggest that the best specification is ARDL(1,1,1,1), which includes one lag for each variable: stock prices, BI Rate, inflation, and PBV. This configuration ensures the model can capture dynamic adjustments over time while avoiding overparameterization.

The final model is specified as:

$$\Delta \text{stock_price}_{it} = \alpha_i + \beta_1 \Delta \text{BI_Rate}_{i,t-1} + \beta_2 \Delta \text{Inflation}_{i,t-1} + \beta_3 \Delta \text{PBV}_{i,t-1} + \lambda_1 \text{BI_Rate}_{i,t-1} + \lambda_2 \text{Inflation}_{i,t-1} + \lambda_3 \text{PBV}_{i,t-1} + \epsilon_{it}$$

Where:

Δ	: First difference operator (short-run effects)
α_i	: Firm-specific fixed effects
$\beta_1, \beta_2, \beta_3$	: Short-run coefficients
$\lambda_1, \lambda_2, \lambda_3$	: Long-run coefficients
ϵ_{it}	: Error term
i	: Firm index
t	: Time index (quarterly, 2021–2024)

This structure allows simultaneous examination of both immediate (short-run) effects and equilibrium (long-run) relationships among macroeconomic variables and stock price dynamics in the technology sector.

Data and Source

Secondary Data : The data used in this study are secondary data in the form of quarterly data from technology companies listed on the Indonesia Stock Exchange (IDX), covering the analysis period from Q1 2021 to Q4 2024.

Variables Used:

- 1. Stock Price:** Stock price data of technology companies listed on the Indonesia Stock Exchange (IDX), obtained from the IDX website or financial market sources
- 2. Inflation:** Annual inflation data for Indonesia, obtained from the Central Bureau of Statistics (BPS).
- 3. BI Rate:** The benchmark interest rate set by Bank Indonesia, sourced from the official website of Bank Indonesia.
- 4. PBV (Price to Book Value):** A ratio that reflects a company's valuation, calculated based on the company's annual reports.

Stages of Analysis

a. Stationarity Test

To ensure that the variables used are stationary, this study applies Unit Root Tests such as the Augmented Dickey-Fuller (ADF) test or the Phillips-Perron (PP) test.

b. ARDL Model

After confirming data stationarity, the ARDL model will be used to analyze the short-term and long-term relationships among the variables. In this context, the ARDL model allows us to:

Short-Run Coefficients: Identify the extent to which changes in macroeconomic variables affect stock prices in the short ter

Long-Run Coefficients: Analyze the more permanent effects of the variables on stock prices.

c. Diagnostic Test

After the ARDL model is estimated, diagnostic tests are conducted to ensure that the model does not violate the basic assumptions of econometrics.

Multicollinearity Test : To ensure there is no strong linear relationship among the independent variables (multicollinearity)

Heteroskedasticity Test : To test whether the error variance in the model is constant (homoskedasticity).

Autocorrelation Test : To ensure that there is no autocorrelation in the model's residuals.

e. Cointegration Test

To test the joint significance of the long-run coefficients, the Wald Test will be conducted to examine whether macroeconomic variables and PBV jointly influence stock prices.

RESULTS AND DISCUSSION

a. General Description of Research Data

This study aims to analyze the effects of the benchmark interest rate (BI Rate), inflation, and firm valuation (PBV) on the stock prices of technology sector companies listed on the Indonesia Stock Exchange (IDX), using the Panel ARDL (Autoregressive Distributed Lag) model. The study covers 12 companies with quarterly data over the period 2021–2024.

b. Stationarity Test

Stationarity testing is conducted to ensure that none of the variables have an integration order of $I(2)$, as the ARDL model can only be applied when all variables are either $I(0)$ or $I(1)$.

Table 1. Stationarity Test

Variable	ADF p-value	Remarks
Stock Price	0.00574	Stasionary
BI Rate	0.00000	Stasionary
Inflation	0.00000	Stasionary
PBV	0.00073	Stasionary

Source: Processed data, 2025

Based on the results of the Augmented Dickey-Fuller (ADF) test, the variables stock price, BI Rate, inflation, and PBV are not stationary at the level. However, all variables have a p-value < 0.05 after differencing. Therefore, all variables meet the prerequisites for use in the Panel ARDL model.

b. ARDL Model

After confirming data stationarity, the ARDL model will be used to analyze the short-term and long-term relationships among the variables. In this context, the ARDL model allows us to :

Table 2. ARDL Model Test

Variable	Coefficient	p-value	Remarks
d_bi_rate	-2003.2	0.0685	Significant at $\alpha = 10\%$ (Negative Effect)
d_inflation	175.70	0.1501	Not Significant
d_pbv	-5.3898	0.8424	Not Significant
bi_rate	550.67	0.0541	Significant at $\alpha = 10\%$ (Positive Effect)
Inflation	661.64	0.0828	Significant at $\alpha = 10\%$ (Positive Effect)
pbv	76.430	0.0033	Significant at $\alpha = 1\%$ (Positive Effect)

Source: Processed data, 2025

Estimated Model with Coefficients:

$$\Delta \text{stock_price_saham_it} = -531.36 - 2003.2 \Delta \text{BI_Rate}_{i,t-1} - 5.389 \Delta \text{PBV}_{i,t-1} + 175.7 \Delta \text{Inflation}_{i,t-1} + 550.67 \text{BI_Rate}_{i,t-1} + 661.64 \text{Inflation}_{i,t-1} + 76.43 \text{PBV}_{i,t-1} + \varepsilon_{it}$$

Short-Run Effects:

In the short run, the coefficient of the BI Rate is -2003.2 with a p-value of 0.0685 , which is statistically significant at the 10% level. This suggests that a rise in the BI Rate tends to depress technology stock prices, likely due to increased borrowing costs that reduce investment appeal. This finding is consistent with Febrianti et al. (2023) and Alzoubi (2022), who found a negative sensitivity of stock markets to interest rate hikes in growth-oriented sectors. In contrast, inflation has a coefficient of 175.70 and a p-value of 0.1501 , indicating that short-term inflation does not have a significant effect on stock prices. Albulescu et al. (2016) also reported that short-term inflation did not significantly affect most sectoral indices, with uncertainty playing a larger role. PBV shows a coefficient of -5.3898 with a p-value of 0.8424 , suggesting no significant short-term relationship with stock prices. Similar conclusions were drawn by Fachrozi et al. (2023) in the context of Islamic banking stocks in Indonesia.

Long-Run Effects:

In the long term, all three variables exhibit positive and statistically significant effects. The BI Rate has a coefficient of 550.67 and a p-value of 0.0541, indicating that investors may interpret a stable interest rate regime as a sign of macroeconomic credibility, thereby supporting stock valuations. Ogbuehi et al. (2024) noted similar positive long-term perceptions of interest rates in emerging markets. Inflation records a coefficient of 661.64 with a p-value of 0.0828, suggesting that over time, technology firms may adjust pricing strategies to cope with inflationary pressures. Van Rooyen & Jones (2018) and Dhanamaru (2024) support this view, highlighting the inflation-hedging ability of the tech sector.

The PBV variable stands out as the most influential, with a coefficient of 76.43 and a p-value of 0.0033, supporting the hypothesis that firm valuation significantly affects stock price performance. This is in line with Zare (2017) and Al-Hajj et al. (2020), who emphasized PBV as a critical valuation metric for long-term investment decisions in volatile markets.

These results underscore the need for investors and policymakers to consider both short- and long-term macroeconomic dynamics when evaluating the performance of technology stocks on the Indonesia Stock Exchange.

These findings are also supported by several previous empirical studies that confirm the interconnected effects of interest rates, inflation, and company valuation on stock prices in emerging markets:

Interaction between Inflation and Interest Rates:

Inflation and interest rates are inherently linked through monetary policy. As inflation rises, central banks typically respond by increasing interest rates, which then affects corporate financing costs and investor sentiment. For instance, (Alzoubi, 2022) found that every 1% increase in interest rates leads to a 5% decline in stock indices, emphasizing the sensitivity of stock prices to monetary tightening.

Inflation's Long-Term Impact on Technology Stocks:

Studies across emerging markets have confirmed that inflation reduces purchasing power and increases uncertainty, affecting long-term investment prospects. (Jarallah et al., 2024). observed that persistent inflation in the GCC countries significantly impacted the valuation of technology and banking sector stocks, underlining the importance of price stability in long-term market expectations.

The Role of Valuation (PBV) in Market Response:

The Price-to-Book Value ratio is a key indicator in investor decision-making, especially in growth-oriented sectors like technology. The results of this study are also consistent with research conducted in Pakistan, which indicated that technology sector valuations (PBV) are highly responsive to macroeconomic pressures and investor sentiment (Ilyas et al., 2020; Al-Hajj et al., 2020).

Simultaneous Effects in ARDL-Based Research:

Gümüş & Mustapha Baba, (2024) analyzed 19 emerging stock markets using the ARDL model and found that inflation and interest rates collectively influenced stock performance in the long term, reinforcing the idea of a joint macro-financial interaction that shapes stock behavior.

Visual Representation of ARDL Findings

To enhance the interpretability of the statistical results, several visualizations are presented below. These charts illustrate both short-term and long-term coefficient effects from the ARDL model, highlighting the significance and direction of each macroeconomic variable:

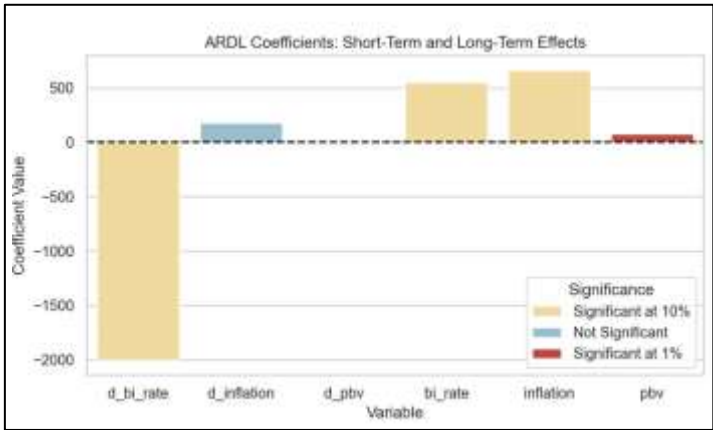


Figure 4 ARDL Coefficients Visual Test

Figure 4 shows the individual coefficients with their respective significance levels. Notably, d_bi_rate has a negative short-term effect, while pbv emerges as the most significant long-term variable.

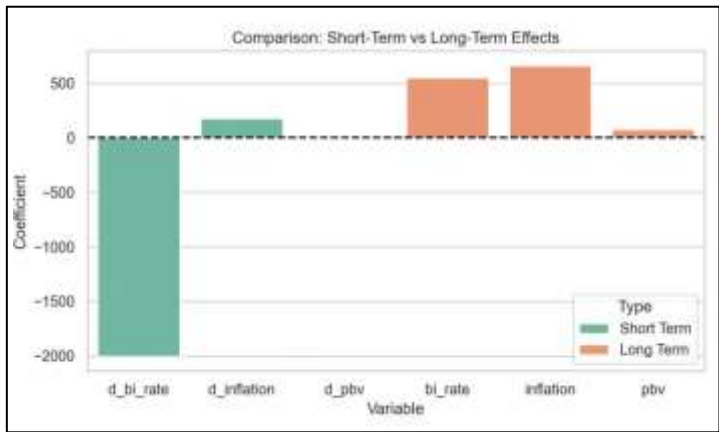


Figure 5. Visual Comparison ARDL Test

Figure 5 compares short- and long-term effects directly, indicating that only the BI Rate is impactful in the short term, whereas all variables show positive influence in the long run.

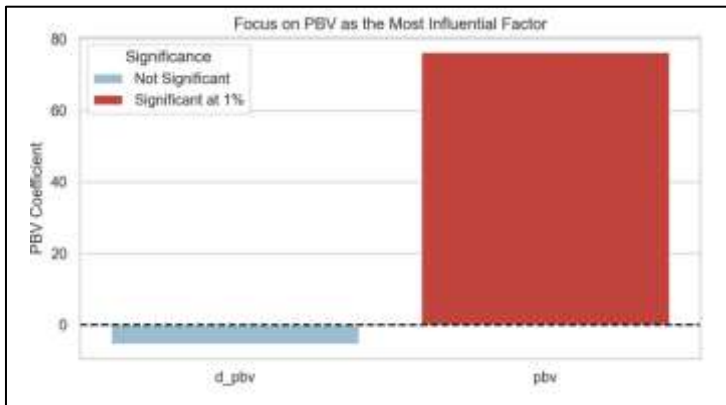


Figure 6. The Most Influential Factor

Figure 6 focuses solely on pbv, reinforcing its importance as a valuation metric that influences stock prices more than inflation or interest rates.

These visual representations provide empirical clarity and strengthen the interpretation of ARDL-based findings, particularly in the context of Indonesia's technology sector under macroeconomic pressures from 2021 to 2024.

c. Diagnostic Test

After the ARDL model is estimated, diagnostic tests are performed to ensure that the model does not violate the basic assumptions of econometrics :

Multicollinearity Test :

Multicollinearity is tested by calculating the Variance Inflation Factor (VIF) for each independent variable..

Table 3. Multicollinearity Test (VIF)

Variable	VIF	Remarks
BI Rate	1.07	No multicollinearity detected
Inflation	1.05	No multicollinearity detected
PBV	1.02	No multicollinearity detected

Source: Processed data, 2025

The results show that all VIF values are below the threshold of 10, indicating that there is no serious multicollinearity among the independent variables in the model.

Heteroskedasticity Test :

The Breusch-Pagan test indicates the presence of heteroskedasticity in the model. Therefore, to correct this issue, the approach of clustered robust standard errors at the entity (firm) level is employed, ensuring that the estimation results are more reliable and consistent.

Table 4. Heteroskedasticity Test

Statistic	Value
LM Statistic	34.99
LM p-value	0,00000012
F-Statistic	13.96
F p-value	0.00000003

Source: Processed data, 2025

Autocorrelation Test :

The Durbin-Watson statistic is approximately 1.98, indicating no autocorrelation in the model's residuals. This supports the validity of the estimation results.

Table 5. Autocorrelation Test

Durbin Watson	1.98
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Source: Processed data, 2025

d. ARDL Panel Model Estimation

Table 6. ARDL Model Estimation

Statistic	Value
R-squared (Overall)	0.2218
F-statistic	2.5148
P-value F-statistic	0.0236
F-statistic (robust)	3.1867
P-value F-statistic (robust)	0.0055

Source: Processed data, 2025

The estimation of the Panel ARDL model with fixed effects yields an R-squared value of 0.2218, indicating that approximately 22.18% of the variation in stock prices can be explained by the BI Rate, inflation, and PBV. The joint significance test produces an F-statistic of 2.5148 with a p-value of 0.0236, which means the model is statistically significant at the 5% level.

To address potential heteroskedasticity, a robust estimation approach is applied, resulting in an F-statistic of 3.1867 with a p-value of 0.0055. Therefore, the model remains valid and appropriate for analyzing both short-run and long-run relationships among the variables.

e. Cointegration Test (Wald Test)

To test the joint significance of the long-run coefficients, the Wald Test will be conducted to examine whether macroeconomic variables and PBV jointly influence stock prices.

Table 7. Wald Test

Statistic	Value
Wald Statistic	3.18
p-value	0.0055

Source: Processed data, 2025

Since the p-value is less than 0.05, the null hypothesis (H_0) is rejected, and it can be concluded that the model is jointly significant. The p-value of 0.0055 confirms that inflation, BI Rate, and PBV collectively have a significant long-term effect on stock prices. This supports the presence of dynamic interactions among the three variables in influencing the performance of technology sector stocks.

CONCLUSION

This study provides empirical evidence on the dynamic influence of macroeconomic variables—namely the BI Rate, inflation, and PBV—on the stock prices of technology sector companies listed on the Indonesia Stock Exchange (IDX) during the 2021–2024 period. The results indicate that in the short term, only the BI Rate has a significant negative effect, suggesting that rising interest rates reduce the attractiveness of technology stocks due to higher capital costs. In contrast, inflation and PBV show no significant short-term effect.

Over the long term, all three variables—BI Rate, inflation, and PBV—exhibit significant positive effects on stock prices. PBV emerges as the most influential factor, highlighting its importance as a valuation metric that reflects investor confidence in a company's fundamentals. The positive long-term impact of inflation suggests that technology firms are capable of adjusting their pricing strategies to offset rising input costs, indicating a level of resilience to inflationary pressures.

These findings highlight the importance of understanding both short- and long-term market dynamics, particularly in sectors like technology that are highly sensitive to macroeconomic changes. They offer useful insights for investors, policymakers, and market analysts in managing risk and formulating strategy during periods of economic uncertainty.

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