The Comparative Effectiveness of RSI and MACD Indicators in Managing Stock Price Volatility of Indonesian State-Owned Banks in 2024

Sunarto*[1] Irenne Putren[2] Yunita Kwartarani[3] Islam Ali Akbar[4] Siti Aisyah Nurrizqi[5] Holiawati[6]

Master of Accounting, University of Pamulang

Abstract

This study investigates the effectiveness of the Relative Strength Index (RSI) and Moving Average Convergence Divergence (MACD) in mitigating stock price volatility in Indonesian state-owned banks (BUMN) during 2024. Using a quantitative approach with daily secondary data, panel data regression with a Fixed Effect Model (FEM) was employed, supported by classical assumption tests, t-tests, and F-tests. The findings show that RSI and MACD each have a significant positive effect on stock prices, and together explain 98.45% of price movements. RSI effectively identifies overbought and oversold conditions, signaling potential corrections, while MACD consistently captures trend momentum and reversals. The integration of both indicators provides a more robust analytical framework for anticipating volatility and optimizing investment decisions. This study enriches technical analysis literature by highlighting the complementary roles of RSI and MACD in strengthening decision-making strategies amid market uncertainty in emerging capital markets.

Keywords *: RSI, MACD, stock volatility, technical analysis, BUMN banks*

Introduction

The capital market plays a crucial role as an intermediary between parties with surplus funds and those requiring capital for business development. One of its defining characteristics is stock price fluctuation, which reflects firms' fundamental conditions, market dynamics, and various external factors at both domestic and global levels. These fluctuations manifest as stock price volatility, indicating the degree of investment risk and uncertainty faced by market participants (Sutrisno, 2023). While volatility is commonly perceived as a risk to be mitigated, it also represents a strategic opportunity for investors to generate returns. Nevertheless, heightened volatility often increases uncertainty in investment decision-making, thereby necessitating analytical approaches capable of providing more reliable and informative market signals.

In the Indonesian context, the year 2024 represents a particularly dynamic period, partly due to political developments such as the general election, which may intensify market uncertainty. Arul Pradana (2024) demonstrates that institutional ownership can play a stabilizing role in reducing stock return volatility, although its effectiveness tends to weaken during periods of heightened political uncertainty. This evidence suggests that fundamental and structural factors alone do not fully explain stock price movements, especially under unstable market conditions. Consequently, technical analysis becomes increasingly relevant, as it focuses on historical price behavior to infer future market dynamics.

Among the most widely used tools in technical analysis are the Relative Strength Index (RSI) and the Moving Average Convergence Divergence (MACD). RSI is designed to identify overbought and oversold conditions that often precede short-term price corrections (Rahmawati, 2024), whereas MACD captures trend direction and momentum through the interaction of short- and long-term moving averages (Santoso, 2022). Prior empirical studies indicate that the combined use of RSI and MACD yields more accurate insights into price dynamics than relying on a single indicator, particularly within the banking sector, which is highly sensitive to macroeconomic policy shifts (Rahmawati & Santoso, 2024).

Recent empirical research shows sustained scholarly interest in the application of technical indicators, particularly RSI and MACD, for analyzing stock price movements and volatility. Post-2020 studies predominantly evaluate predictive accuracy, trading performance, or the optimization of technical-indicator-based strategies, often using single-asset, cross-sector, or machine-learning-driven approaches (Mostafavi et al., 2025; Saud et al., 2024;

Mokhtari et al., 2021). While these studies confirm the continued relevance of RSI and MACD, they largely emphasize forecasting capability rather than explanatory power.

Moreover, despite methodological advances, comparatively limited attention has been given to econometric panel data approaches that control for unobserved firm-specific heterogeneity. This limitation is particularly evident in studies focusing on homogeneous sectors such as state-owned banks in emerging markets, where firm characteristics and regulatory structures may systematically influence price dynamics. Existing research further highlights that the effectiveness of MACD and other momentum indicators is highly sensitive to parameter selection and market structure, underscoring the importance of context-specific analysis rather than universally applicable trading rules (Kang et al., 2023; Chio, 2022).

Accordingly, a clear research gap remains regarding explanatory investigations that integrate RSI and MACD within a fixed-effect panel framework to analyze stock price volatility in Indonesian state-owned banks (BUMN). Given the strategic role of the banking sector in maintaining financial system stability, a deeper examination of its stock price behavior under conditions of market uncertainty is essential. Therefore, this study aims to analyze the effectiveness of RSI and MACD indicators in explaining stock price movements of Indonesian state-owned banks during 2024. Specifically, this research seeks to: (1) examine the effect of RSI on stock prices, (2) assess the effect of MACD on stock prices, and (3) analyze the simultaneous influence of RSI and MACD on stock prices. The findings are expected to contribute to the development of technical analysis literature and provide practical insights for investors and market participants in managing stock price volatility within Indonesia's capital market.

Literature Review

Efficient Market Hypothesis (EMH)

The main theoretical foundation of this research is the Efficient Market Hypothesis (EMH), initially introduced by Fama (1970) and further developed in modern financial literature. EMH posits that stock prices essentially reflect all available market information, implying that no investor can consistently achieve abnormal returns solely by relying on publicly available information (Tandelilin, 2023). However, in practice, market imperfections

often give rise to price anomalies. At this point, technical analysis becomes a valuable tool to identify potential investment opportunities that emerge from market behavior that is not fully efficient. The use of indicators such as RSI and MACD represents an adaptation of EMH to the realities of high volatility in the capital market.

In addition to the Efficient Market Hypothesis (EMH), this study is also aligned with the Adaptive Market Hypothesis (AMH) proposed by Lo (2004), which suggests that market efficiency evolves over time as investors adapt to changing market environments. AMH bridges the gap between traditional EMH and behavioral finance by acknowledging that technical indicators may generate value under certain market conditions. Within this framework, RSI and MACD are not seen as market anomalies, but as adaptive tools that capture recurring behavioral patterns embedded in price movements. This theoretical perspective strengthens the justification for using technical indicators in emerging markets such as Indonesia, where market efficiency is often partial and dynamic.

Stock Price Volatility

Stock price volatility reflects the level of uncertainty and investment risk, indicated by the magnitude of price fluctuations over a specific period (Sutrisno, 2023). High volatility may indicate market turbulence arising from internal factors, such as company financial performance, or external factors, such as macroeconomic conditions, government policies, or political events. Research by Arul Pradana (2024) shows that institutional ownership serves as a stabilizing factor against volatility, although its influence may not always be significant during periods of heightened uncertainty, such as the 2024 general election. Therefore, volatility analysis should not merely be viewed as a measure of risk but also as a foundation for developing investment decision-making strategies.

Relative Strength Index (RSI)

The Relative Strength Index (RSI), introduced by Welles Wilder in 1978, is a momentum indicator used to measure the relative strength of stock price movements over a given period (Rahmawati, 2024). RSI ranges from 0 to 100, where values above 70 indicate an *overbought* condition, and values below 30 indicate an *oversold* condition. This indicator is often employed to detect potential price reversals and identify entry or exit points in the market. Previous studies have confirmed that RSI is effective in providing early warning signals for extreme

price movements, particularly in the banking sector, which tends to exhibit high volatility (Fitria & Maulana, 2021).

Moving Average Convergence Divergence (MACD)

The **Moving Average Convergence Divergence (MACD)** indicator, developed by **Gerald Appel**, is used to identify the direction and momentum of stock price trends. MACD is calculated by subtracting two **Exponential Moving Averages (EMA)** of different periods and comparing the result with a **signal line**. The intersection between the MACD line and the signal line generates buy or sell signals, while divergences between the MACD and the stock price can indicate potential trend reversals (Santoso, 2022). Research by Rahmawati and Santoso (2024) demonstrated that MACD provides consistent signals regarding trend direction, making it effective in anticipating market volatility.

Combination of RSI and MACD

Although RSI and MACD serve different functions, they are often used together to provide a more comprehensive view of stock price movements. RSI focuses on identifying overbought or oversold conditions that reflect potential extreme movements, while MACD confirms trend direction and momentum. Previous research indicates that combining RSI and MACD yields more accurate measurements of volatility than using either indicator individually (Lestari & Pratama, 2023). Therefore, the simultaneous use of both indicators can reduce the risk of misinterpreting market signals.

Conceptual Framework

Based on the theoretical foundations and previous studies, a conceptual framework can be formulated that the stock price volatility of Indonesia's state-owned banks in 2024 can be explained through the effectiveness of RSI and MACD indicators. Partially, RSI is hypothesized to have a significant effect on stock prices by identifying extreme price movements. Similarly, MACD is hypothesized to have a significant influence by detecting market trends and momentum. Furthermore, the combination of both indicators is expected to explain stock price movements more comprehensively. Thus, this study emphasizes the importance of synergy between RSI and MACD in analyzing stock volatility within an uncertain capital market environment.

Conceptual Framework
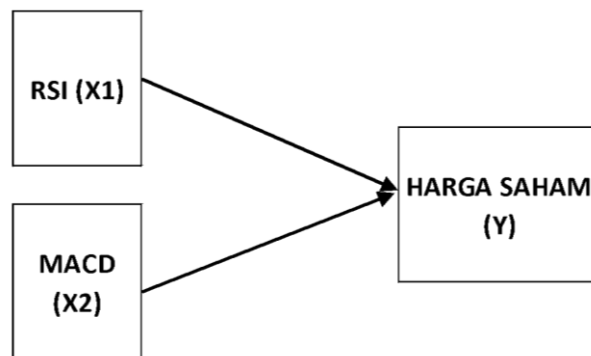
Picture 1. Conceptual Framework

Hypothesis Development

The Effect of Relative Strength Index (RSI) on Stock Prices

The Relative Strength Index (RSI) is a momentum indicator commonly used to measure overbought and oversold conditions in stock prices. When the RSI value exceeds 70, the stock is considered to be in an overbought condition and is likely to experience a price correction. Conversely, when the RSI value falls below 30, the stock is categorized as oversold and may potentially rebound (Rahmawati, 2024). The study by Fitria and Maulana (2021) found that RSI has a significant influence on investment decisions in the banking sector listed on the Indonesia Stock Exchange (IDX). Therefore, the higher the RSI value, the greater the likelihood of a stock price movement.

H1: The Relative Strength Index (RSI) has a significant effect on the stock prices of Indonesian State-Owned Banks (BUMN).

The Effect of Moving Average Convergence Divergence (MACD) on Stock Prices

The Moving Average Convergence Divergence (MACD) indicator is used to identify stock price trend directions and their momentum through the difference between long-term and short-term exponential moving averages (EMA). The intersection between the MACD line and the

signal line generates buy or sell signals that are crucial in technical analysis (Santoso, 2022). Rahmawati and Santoso (2024) demonstrated that MACD effectively provides accurate trend signals and influences stock price volatility in the banking sector. Accordingly, when the MACD line consistently remains above the signal line, it indicates a strong upward trend, and vice versa.

H2: The Moving Average Convergence Divergence (MACD) has a significant effect on the stock prices of Indonesian State-Owned Banks (BUMN).

The Combined Effect of RSI and MACD on Stock Prices

Using a single technical indicator has limitations; therefore, the combination of RSI and MACD can provide a more comprehensive analysis. RSI effectively detects extreme market conditions, while MACD functions as a confirmation tool for trend direction and momentum. Studies by Lestari and Pratama (2023) and Rahmawati & Santoso (2024) revealed that combining both indicators produces more accurate predictions of stock price volatility compared to using each indicator individually. This demonstrates a significant synergy between the two in explaining stock price movements.

H3: The Relative Strength Index (RSI) and Moving Average Convergence Divergence (MACD) simultaneously have a significant effect on the stock prices of Indonesian State-Owned Banks (BUMN).

Research Method

This study employs a quantitative approach using technical analysis methods to examine the effectiveness of the Relative Strength Index (RSI) and Moving Average Convergence Divergence (MACD) indicators in explaining stock price volatility of Indonesia's State-Owned Banks (BUMN) during the year 2024. The quantitative approach is chosen because it allows for the objective measurement of relationships among variables based on numerical data and enables hypothesis testing through statistical analysis.

The study uses secondary data, consisting of daily stock prices of State-Owned Banks listed on the Indonesia Stock Exchange (IDX) from January to December 2024. This period was selected due to the capital market dynamics influenced by political events, particularly the 2024 General Election, which is believed to have increased stock price volatility. The independent variables in this study are RSI and MACD, while the dependent variable is the stock price, measured using the closing price.

Table 1 Operational Variables

Variable	Symbol	Definition	Measurement / Indicator	Data Scale	Source
Stock Price	Y	Market value of a company's stock reflecting investors' collective valuation at a given point in time	Daily closing stock price (IDR)	Ratio	Indonesia Stock Exchange (IDX); Tandelilin (2023)
Relative Strength Index	RSI	A momentum indicator used to identify overbought and oversold conditions in stock prices	RSI value (0–100), calculated based on average gains and losses over a specified period	Ratio	Wilder (1978); Rahmawati (2024)
Moving Average Convergence Divergence	MACD	A trend-following indicator capturing price momentum through the difference between	MACD line value (EMA short − EMA long)	Ratio	Appel (2005); Santoso (2022)

Variable	Symbol Definition	Measurement / Indicator	Data Scale	Source
	short-term and long-term exponential moving averages			

Data analysis was conducted in several stages. First, the RSI values were calculated by comparing the average gains and losses of stock prices over a specific period. Meanwhile, MACD values were obtained by subtracting two EMAs with different periods and comparing them with the signal line. Second, the results of these indicator calculations were analyzed using panel data regression, as the dataset combines time series data (12 months of observations) and cross-sectional data (five State-Owned Banks).

Model Specification and Mathematical Equation

To examine the effect of the Relative Strength Index (RSI) and Moving Average Convergence Divergence (MACD) on stock prices of Indonesian state-owned banks, this study employs a panel data regression model. Based on the Chow test and Hausman test results, the Fixed Effect Model (FEM) is selected as the most appropriate specification.

Panel Data Regression Model

$$Y_{it} = \alpha_i + \beta_1 RSI_{it} + \beta_2 MACD_{it} + \varepsilon_{it}$$

Where:

- Y_{it} = stock price of bank i at time t
- α_i = individual fixed effect capturing firm-specific characteristics
- RSI_{it} = Relative Strength Index of bank i at time t
- $MACD_{it}$ = Moving Average Convergence Divergence of bank i at time t
- β_1, β_2 = regression coefficients
- ε_{it} = error term

This specification enables the model to control for unobserved heterogeneity across state-owned banks, ensuring that the estimated effects of RSI and MACD reflect their substantive influence on stock price movements rather than differences arising from firm-specific characteristics.

To identify the most suitable panel regression model, three alternative specifications were initially considered: the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM). Model selection was conducted using the Chow test, the Hausman test, and the Lagrange Multiplier (LM) test. In addition, classical assumption tests were performed to ensure the reliability of the estimated model, including tests for normality, multicollinearity, autocorrelation, and heteroscedasticity.

The final stage of the analysis involved hypothesis testing. The t-test was employed to examine the partial effects of RSI and MACD on stock prices, while the F-test was used to assess their simultaneous effects. Furthermore, the coefficient of determination (R^2) was calculated to evaluate the extent to which variations in stock prices are explained by the independent variables. All statistical and econometric analyses were conducted using EViews software, which provides robust tools for panel data estimation and diagnostic testing.

Results and Discussion

Panel Data Regression Results

Based on the results of the Chow Test and the Hausman Test, the best model selected for this study is the Fixed Effect Model (FEM). This model was chosen because it effectively captures the differences in characteristics among the State-Owned Banks (BUMN) that serve as the research sample. Subsequently, a classical assumption test was conducted, indicating that the data are normally distributed and free from multicollinearity, heteroscedasticity, and autocorrelation problems. These results confirm that the regression model used in this study is appropriate and reliable for further analysis.

<div align="center">**Tabel 2 Fixed Effect Regression Output**</div>

Variabel	Coefficient	Std. Error	t-Statistic	Prob.
C	2162.792	236.2500	9.154673	0.0000
RSI (X1)	2425.449	454.4153	5.337517	0.0000
MACD (X2)	2.582507	0.497882	5.186984	0.0000

Table 3 Statistic Model Summary

Statistics	Value
R-squared	0.984486
Adjusted R-squared	0.982729
S.E. of Regression	262.9156
Sum Squared Residuals	3,638,204
Log Likelihood	−4,161.7247
F-statistic	560.5355
Prob(F-statistic)	0.000000

Statistics	Value
Mean Dependent Variable	4,088.167
S.D. Dependent Variable	2,000.612
Akaike Information Criterion	14.00982
Schwarz Criterion	14.33516
Hannan–Quinn Criterion	14.1840
Durbin–Watson Statistic	0.840738

Table 4 t-test

Variable	t-Statistic	t-Table (0.05; n = 60)	Probability	Result
Stock Price (Y)	9.154673	2.00030	0.0000	Significant
RSI	5.337517	2.00030	0.0000	Significant
MACD	5.186984	2.00030	0.0000	Significant

t-Test

The results of the *t*-test indicate that both RSI and MACD have a significant influence on stock prices. Based on Table 1 above, the RSI variable has a *t*-statistic value of 5.337517, which is greater than the *t*-table value (2.0003), with a *p*-value of 0.000 < 0.05. This finding implies that RSI has a significant effect on stock prices. Similarly, the MACD variable has a *t*-statistic value of 5.186984, which also exceeds the *t*-table value (2.0003), with a *p*-value of 0.000 < 0.05. Therefore, it can be concluded that MACD also exerts a significant influence on stock prices.

F-Test

The *F*-test was used to determine the simultaneous effect of the independent variables on the dependent variable. The results, as presented in Table 1, show an *F*-statistic value of **560.5355**, which is greater than the *F*-table value (3.1588), with a probability value of **0.0000 < 0.05**. This indicates that RSI and MACD together have a significant simultaneous effect on the stock prices of Indonesia's State-Owned Banks (BUMN).

Coefficient of Determination (R²)

The coefficient of determination (R^2) obtained is 0.984486, indicating that 98.45% of the variation in stock prices can be explained by the RSI and MACD variables, while the remaining **1.55%** is explained by other factors outside the model. Although the coefficient of determination (R^2) is relatively high at 98.45%, this value does not necessarily indicate overfitting. This is because the study employs daily panel data within a homogeneous sector (state-owned banks), where price movements tend to follow similar behavioral and technical patterns. In addition, RSI and MACD are derived directly from price data, which explains their strong explanatory power. Nevertheless, this study acknowledges that future research should incorporate macroeconomic or sentiment-based control variables to test the robustness of the model further.

Discussion

Existing literature on technical indicators largely supports the relevance of RSI and MACD in capturing non-random patterns in financial markets; however, most studies approach this relevance primarily from a predictive or trading-performance perspective. Empirical evidence in the Indonesian capital market also confirms that stock price volatility constitutes a

central source of investment risk, thereby motivating the use of technical indicators as risk-management tools (Handayani & Putra, 2022). Recent works employing machine learning and deep learning frameworks further demonstrate that RSI and MACD remain statistically significant inputs for forecasting stock prices and optimizing trading strategies in both developed and global markets (Mostafavi et al., 2025; Saud et al., 2024; Saputra et al., 2023; Shi et al., 2022). While these findings confirm the empirical usefulness of technical indicators, they provide limited insight into the explanatory mechanisms through which price adjustments occur, particularly in relation to market efficiency.

From an efficiency standpoint, several studies implicitly challenge the notion of fully efficient markets by showing that price patterns can be systematically exploited. Research focusing on MACD-based trading strategies and parameter optimization finds that past price momentum continues to influence future price movements under certain market conditions (Chio, 2022; Kang et al., 2023). Similar evidence from the Indonesian financial sector suggests that institutional characteristics may reduce volatility, but their stabilizing role weakens during periods of heightened uncertainty, reinforcing the relevance of technical signals in such contexts (Sari & Nugroho, 2025). These results are consistent with the notion of delayed price adjustment and momentum persistence. Nevertheless, most studies emphasize trading outcomes rather than explaining why momentum effects persist, leaving the behavioral foundations of these anomalies underexplored.

Parallel evidence from high-frequency trading and artificial intelligence research further suggests that technical indicators retain explanatory relevance even in environments characterized by rapid information flow and algorithm-driven transactions (Mokhtari et al., 2021; Deep et al., 2024). In these studies, however, technical indicators are predominantly treated as computational features embedded in predictive models rather than as representations of investor behavior. Consequently, their role in reflecting psychological biases—such as overreaction, underreaction, and heuristic-based decision-making—remains largely implicit rather than analytically articulated.

Comparative analyses across different asset classes, including highly volatile cryptocurrency markets, further reinforce the adaptability of RSI and MACD across diverse market regimes (Ziet, 2023; Melda, 2025). These studies demonstrate that RSI effectively captures short-term overbought and oversold conditions, while MACD identifies momentum persistence across speculative environments. However, much of this literature relies on

aggregated samples or heterogeneous asset classes, limiting its ability to distinguish between short-term corrective forces and medium-term trend reinforcement within structurally similar firms, such as state-owned banks.

The novelty of the present study lies in three interrelated contributions. First, unlike the dominant strand of prior research that treats RSI and MACD as predictive or trading tools, this study repositions both indicators as explanatory variables within a fixed-effect panel data framework. By explicitly controlling for unobserved firm-specific heterogeneity, the analysis moves beyond signal accuracy to uncover how technical indicators systematically explain stock price movements in a homogeneous banking sector. Second, this research provides empirical evidence from an emerging market context that links the statistical significance of RSI and MACD to behavioral adjustment processes rather than mechanical price prediction. RSI is shown to capture short-term market overreactions consistent with bounded rationality, while MACD reflects medium-term momentum continuation driven by trend-following behavior. Third, by focusing on Indonesian state-owned banks during a politically and economically uncertain period, this study demonstrates that the interaction between short-term corrective mechanisms and medium-term momentum persistence constitutes a structural driver of stock price volatility under partial market efficiency.

By articulating these contributions, the present study advances the technical analysis literature in two important ways. Conceptually, it bridges technical analysis with the Adaptive Market Hypothesis by interpreting RSI and MACD as manifestations of evolving investor behavior rather than static anomalies. Methodologically, it enriches existing evidence by introducing a fixed-effect explanatory approach that is rarely applied in technical-indicator studies within emerging markets. Consequently, RSI and MACD emerge not merely as trading signals, but as analytical instruments that reveal deeper behavioral and structural dynamics governing stock price movements in homogeneous banking sectors.

Conclusion

This study contributes to the existing literature by empirically demonstrating that the integration of the Relative Strength Index (RSI) and Moving Average Convergence Divergence

(MACD) provides a robust explanatory framework for stock price movements in a partially efficient emerging market. Unlike prior studies that analyze technical indicators in isolation, the findings confirm the complementary role of momentum and trend indicators within a unified panel data framework. From a practical standpoint, this evidence offers investors a validated analytical approach to managing price volatility in the Indonesian banking sector, highlighting the importance of combining indicators to enhance decision-making under market uncertainty.

Despite its contributions, this study has several limitations that warrant further investigation. The exclusive focus on State-Owned Banks (BUMN) restricts the generalizability of the findings across the broader Indonesian capital market, while the use of one-year data (2024) may not fully capture long-term dynamics or different market cycles. In addition, the analysis is limited to two technical indicators, namely RSI and MACD. Future research is therefore encouraged to expand the sample to other sectors, employ multi-year datasets, and incorporate additional technical indicators such as Bollinger Bands, Stochastic Oscillator, or Average True Range (ATR). Practically, investors are advised not to rely on a single indicator but to adopt a multidimensional analytical approach that integrates technical indicators with fundamental analysis and market sentiment.

Acknowledgement

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