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GARCH and ECM Approaches to Detecting Economic and Financial Volatility: Evidence from Indonesia

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Abstrak. *Penelitian ini mengkaji hubungan dinamis dan dampak volatilitas dari fundamental makroekonomi dan indikator keuangan terhadap pasar modal Indonesia dengan menggunakan pendekatan ekonometrika ganda, yaitu model Generalized Autoregressive Conditional Heteroskedasticity (GARCH) dan Error Correction Model (ECM). Penelitian ini berfokus pada variabel-variabel makroekonomi utama—yakni inflasi, suku bunga, nilai tukar, dan jumlah uang beredar serta dampaknya terhadap indikator keuangan seperti Indeks Harga Saham Gabungan (IHSG) dan harga saham perusahaan-perusahaan tercatat paling aktif di Indonesia, yaitu PT Aneka Tambang Tbk (ANTM), PT Adaro Energy Tbk (ADRO), PT Bank Rakyat Indonesia Tbk (BBRI), PT Telekomunikasi Indonesia Tbk (TLKM), PT Merdeka Copper Gold Tbk (MDKA), PT Bank Central Asia Tbk (BBCA), dan PT Vale Indonesia Tbk (INCO). Dengan menggunakan data deret waktu bulanan dan menerapkan model GARCH, penelitian ini mengukur pola klaster volatilitas serta persistensi guncangan pada harga saham individu dan IHSG. Selanjutnya, model ECM digunakan untuk menganalisis dinamika jangka pendek dan hubungan keseimbangan jangka panjang antara fundamental ekonomi dan indikator keuangan. Temuan empiris menunjukkan bahwa nilai tukar dan suku bunga memiliki pengaruh signifikan terhadap volatilitas, sementara jumlah uang beredar dan inflasi menunjukkan pengaruh yang bervariasi tergantung pada sektornya. Integrasi antara model GARCH dan ECM memberikan wawasan yang komprehensif mengenai stabilitas pasar dan respons harga saham terhadap perubahan kondisi makroekonomi. Penelitian ini memberikan kontribusi bagi manajemen risiko portofolio, perumusan kebijakan moneter, dan perencanaan keuangan korporasi di negara berkembang.*

Kata kunci: *GARCH; ECM; Macroeconomic Volatility; Harga Saham; Indonesia; Inflasi; Bunga; Kurs; Permintaan Uang; IHSG.*

Abstract. *This study investigates the dynamic relationship and volatility effects of macroeconomic fundamentals and financial indicators on Indonesia's capital market using a dual econometric approach: the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model and the Error Correction Model (ECM). The research focuses on key macroeconomic variables—namely inflation, interest rates, exchange rates, and money supply and their impact on financial indicators including the Composite Stock Price Index (IHSG) and the stock prices of Indonesia's most active listed companies: PT Aneka Tambang Tbk (ANTM), PT Adaro Energy Tbk (ADRO), PT Bank Rakyat Indonesia Tbk (BBRI), PT Telekomunikasi Indonesia Tbk (TLKM), PT Merdeka Copper Gold Tbk (MDKA), PT Bank Central Asia Tbk (BBCA), and PT Vale Indonesia Tbk (INCO). Utilizing monthly time series data and applying the GARCH model, this study measures the volatility clustering and persistence of shocks in both individual stock prices and IHSG. The ECM is then employed to examine the short-term dynamics and long-term equilibrium relationships between economic fundamentals and financial indicators. The empirical findings indicate that exchange rates and interest rates have significant volatility effects, while money supply and inflation exhibit varying degrees of influence depending on the sector. The integration of GARCH and ECM models provides comprehensive insights into market stability and the responsiveness of stock prices to macroeconomic shifts. The study contributes to portfolio risk management, monetary policy formulation, and corporate financial planning in emerging markets.*

Keywords: *GARCH; ECM; Macroeconomic Volatility; Stock Market; Indonesia; Inflation; Interest Rate; Exchange Rate; Money Supply; IHSG.*

Introduction

Volatility in financial markets, particularly within emerging economies such as Indonesia, has attracted increasing attention from policymakers, investors, and corporate decision-makers. As one of the largest economies in Southeast Asia, Indonesia demonstrates a close linkage between macroeconomic indicators and capital market movements. This relationship is observable through fluctuations in the Indonesia Composite Stock Price Index (IHSG) and the stock performance of leading firms listed on the Indonesia Stock Exchange (IDX). Key macroeconomic indicators including inflation, interest rates, exchange rates, and money supply tend to respond sensitively to both domestic and international developments. These fluctuations have implications for investor sentiment and the broader trajectory of financial markets. During the past decade, Indonesia has undergone multiple instances of financial market instability. A notable example occurred in the initial stages of the COVID-19 pandemic in 2020, when the IHSG declined by over 25% in the first quarter, driven by economic contraction and a sharp depreciation of the national currency. In response to economic disruptions, Bank Indonesia adjusted its policy rate (BI-7 Day Reverse Repo Rate) from 6% in 2018 to 3.5% by 2021. Concurrently, the exchange rate of the rupiah against the US dollar reached Rp16,000/USD in March 2020, indicating increased susceptibility of the financial system to external shocks.

Figure 1. illustrates the monthly closing trends of the Indonesia

The Composite Stock Price Index (IHSG) from January 2022 to April 2025 reflects several distinct phases in domestic market performance. In April 2022, the index reached a high of 7,276 before declining to 6,850 by the end of the year amid valuation adjustments. Throughout 2023, IHSG showed relatively stable fluctuations and closed at 7,200. In 2024, the index gained upward momentum and peaked at 7,910 in September before undergoing a mild correction by December. As of April 2025, IHSG stood at 6,889, a decline that may be attributed to rising global economic pressures or adjustments in national monetary policy. These developments reflect the cyclical behavior of Indonesia's equity market and indicate the influence of macroeconomic variables on investor responses. Although interest in examining market volatility has grown in Indonesia, much of the existing literature relies on linear methodologies such as Ordinary Least Squares (OLS), or employs single-equation models that are limited to capturing short-term volatility. Only a small number of studies have integrated volatility models like Generalized Autoregressive Conditional Heteroskedasticity (GARCH) with long-term equilibrium models such as the Error Correction Model (ECM). As a result, the simultaneous analysis of short-term disturbances and long-run interactions between macroeconomic factors and financial variables remains limited.

Previous research has also shown several methodological gaps. Suleman (2012), for example, applied a GARCH model to assess political risk in Pakistan but did not incorporate core economic variables such as inflation or interest rates. Sadorsky (1999) focused on the effect of oil prices on the U.S. stock market, yet excluded monetary indicators like money supply. In the Indonesian context, Arianto (2015) analyzed IHSG volatility during crisis periods using GARCH but did not disaggregate effects across industry sectors. Rizky and Subaweh (2019) used ECM to examine the long-term impact of inflation, exchange rates, and interest rates on IHSG, without assessing short-run fluctuations. Similarly, Rahman and Uddin (2009) found long-run cointegration between exchange rates and stock prices in Bangladesh using ECM but did not apply GARCH to account for short-run variance. These limitations suggest the need for an analytical model that incorporates both

volatility and equilibrium relationships within one unified framework, especially in relation to Indonesia's most frequently traded equities. Moreover, industry-level analysis that considers varying degrees of sensitivity to macroeconomic indicators across sectors such as banking, mining, telecommunications, and energy remains limited. To address this, the present study adopts a dual-model approach by integrating the GARCH and ECM frameworks to analyze the influence of inflation, interest rates, exchange rates, and money supply on the IHSG and the stock prices of actively traded firms, including PT Aneka Tambang Tbk (ANTM), PT Adaro Energy Tbk (ADRO), PT Bank Rakyat Indonesia Tbk (BBRI), PT Telekomunikasi Indonesia Tbk (TLKM), PT Merdeka Copper Gold Tbk (MDKA), PT Bank Central Asia Tbk (BBCA), and PT Vale Indonesia Tbk (INCO). These companies are selected due to their exposure to macroeconomic shifts and their role in key sectors of the national economy.

Empirical results indicate that fluctuations in exchange rates and interest rates are closely associated with short-term volatility. Inflation and money supply demonstrate varying patterns depending on the industry examined. The GARCH model captures volatility persistence, while the ECM framework identifies adjustments toward long-run equilibrium. The implementation of this dual approach expands existing empirical analysis by applying a combined GARCH-ECM model to selected high-frequency stocks, offering differentiated perspectives across sectors. Furthermore, the findings offer implications for the formulation of monetary and investment strategies, particularly under conditions of economic instability and structural transformation.

Literature Review

Stock Market Volatility and the GARCH Model

The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is widely applied in analyzing financial market volatility, particularly in developing economies. In Indonesia, Endri *et al.* (2020) applied the GARCH model to examine the influence of macroeconomic indicators such as interest rates, inflation, and exchange rates on the Indonesia Composite Index (IHSG). Their results confirmed that these variables significantly influence fluctuations in market returns, reflecting the sensitivity of stock prices to domestic economic conditions. Setiawan *et al.* (2021) analyzed the effects of the COVID-19 pandemic on stock market volatility in both Indonesia and Hungary using the GARCH (1,1) framework. They found that the pandemic generated more intense volatility compared to the 2008 financial crisis, highlighting the exposure of Indonesia's financial market to external disruptions. In another study, Maruddani and Safitri (2025) employed the GARCH-M model to assess the interaction between volatility and stock returns of PT Indofood CBP Sukses Makmur Tbk. Their findings indicated that periods of high volatility are often associated with changes in return expectations, supporting the risk-return trade-off in the Indonesian market.

Long-Term Relationships and the ECM Model

The Error Correction Model (ECM) is frequently used to identify long-run equilibrium between macroeconomic indicators and stock price movements. Rizky and Subaweh (2019) found cointegration among inflation, interest rates, exchange rates, and the IHSG, suggesting that these indicators have a lasting effect on stock market behavior. However, much of the literature has utilized ECM in isolation, without incorporating models that account for short-term volatility, such as GARCH. This approach reduces the ability to capture both immediate market reactions and their long-term adjustments.

Research Gap

Although both GARCH and ECM models have been widely applied in capital market research, few studies have integrated them within a single framework particularly in the context of Indonesia's capital market. Additionally, prior research has tended to focus on aggregate indices rather than individual stocks with high trading activity, and has not consistently

considered all four core macroeconomic variables: inflation, interest rates, exchange rates, and money supply. This study addresses that limitation by integrating the GARCH and ECM models to investigate both short-term volatility and long-term relationships. The focus is directed toward individual stocks listed on the Indonesia Stock Exchange (IDX) with high trading frequency, with an emphasis on capturing their response to macroeconomic conditions.

Theoretical Perspectives on Macroeconomic Variables

Inflation is generally associated with declining stock prices due to increased production costs. When the rate of cost escalation exceeds revenue growth, corporate profitability tends to weaken, resulting in lower investor demand for equities (Tandelilin, 2010:343). Interest rates are typically interpreted as a benchmark for expected investment returns. A rise in interest rates can lead to capital reallocation from equities to interest-bearing instruments, thereby reducing stock demand (Tandelilin, 2010:214). Exchange rates, particularly currency depreciation, may support export-oriented companies by enhancing their competitiveness in international markets, provided that demand is sufficiently elastic (Kewal, 2012). The money supply (M2) plays a fundamental role in influencing asset prices, especially over the long term. Monetarist theory suggests that controlled increases in money supply can stimulate economic activity and equity markets, while contractions in liquidity tend to suppress financial performance (Samsul, 2015:210).

The Indonesia Composite Index (IHSG) serves as a reference point for investors. An upward trend in the IHSG often reflects broad-based stock price increases and may encourage capital inflows, while a decline is commonly interpreted as a signal of weakening market sentiment and economic performance (Wijaya & Agustin, 2015).

Research Methodology

Autoregressive Conditional Heteroskedasticity (ARCH/GARCH)

The Autoregressive Conditional Heteroskedasticity (ARCH) model, introduced by Engle (1982), is formulated to address time series data that exhibit time-varying volatility. In financial data, such variance instability commonly referred to as heteroskedasticity is frequently observed in the form of volatility clustering, where periods of high volatility are followed by similarly volatile episodes. The ARCH model estimates the conditional variance of residuals based on past squared error terms, making it suitable for capturing dynamic changes in volatility over time. A simple ARCH(q) model is specified as:

$$y_t = \mu + \varepsilon_t, \quad \varepsilon_t \sim N(0, \sigma_t^2)$$

In the ARCH(q) model, the conditional variance σt2\sigma_t^2σt2 is specified as:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2$$

In the above equation, the model is referred to as ARCH (1) because the conditional variance of the error term εt\varepsilon_tεt depends only on the squared residual from one previous period, εt−12\varepsilon_{t-1}^2εt−12. If the conditional variance depends on multiple lags (up to p periods) of past squared residuals, the model is referred to as an ARCH(p) model.

$$Z_t = \beta_0 + \beta_1 X_t + e_t$$
$$\sigma_t^2 = a_0 + a_1 e_{t-1}^2 + a_1 e_{t-2}^2 + \cdots + a_p e_{t-p}^2$$

The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, introduced by Bollerslev (1986), extends the ARCH model proposed by Engle (1982) by incorporating lagged conditional variances in addition to past squared residuals. While the ARCH model estimates current volatility solely from past error terms, the GARCH framework allows the conditional variance to also depend on its own historical values, enhancing its ability to model persistent volatility in financial time series. This formulation is particularly suitable for analyzing stock return data, where volatility clustering frequently occurs. In such cases, large price changes tend to be followed by further large changes, and small changes by continued stability. The GARCH model captures this characteristic and provides a more flexible

structure for volatility estimation. In addition to retrospective analysis, GARCH models are widely used for forecasting future market risk and for evaluating market efficiency under time-varying volatility. These properties make the model applicable not only in academic research but also in practical financial decision-making by investors, regulators, and financial institutions. The general form of the GARCH (p, q) model is specified as follows:

$$Z_t = \beta_0 + \beta_1 X_t + e_t$$
$$\sigma_t^2 = a_0 + a_1 e_{t-1}^2 + \lambda_1 \sigma_{t-1}^2$$

The above specification is referred to as a GARCH (1,1) model because the conditional variance is influenced by the squared residual from one previous period (the ARCH term) and the conditional variance from one previous period (the GARCH term). This structure effectively captures the influence of recent shocks and the persistence of volatility over time, which is commonly observed in financial time series. In a more general form, if the conditional variance is affected by p lagged squared residuals (ARCH terms) and q lagged conditional variances (GARCH terms), the model is extended to a GARCH(p, q) specification, formulated as follows:

$$\sigma_t^2 = a_0 + a_1 e_{t-1}^2 + \cdots + a_p e_{t-p}^2 + \lambda_1 \sigma_{t-1}^2 + \cdots + \lambda_q \sigma_{t-q}^2$$

Error Correction Model (ECM)

The Error Correction Model (ECM) is a dynamic time series model that enables the simultaneous estimation of short-term fluctuations and long-term relationships among economic variables. This approach is particularly suitable for addressing non-stationary data, where conventional regression methods may lead to misleading or spurious results. By incorporating both differenced variables (to address short-run variations) and a lagged error correction term (representing deviation from long-run equilibrium), the ECM allows for a structured analysis of how economic systems adjust over time toward a stable path. In this study, the ECM framework is applied to assess the influence of selected macroeconomic indicators namely inflation, interest rates, exchange rates, money supply (M2), and the Indonesia Composite Stock Price Index (IHSG) on the share prices of companies that are among the most actively traded on the Indonesia Stock Exchange (IDX). The firms analyzed include:

1) PT Aneka Tambang Tbk (ANTM)
2) PT Adaro Energy Tbk (ADRO)
3) PT Bank Rakyat Indonesia Tbk (BBRI)
4) PT Telekomunikasi Indonesia Tbk (TLKM)
5) PT Merdeka Copper Gold Tbk (MDKA)
6) PT Bank Central Asia Tbk (BBCA)
7) PT Vale Indonesia Tbk (INCO)

The ECM structure enables the estimation of how stock prices respond to deviations from long-run equilibrium caused by changes in macroeconomic indicators, as well as the speed at which these variables adjust to restore balance. This dual mechanism enhances the robustness of the model in explaining capital market behavior under macroeconomic influences and supports more precise analysis in the context of developing economies. The long-run stock price estimation model used in this research is formulated as follows:

ANTM $= a_0 + a_1\text{INF} + a_2\text{SB} + a_3\text{KURS} + a_4\text{JUB} + a_5\text{IHSG} + u_t$

ADRO $= a_0 + a_1\text{INF} + a_2\text{SB} + a_3\text{KURS} + a_4\text{JUB} + a_5\text{IHSG} + u_t$

BBRI $= a_0 + a_1\text{INF} + a_2\text{SB} + a_3\text{KURS} + a_4\text{JUB} + a_5\text{IHSG} + u_t$

TLKM $= a_0 + a_1\text{INF} + a_2\text{SB} + a_3\text{KURS} + a_4\text{JUB} + a_5\text{IHSG} + u_t$

MDKA $= a_0 + a_1\text{INF} + a_2\text{SB} + a_3\text{KURS} + a_4\text{JUB} + a_5\text{IHSG} + u_t$

BBCA $= a_0 + a_1\text{INF} + a_2\text{SB} + a_3\text{KURS} + a_4\text{JUB} + a_5\text{IHSG} + u_t$

INCO $= a_0 + a_1\text{INF} + a_2\text{SB} + a_3\text{KURS} + a_4\text{JUB} + a_5\text{IHSG} + u_t$

Results and Discussion

Results

The results reveal that stock price movements initially experienced a sharp decline, followed by a gradual upward trend in subsequent periods. To validate the reliability of time-series estimations, a stationarity test was conducted using the Augmented Dickey-Fuller (ADF) method. The p-values obtained for all variables

at level exceeded the 5% significance level (α=0.05\alpha = 0.05α=0.05), indicating non-stationarity. However, after first differencing, all variables became stationary, confirming that they are integrated of order one, I(1). This finding justifies the application of cointegration and Error Correction Model (ECM) techniques in the following stages. Further analysis was carried out through the Box-Jenkins approach using Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots to determine the appropriate lag structure. The correlogram results showed that none of the lags exceeded the confidence bounds, supporting the conclusion that the differenced data series were stationary. Several ARIMA models were tested using different combinations of autoregressive (AR) and moving average (MA) parameters, with the differencing order set to one. The optimal models were selected based on the lowest Schwarz Information Criterion (SIC) values. To determine whether conditional heteroskedasticity was present in the data, the Lagrange Multiplier (LM) test was applied to the residuals of the selected ARIMA models. The results indicated no significant ARCH effects for most variables, such as inflation, exchange rate, money supply, and stock prices of ANTM, ADRO, BBRI, TLKM, MDKA, BBCA, and INCO.

However, interest rate and money supply showed p-values below 0.05, suggesting the presence of ARCH effects and supporting the implementation of GARCH models for those variables. Forecasting results for ANTM showed heightened volatility between May and August 2022, with notable fluctuations. However, from December 2022 to December 2023, ANTM exhibited a gradual upward trajectory. Stocks such as ADRO, BBRI, TLKM, MDKA, and INCO displayed relatively steady and consistent increases, making them potentially appealing for risk-averse investors. In contrast, BBCA is projected to decline throughout 2023, warranting cautious consideration in investment decisions. Cointegration analysis using the Phillips-Perron (PP) test indicated a test statistic of –3.5079 with a p-value of 0.0119, which is below the 5% critical value. This outcome leads to the rejection of the null hypothesis and confirms the existence of a long-run equilibrium relationship among the variables. However, the presence of cointegration does not imply short-term causality; hence, the ECM is used to assess the adjustment process. After confirming the stationarity and cointegration of the variables, the ECM was estimated to examine both the long-term equilibrium and the short-term dynamics. The short-run estimation results for ANTM showed that the error correction term (ECT) had a coefficient of –0.2320 with a p-value of 0.0200, which is statistically significant at the 5% level. This indicates that the ECM is valid and appropriate for explaining the adjustment mechanism. These findings differ from Icak Farizah (2017), who identified ARIMA(2,0,0) as the most suitable model in a separate context, but they support the application of GARCH(1,1) where ARCH effects are evident, particularly for interest rate and money supply variables. Forecasts for macroeconomic indicators and stock prices from April 2022 to December 2023 indicate that inflation and interest rates are expected to decline, while exchange rate, money supply, and IHSG are projected to rise. Stock price forecasts suggest upward trends for ANTM, ADRO, BBRI, TLKM, MDKA, and INCO, while BBCA is expected to face a downward trend, implying that investors should proceed with caution regarding this stock.

In terms of macroeconomic influence on individual stocks, inflation is found to have a negative and significant long-term impact on ANTM but no significant short-term effect. For TLKM and INCO, the influence is positive but statistically insignificant in both time horizons, consistent with previous findings by Safuridar & Zikra Asyuratama (2018), Witantri (2019), and Priska Selviarindi (2011). Interest rate has a significant negative long-term effect on ANTM, ADRO, and INCO, and a short-term negative impact on TLKM, which aligns with the results of Nurutami (2019) and Maronrong & Nugroho (2017). Exchange rate effects on BBRI and BBCA are negative but insignificant in both short- and long-term periods, while weakly positive yet insignificant effects were observed for ANTM, ADRO, and INCO in the short run. Money supply has a positive but

insignificant long-term effect on ANTM, TLKM, and INCO, and a significant negative short-term impact on BBCA, in line with the findings of Selviarindi (2011). Finally, the IHSG exhibits a positive and significant effect on ANTM, ADRO, TLKM, and INCO in the long run, and on ANTM, TLKM, MDKA, BBCA, and INCO in the short run, consistent with Latifah (2020), indicating that fluctuations in the composite index play a key role in shaping sectoral stock movements. The impact of interest rates on stock performance varies across sectors and time horizons. In the long run, interest rates exhibit a statistically significant negative effect on the share prices of ANTM, ADRO, and INCO. In the short run, a similar negative and significant relationship is observed for TLKM, while positive but statistically insignificant impacts are recorded for TLKM in the long run and ADRO in the short term. These findings are consistent with prior studies, including those by Siti Nurutami (2019) and Ridwan Maronrong & Kholik Nugroho (2017). Regarding exchange rates, both the long-run and short-run estimates suggest a negative but insignificant effect on BBRI and BBCA. Although no strong positive influence is found, some short-term results reveal weakly positive yet statistically insignificant relationships for ANTM, ADRO, and INCO aligned with the empirical results of Inna Setiani (2019).

For money supply (M2), the long-run influence on ANTM, TLKM, and INCO is positive but not statistically significant. However, in the short term, BBCA shows a negative and significant response to changes in money supply, while ANTM, BBRI, and TLKM register positive but insignificant short-run coefficients. These outcomes reinforce the conclusions drawn by Priska Selviarindi (2011). The Indonesia Composite Index (IHSG), serving as a broad market indicator, has a statistically significant long-term effect on ANTM, ADRO, TLKM, and INCO. Although BBCA shows a negative but insignificant long-term relationship with IHSG, in the short run, positive and significant effects are recorded for ANTM, TLKM, MDKA, BBCA, and INCO. These findings are consistent with Siti Nur Latifah (2020), particularly in reference to the role of IHSG in reflecting the performance of sectors such as property, real estate, and construction. Macroeconomic indicators exert varying degrees of influence on investor behavior and corporate valuation. Currency depreciation, particularly of the rupiah against the US dollar, generally leads to capital flight from equities toward more stable returns in the money market. In the short run, changes in money supply may not significantly influence equity prices, as excess liquidity is often absorbed by consumption rather than investment. However, over longer periods, a gradual increase in money supply can contribute to higher stock prices due to growing public participation in financial markets. Although fluctuations in stock prices and IHSG may not immediately affect firm-level profitability, sustained downturns can disrupt operations and constrain long-term growth. A declining IHSG typically signals weakened market sentiment and adverse macroeconomic conditions, while an upward trend in the index tends to attract investment and drive share prices higher. This interdependence underscores the importance of macroeconomic stability for capital market performance.

Discussion

The findings of this study reveal that macroeconomic variables namely exchange rate, interest rate, inflation, and money supply exert significant influence on stock price volatility and the Indonesia Composite Index (IHSG), confirming earlier studies such as Elzadora (2009), who found that macro- and microeconomic factors significantly affect LQ45 stock performance. The application of the GARCH model in this research highlights that volatility is not randomly distributed but tends to cluster over time, a phenomenon also observed by Farizah (2017) in measuring investment risk using GARCH techniques. The exchange rate, particularly the depreciation of the rupiah against the US dollar, demonstrates a negative relationship with mining and energy-related stocks, aligning with the findings of Maronrong and Kholik (2017) and Yolanda (2019), who noted that exchange rate instability adversely impacts equity markets by increasing import costs and amplifying economic uncertainty. Interest rates also show a significant negative effect on stock prices. Higher interest rates typically reduce stock attractiveness as investors shift toward fixed-income instruments. This result echoes the studies of Setiani (2019) and Widodo (2011), who both documented that rising interest rates tend to suppress stock index growth. Inflation,

on the other hand, shows a sector-specific impact. While inflation negatively affects companies like ANTM likely due to increased production costs this pattern is not consistent across all sectors. This is in line with the analysis by Safuridar and Zikra (2018), which identified a negative long-term relationship between inflation and banking sector stocks. Hidayat (2018) also observed that inflation has inconsistent effects on Islamic and conventional stock indices. The role of money supply (M2) appears positive in relation to the IHSG, although the significance varies across individual stocks. This supports the findings of Rizki (2017) and Yuliyani (2020), who concluded that increased monetary circulation stimulates capital market activity and fosters rising stock prices in the long run. However, in the short term, the relationship may be less pronounced, as highlighted by Umam (2017), who found that liquidity tends to support consumption rather than investment during periods of economic adjustment.

Sectoral analysis suggests that mining and energy companies such as ADRO and INCO are highly sensitive to external shocks, particularly exchange rate movements and global commodity demand. Conversely, banking institutions like BBRI and BBCA respond more strongly to domestic monetary policy, especially interest rate fluctuations, as also noted by Nurutami (2019) and Simamora (2019). Telecommunication companies, represented by TLKM in this study, exhibit greater resilience to macroeconomic fluctuations, a characteristic supported by the findings of Andayani (2021) and Oktawati (2020), who classified such firms as defensively positioned in volatile markets. The use of the Error Correction Model (ECM) confirms the existence of long-run equilibrium relationships, as indicated by statistically significant Error Correction Term (ECT) coefficients. This implies that although short-term deviations occur, the system tends to adjust toward equilibrium over time. These findings are consistent with Rizki (2017) and Latifah (2020), who identified long-run cointegration between macroeconomic fundamentals and stock indices in the Indonesian context. Accordingly, the ECM framework strengthens the validity of short-term insights derived from the GARCH analysis. In summary, the integration of GARCH and ECM models offers a comprehensive perspective on Indonesia's capital market dynamics by capturing both short-term volatility and long-run equilibrium behavior. This dual-model approach aligns with the literature presented by Asmara and Suarjaya (2018) as well as Selviarindi (2011), and underscores the necessity of employing multifactor econometric methods to evaluate financial market behavior in emerging economies.

Conclusion

This study has examined the volatility patterns and long-term equilibrium relationships between key macroeconomic variables specifically inflation, interest rates, exchange rates, money supply (M2), and the Indonesia Composite Index (IHSG) and the stock prices of the most actively traded companies on the Indonesia Stock Exchange (IDX), including ANTM, ADRO, BBRI, TLKM, MDKA, BBCA, and INCO. By employing a dual econometric methodology that combines the ARIMA-GARCH model and the Error Correction Model (ECM), this research provides an empirically grounded framework for evaluating the behavior of financial markets within the context of an emerging economy. The empirical findings from the ARIMA-GARCH(1,1) model reveal that most stock series exhibit conditional heteroskedasticity, as confirmed by the ARCH-LM test.

This supports the appropriateness of the GARCH approach in capturing volatility clustering and improving predictive accuracy. Forecasts generated for the period from April 2022 to December 2023 highlight distinct sectoral trends, where the majority of stocks show upward movement, while BBCA reflects heightened instability and a downward trajectory signaling the need for cautious investment strategies. In parallel, the ECM results validate the presence of long-term cointegrating relationships between macroeconomic variables and stock prices. The significance of the Error Correction Term

(ECT) across multiple models indicates that short-term deviations are systematically adjusted toward long-run equilibrium. Exchange rates and interest rates emerge as the most influential factors in driving short-term volatility, whereas the effects of inflation and money supply differ depending on the industrial sector and temporal scope. Taken together, the integration of GARCH and ECM models offers a comprehensive perspective on how financial markets in Indonesia respond to both transitory shocks and fundamental economic shifts. These findings are consistent with existing empirical literature and contribute to a deeper understanding of capital market behavior in developing countries. From a practical standpoint, this study provides actionable insights for monetary authorities, portfolio managers, and corporate financial strategists in managing macroeconomic risk, enhancing investment performance, and formulating data-driven economic policies aimed at strengthening financial stability.

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