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Determinants of Stock Volatility of Indonesian State-Owned Enterprises on the Indonesia Stock Exchange: A Panel-Data Modelling Approach with Firm Size as a Moderating Variable

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Abstract

This study examines the determinants of stock-price volatility among Indonesian State-Owned Enterprises (SOEs) listed on the Indonesia Stock Exchange (IDX) and tests whether Firm Size (FS) moderates these relationships. Five groups of explanatory features are integrated into a single model: macro fundamentals (MF), micro fundamentals (MiF), capital structure measured by Government Funding (GF), Stock-Market Volatility (SMV), and Market Liquidity (ML). Using a balanced panel of 24 listed SOEs over 2019–2024 (144 firm-year observations), model selection across common-, fixed-, and random-effects specifications identifies the Common Effects Model (CEM) as the most appropriate. The model is jointly significant (Prob. F = 0.0001) and explains 40.37% of the variation in volatility (R2 = 0.4037). The findings reveal that inflation (β = -29.412, p = 0.022), the debt-to-equity ratio (β = -0.9996, p = 0.035), return on assets (β = -1.6373, p = 0.011), and government funding (β = -0.0197, p = 0.002) each significantly and negatively shape stock volatility. Broad market volatility and trading volume are statistically insignificant. Furthermore, firm size significantly moderates the exchange rate effect (β = 5.1933, p = 0.003) and the return on assets effect (β = -0.4727, p = 0.023). This paper contributes to literature by offering a unified, data-driven framework and extending efficient-market, behavioural-finance, and trade-off theories to state ownership, demonstrating that state-backed funding acts as a stabilizing capital component rather than a risk driver. Practical recommendations for the Ministry of SOEs include establishing performance-linked funding benchmarks and public-service account separation to mitigate market distortions and stock volatility.

Keywords: Stock Volatility, State-Owned Enterprises, Panel Data, Government Funding, Firm Size Moderation

1. Introduction

State-Owned Enterprises (SOEs) remain central to many national economies, supplying employment, public services, and a meaningful share of fiscal revenue [1], [2]. Across emerging and transition economies they also operate as instruments of development policy, delivering infrastructure, strategic industries, and financial inclusion [3]. In Indonesia, SOEs (Badan Usaha Milik Negara, BUMN) are tasked with advancing public welfare while generating returns for the state as majority shareholder; their contribution to the national budget rose steadily over 2004-2024, reaching approximately IDR 85.8 trillion in 2024.

Beyond their fiscal role, Indonesian SOEs are positioned as agents of economic transformation under the national long-term development agenda, with mandates spanning infrastructure construction, strategic industry, financial inclusion, and sustainable development. This strategic positioning means that the market valuation of listed SOEs is shaped not only by ordinary commercial performance but also by state policy, public-service obligations, and the government's standing as controlling owner. These features make SOE equities an analytically distinct population whose price behaviour cannot be assumed to mirror that of private firms. Beginning in the late 1990s, the Indonesian government partially privatized selected SOEs by listing their shares on the Indonesia Stock Exchange (IDX). By 2024, thirty SOEs

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spanning finance, mining, energy, construction, industry, transportation, and telecommunications were listed, although the state retained majority control. Evidence indicates that partial privatization improved efficiency and governance and allowed SOE shares to compete with private counterparts [4], [5], [6], [7]. Yet listing also exposed these firms to stock-price volatility, the dispersion of returns around their central tendency driven by external and internal forces [8], [9].

Volatility is consequential for both investors and policymakers. On Tuesday, 18 March 2025, the IDX triggered a 30-minute trading halt at 11:19 JATS after the Jakarta Composite Index (JCI) plummeted over 5% intraday, ultimately closing the session down 6.12%. This market crash was heavily driven by domestic political transitions, speculation surrounding the resignation of the finance minister, and rising concerns over fiscal sustainability under the incoming administration. Crucially, large-cap state-owned banks, including PT Bank Rakyat Indonesia (BBRI), PT Bank Mandiri (BMRI), and PT Bank Negara Indonesia (BBNI), experienced disproportionately heavy foreign capital outflows and hit Auto-Rejection Lower Limits (ARB) faster than their private peers (such as BBCA). This discrepancy suggests that state-linked stocks bear the brunt of sovereign-policy risk during periods of national transition. Episodes such as this underline that volatility in state-linked equities can rapidly transmit to the wider financial system, making the question of what drives SOE volatility a critical concern for market stability. Because the government can simultaneously influence firm-level decisions and set the macroeconomic and regulatory environment, the determinants of SOE volatility are different in mix and magnitude from those documented for private firms, warranting dedicated analysis.

From a data-science perspective, explaining volatility is an empirical modelling problem: assembling a structured panel of macro, firm-level, and market features and quantifying their explanatory contribution. Prior studies, however, have largely examined these determinants in isolation, including MF [10], [11], MiF [12], [13], market volatility [14], and liquidity [15], [16], and rarely within a single integrated model, rarely for the full population of listed SOEs, and rarely with a moderating variable. Most Indonesian work has been sector-specific rather than population-wide [17]. This fragmentation leaves open whether the determinants retain their explanatory power once estimated jointly, and whether their influence is uniform across firms of different scale.

To address these gaps, this study develops and tests an integrated model that links macro fundamentals (MF), micro fundamentals (MiF), capital structure measured by government funding (GF), stock-market volatility (SMV), and market liquidity (ML) to the stock volatility of Indonesian SOEs, with firm size (FS) introduced as a moderating variable, an element seldom used in volatility-determinant research [18], [19]. The objective is to clarify which determinants drive volatility once they are estimated jointly on the complete set of listed SOEs, and whether their influence is uniform across firms of different scale. By highlighting these relationships, the study contributes both theoretically, by reconstructing fragmented, partial models into one comprehensive specification and extending efficient-market, behavioural-finance, and trade-off perspectives to the state-ownership context, and practically, by offering policymakers and investors evidence on the levers most associated with the stability of strategically important state-owned equities. The remainder of the paper reviews the theoretical foundations and prior evidence, describes the data and panel-modelling procedure and develops the hypotheses, reports the estimation and hypothesis tests, and discusses the implications for theory and policy.

2. Literature Review

2.1. Conceptualizing Stock Volatility and Market Efficiency

Stock Volatility (SV) denotes the degree of variation in a share's price around its central tendency, conventionally measured by the standard deviation of returns and long modelled as a stochastic process whose intensity rises with news, uncertainty, and trading [8], [9]. Portfolio theory establishes return dispersion as the core measure of investment risk [20], standard treatments of investments formalize its role in asset pricing [21], and conditional-variance models capture its time-varying and clustering behaviour [22].

The efficient market hypothesis (EMH) provides the dominant lens for interpreting these movements, holding that asset prices fully reflect available information, so that price changes, and hence volatility, are a response to the arrival of new information rather than to predictable patterns [23]. Under this view, the macroeconomic environment, firm fundamentals, and market-wide conditions are simultaneous information sources, and volatility rises when these signals

are noisy, conflicting, or rapidly changing. The EMH justifies modelling volatility as a function of an information set composed of macro, micro, capital-structure, market-volatility, and liquidity variables, and it predicts that the variables carrying the most decision-relevant information for a given population of firms will exert the strongest influence.

2.2. Behavioural Finance and Investor Sentiment in State-Owned Firms

Behavioural finance (BF) qualifies the efficient-market account by recognizing that investors are subject to sentiment and cognitive biases, so prices can move beyond what fundamentals alone would justify [24]. Empirical work links such behaviour to market anomalies and to episodes of elevated volatility, particularly during stress [25]. In the SOE context the perspective is especially relevant, because perceptions of implicit state support, political backing, or public-service obligations can anchor or distort investor expectations, dampening reactions to some signals while amplifying reactions to others. Behavioural finance thus explains why the empirical weight of market sentiment relative to firm fundamentals may differ for state-owned firms compared with private firms, motivating a model that admits both fundamental and sentiment-driven channels.

2.3. Trade-off Theory and the Role of State Ownership

Trade-off theory (TOT) frames capital structure as a balance between the tax and disciplinary benefits of debt and the expected costs of financial distress [26], building on the agency perspective of the firm in which ownership and financing choices shape risk and incentives [27]. For SOEs this balance is altered because the government is simultaneously controlling owner, funder, and de facto guarantor. State ownership and funding can lower the cost of debt and the perceived probability of distress through implicit guarantees [28], [29], and political and fiscal considerations can shape financing and investment in ways not seen in private firms [30]. Trade-off theory therefore motivates treating GF as a distinct component of SOE capital structure rather than folding it into ordinary leverage.

2.4. Macro Fundamentals as Drivers of Stock Volatility

MF describe the economy-wide conditions that shape the information environment in which equity prices are formed. Because SOEs operate across strategic sectors that are closely tied to the national economy, their share prices are particularly sensitive to shifts in these conditions. A large body of evidence from both emerging and developed markets confirms that macroeconomic conditions significantly influence SMV [10], [11], [31], [32]. Building on this evidence, the present study examines four macroeconomic indicators, and each is reviewed individually in the paragraphs that follow.

The exchange rate captures the external value of the domestic currency and is among the most closely watched macroeconomic signals in an open economy. When the currency depreciates, the cost of imported inputs and of servicing foreign-currency debt rises, which can compress margins and weaken the financial position of affected firms. A depreciation can also signal broader external imbalance, prompting investors to reprice firms that are exposed to trade and foreign funding. These adjustments are rarely smooth, so currency movements often translate into sharper swings in share prices. Consistent with this reasoning, documented spillovers between currency and equity markets show that exchange-rate movements transmit directly into stock volatility [33], [14].

Inflation reflects the rate at which the general price level rises and serves as a barometer of macroeconomic stability. Higher inflation erodes the real value of future returns and raises uncertainty about firms' future cash flows. It can also undermine confidence in the credibility of monetary and fiscal policy, which unsettles investor expectations. When these effects combine, they tend to widen the dispersion of equity prices and elevate volatility. Cross-country evidence accordingly links inflation to greater equity-market volatility, underscoring its relevance as a determinant in this study [34].

The interest rate represents the cost of money and reflects the prevailing stance of monetary policy. As rates rise, the discount applied to firms' future cash flows increases, lowering present valuations, while the opportunity cost of holding equity relative to fixed-income assets also grows. These shifts frequently trigger a reallocation of portfolios between bonds and stocks, and such reallocations can intensify price movements. For capital-intensive SOEs that rely heavily on borrowing, changes in the policy rate are especially consequential. The resulting spillovers between interest-rate and equity markets are well documented in the literature [35].

Economic growth proxies the expansion of aggregate output over the business cycle and signals the overall health of the economy. Stronger growth generally improves earnings expectations and can stabilize prices by reinforcing investor confidence. Periods of contraction, by contrast, raise uncertainty about corporate performance and tend to heighten volatility. Empirical work consistently identifies growth among the macroeconomic determinants that shape SMV [10], [32]. For state-linked firms, however, these four channels may operate differently: their effects can be muted by government policy support or, conversely, amplified by the firms' concentrated exposure to strategic sectors.

2.5. 2.5 Micro Fundamentals and Firm-Level Performance

MiF are firm-specific financial ratios that convey performance information investors rely on to reassess risk and adjust their positions. Unlike macroeconomic indicators, which affect all listed firms broadly, these ratios capture conditions unique to each company and therefore help explain why the volatility of individual shares can diverge. Both classical and contemporary evidence shows that such information feeds into volatility, doing so directly as new figures are released and indirectly as investors revise their expectations about future performance [12], [13], [36], [17]. To capture the main dimensions of firm performance, this study reviews seven ratios spanning five dimensions, each discussed in turn below.

The current ratio measures short-term liquidity, that is, a firm's ability to meet its current obligations using its current assets. Adequate liquidity reduces the risk of short-term financial distress and reassures investors that the firm can absorb near-term shocks, which generally helps steady its share price. When liquidity is weak, by contrast, doubts about the firm's ability to honour its obligations can grow. Such doubts tend to heighten uncertainty among investors and, in turn, increase volatility [36].

The debt-to-equity ratio measures solvency, reflecting the firm's relative reliance on debt versus equity financing. Conventional theory holds that higher leverage raises financial risk because it commits the firm to fixed obligations, making its equity more sensitive to shocks. This sensitivity typically translates into wider swings in share prices when conditions change. In firms that enjoy strong external backing, however, the relationship can be attenuated, since perceived support lowers the market's assessment of default risk [13].

Total asset turnover measures activity, capturing how efficiently a firm uses its assets to generate sales. More efficient asset use signals operational strength and competent management, which reduces uncertainty about the firm's future performance and can calm its share price. Weaker turnover, on the other hand, often accompanies less efficient operations and more variable results. Because such results are harder for investors to anticipate, low turnover may be associated with greater volatility [12].

Profitability is captured by three complementary ratios that view firm performance from different angles. Net profit margin reflects the share of earnings retained from each unit of sales, return on assets reflects how effectively the firm's assets generate profit, and return on equity reflects the return ultimately delivered to shareholders. Taken together, higher values on these measures generally signal quality and stability, and they are associated with calmer pricing because they reassure investors about the durability of earnings. When firms report losses or erratic earnings, however, confidence weakens and the dispersion of returns widens [13].

The market-to-book ratio is a market-valuation measure that compares a firm's market price to its book value, thereby reflecting investors' growth expectations and prevailing sentiment. A high ratio indicates that the market prices the firm well above its accounting value, often in anticipation of strong future growth. Such valuations, however, rest heavily on expectations that can shift quickly as new information arrives. When those expectations are elevated or unstable, the ratio can be accompanied by greater variability in the firm's share price [36].

2.6. Capital Structure and Government Funding in SOEs

For SOEs, capital structure extends well beyond the ordinary mix of debt and equity to include GF, the capital that the state injects or commits in its role as controlling owner. This element has no direct equivalent in fully private firms, and it fundamentally alters how the financing of an SOE should be understood. Because government backing can operate as an implicit guarantee, investors may treat the firm as less likely to default even when its formal leverage is high. As a result, such support can lower the firm's cost of debt and reduce the perceived probability of financial distress. In doing so, it may dampen volatility in a way that conventional trade-off theory, framed only around the costs

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and benefits of private debt and equity, does not capture [28], [29], [30]. The presence of state funding can also shape investor sentiment more broadly, signalling that the government has a continuing stake in the firm's stability and strategic role. For these reasons, GF represents a distinctive and potentially stabilizing component of SOE financing, and this study examines it as a separate determinant rather than folding it into ordinary measures of leverage.

2.7. Stock-Market Volatility and Spillover Effects

Beyond firm-specific and macroeconomic factors, individual shares are exposed to the volatility of the market. No listed firm trades in isolation, so broad swings in market sentiment inevitably exert pressure on the prices of individual stocks. During high-volatility regimes, even fundamentally sound and otherwise stable shares can move sharply, because investors increasingly react to aggregate sentiment rather than to information specific to a given firm. This tendency for turbulence to propagate from the wider market to individual securities, and from one market to another, is well documented in studies of volatility spillovers [14], [37]. In emerging markets in particular, such spillovers can be pronounced, as shifts in global sentiment and capital flows are transmitted rapidly to local exchanges. To capture this dimension of systematic exposure, the present study uses the Jakarta Composite Index (JCI) as a proxy for market-wide volatility (SMV) on the Indonesia Stock Exchange. Including this measure allows the analysis to account for the portion of an SOE's volatility that reflects the condition of the overall market rather than the firm itself.

2.8. Market Liquidity and Trading Volume

ML describes the ease with which shares can be bought or sold without forcing large concessions in price, and it is closely tied to the intensity of information flowing through the market. A liquid stock can absorb sizeable orders with only modest price movement, whereas an illiquid one may swing considerably in response to relatively small trades. Trading volume serves as a standard proxy for this condition, because it reflects how actively a security is being exchanged at any given time. Two related mechanisms connect volume to price variability: the price impact that trades exert as they are executed, and the speed with which new information is incorporated into prices as investors act on it. Through these channels, thinly traded shares may exhibit larger and more abrupt price jumps, since each transaction carries greater weight. Heavy trading volume, by contrast, often accompanies the rapid repricing of a security as a flood of new information is absorbed. The link between volume, liquidity, and volatility is therefore central to understanding short-term price behaviour, and it is well established in the literature [15], [16], [38], [39].

2.9. Firm Size as a Moderating Factor

FS conditions the way in which various risk factors are translated into the behaviour of a firm's share price. Larger firms typically operate within richer information environments, attract broader analyst coverage, and hold a greater share of institutional ownership, all of which can help dampen the idiosyncratic component of their volatility. At the same time, these firms are often more deeply integrated into the wider economy and may therefore carry greater exposure to systematic and currency risk. Because these two tendencies push in opposite directions, the empirical evidence on the relationship between size and volatility is decidedly mixed, with results varying across markets, periods, and sectors [18], [40], [19], [41]. This ambiguity is precisely what makes FS a compelling candidate for a moderating role rather than a simple direct determinant. In the present study, FS is measured by market capitalization and is treated as a moderator that may either strengthen or weaken the influence of each determinant on volatility. This treatment follows the standard methodological framework for identifying and analysing moderator variables [42], and it allows the analysis to test whether the effects of the other determinants depend on the scale of the firm.

2.10. Summary of Literature Review

The literature establishes that stock volatility responds to a combination of macroeconomic conditions, firm-level fundamentals, capital structure, market-wide movement, and liquidity, interpreted jointly through efficient-market, behavioural-finance, and trade-off perspectives. For SOEs, however, two features distinguish the setting: GF acts as a potentially stabilizing component of capital structure, and investor perceptions of state backing may reweight the influence of market sentiment relative to fundamentals. Prior studies have largely tested these determinants in isolation, in single sectors, and without a moderating variable, leaving open how they perform once integrated for the full population of listed SOEs and whether FS conditions their effects.

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3. Methodology

3.1. Research Design and Data Collection

The study adopts a quantitative, explanatory research design using panel-data analysis, which combines cross-sectional units (firms) with a time dimension (years) and is well suited to estimating determinant effects while accounting for firm-level heterogeneity [43], [44]. The analysis relies on secondary data. Firm-level variables are computed from audited annual financial statements and market data published by the Indonesia Stock Exchange [45], while the macroeconomic series are obtained from official national authorities (the central bank and the national statistics and finance agencies). The 2019-2024 window is chosen because it captures a full cycle of market conditions, including the COVID-19 shock and the subsequent recovery, providing variation in both the dependent variable and the macro regressors. Variable selection was informed by a structured, bibliometric scoping of the volatility literature in which publication and citation records were cleaned and mapped using VOSviewer [46], situating the study within a fast-growing research front and reinforcing its data-driven orientation [47], [48].

3.2. Population and Sample

The population comprises the 30 SOEs listed on the Indonesia Stock Exchange as of 2024. A purposive sampling procedure is applied, retaining only firms that were already listed before the start of the observation period and that report complete data for every variable across 2019-2024. This procedure yields a balanced panel of 24 firms and 144 firm-year observations (24 firms x 6 years), as summarized in table 1. The retained firms span the principal sectors in which Indonesian SOEs operate, including finance and banking, basic materials, energy, infrastructure and construction, and transportation, supporting the cross-sectional representativeness of the sample.

Table 1. Sample selection procedure

Criterion	Firms
SOEs listed on the Indonesia Stock Exchange as of 2024	30
Less: firms not yet listed before the 2019 observation window or with incomplete data	6
Final sample of SOEs	24
Observation period (years), 2019-2024	6
Total firm-year observations (24 x 6)	144

3.3. Research Model and Hypothesis Development

The conceptual framework integrates MF, MiF, capital structure measured by GF, SMV, and ML as determinants of stock volatility (SV), with FS acting as a moderator on each determinant. Building on the efficient-market, behavioural-finance, and trade-off perspectives reviewed above, the framework treats the five groups as simultaneous information signals whose marginal influence may vary with firm scale. Six hypotheses are derived.

Macroeconomic conditions form the external information environment for equity prices, and exchange-rate, inflation, interest-rate, and growth dynamics have all been shown to transmit into volatility across emerging and developed markets [10], [11], [31], [32]. This brings us to H1, which proposes that MF influence the stock volatility of Indonesian SOEs.

H1: MF (exchange rate, inflation, interest rate, and economic growth) significantly influence SOE stock volatility.

Firm-level ratios capturing liquidity, solvency, activity, profitability, and market valuation convey performance information that investors use to reassess risk, and prior studies link these ratios to price variability [12], [13], [36], [17]. This brings us to H2, which proposes that MiF influence the stock volatility of Indonesian SOEs.

H2: MiF (current ratio, debt-to-equity ratio, total asset turnover, net profit margin, return on assets, return on equity, and market-to-book ratio) significantly influence SOE stock volatility.

For state-owned firms, GF constitutes a distinctive element of capital structure whose implicit-guarantee character can lower perceived distress risk in a way ordinary leverage does not [28], [29], [30]. This brings us to H3, which proposes that capital structure, measured by GF, influences the stock volatility of Indonesian SOEs.

H3: Capital structure, measured by GF, significantly influences SOE stock volatility.

Individual shares are exposed to systematic movement, and during high-volatility regimes even stable shares reprice in response to aggregate sentiment [14], [37]. This brings us to H4, which proposes that SMV influences the stock volatility of Indonesian SOEs.

H4: SMV, measured by the Jakarta Composite Index, significantly influences SOE stock volatility.

Liquidity, proxied by trading volume, governs the price impact of trades and the speed at which information is incorporated, both of which are tied to price variability [15], [16], [38], [39]. This brings us to H5, which proposes that ML influences the stock volatility of Indonesian SOEs.

H5: ML, measured by trading volume, significantly influences SOE stock volatility.

Finally, FS shapes the information environment and risk exposure of a firm and can either dampen or amplify the influence of the determinants above [18], [40], [19], [41], [42]. This brings us to H6, which proposes that FS moderates the effect of each determinant group on the stock volatility of Indonesian SOEs.

H6: FS (market capitalization) moderates the effects of MF, MiF, capital structure, SMV, and ML on SOE stock volatility.

Figure 1 illustrates the hypothesized model, showing the direct paths from the five determinant groups to stock volatility (H1-H5) and the moderating role of FS on those paths (H6).

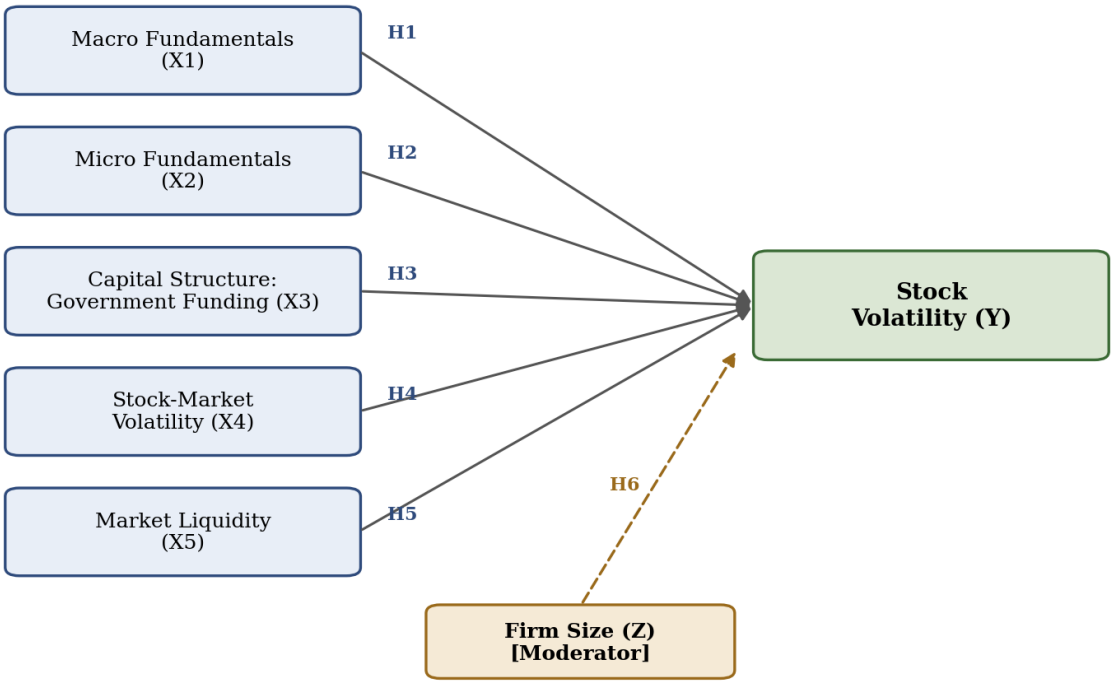

Figure 1. Research model framework

3.4. Variables and Operationalization

The model comprises one dependent variable, fourteen indicators grouped into five determinant constructs, and one moderating variable. Table 2 reports the operational definition, measurement or formula, and notation of each variable, and table 3 details the data type, period, and source for every construct.

Table 2. Operationalization and measurement of variables

Variable (notation)	Construct	Measurement / formula	Scale
Stock volatility (Y)	Dependent	Standard deviation of annual stock returns	Index
Exchange rate (X1.1)	Macro fundamentals	Annual change in the IDR/USD exchange rate	%
Inflation (X1.2)	Macro fundamentals	Change in the Consumer Price Index (CPI)	%

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Variable (notation)	Construct	Measurement / formula	Scale
Interest rate (X1.3)	Macro fundamentals	Central bank policy interest rate	%
Economic growth (X1.4)	Macro fundamentals	Change in Gross Domestic Product (GDP)	%
Current ratio (X2.1)	Micro fundamentals	Current assets / current liabilities	Ratio
Debt-to-equity ratio (X2.2)	Micro fundamentals	Total debt / total equity	Ratio
Total asset turnover (X2.3)	Micro fundamentals	Sales / total assets	Ratio
Net profit margin (X2.4.1)	Micro fundamentals	Net income / sales	Ratio
Return on assets (X2.4.2)	Micro fundamentals	Net income / total assets	Ratio
Return on equity (X2.4.3)	Micro fundamentals	Net income / total equity	Ratio
Market-to-book ratio (X2.5)	Micro fundamentals	Market price per share / book value per share	Ratio
Government funding (X3.1)	Capital structure	State capital injection / funding to the SOE	IDR
Stock-market volatility (X4.1)	Stock-market volatility	Volatility of the Jakarta Composite Index	Index
Trading volume (X5.1)	Market liquidity	Volume of shares traded	Shares
Market capitalization (Z1)	Firm size (moderator)	ln (shares outstanding x share price)	IDR (log)

Table 3. Data type, period, and source by construct

Construct	Data type	Period	Source
Stock volatility	Annual	2019-2024	Indonesia Stock Exchange
Macro fundamentals	Annual	2019-2024	Central bank; national statistics and finance agencies
Micro fundamentals	Annual	2019-2024	Audited financial statements / Indonesia Stock Exchange
Capital structure (government funding)	Annual	2019-2024	Ministry of Finance / Ministry of SOEs
Stock-market volatility (JCI)	Annual	2019-2024	Indonesia Stock Exchange
Market liquidity (trading volume)	Annual	2019-2024	Indonesia Stock Exchange
Firm size (market capitalization)	Annual	2019-2024	Indonesia Stock Exchange

3.5. Data Analysis

Stock volatility is modelled as a linear function of the five determinant groups, the moderating variable, and the interaction of firm size with each determinant. The estimated regression equation (1) is as follow.

$$\begin{aligned} SV = {} & \alpha + \beta_{1.1}X_{1.1} + \beta_{1.2}X_{1.2} + \beta_{1.3}X_{1.3} + \beta_{1.4}X_{1.4} \\ & + \beta_{2.1}X_{2.1} + \beta_{2.2}X_{2.2} + \beta_{2.3}X_{2.3} + \beta_{2.4.1}X_{2.4.1} \\ & + \beta_{2.4.2}X_{2.4.2} + \beta_{2.4.3}X_{2.4.3} + \beta_{2.5}X_{2.5} + \beta_{3.1}X_{3.1} \\ & + \beta_{4.1}X_{4.1} + \beta_{5.1}X_{5.1} + \beta_{6}Z_{1} + \beta_{7}(Z_{1} \times X_{k}) + \varepsilon \end{aligned} \quad (1)$$

SV is stock volatility, X1.1-X5.1 are the fourteen determinant indicators defined in table 2, Z1 is firm size, $(Z_1 \times X_k)$ denotes the set of interaction terms between firm size and each determinant, a is the intercept, the b coefficients are the parameters to be estimated, and e is the error term. The interaction terms operationalize the moderation hypothesis by allowing the marginal effect of each determinant to vary with firm size.

Estimation is carried out using the STATA statistical package, which is well suited to the panel structure of the data. Because the dataset combines a cross-section of firms with observations over several years, the analysis must first determine which panel specification best fits the data. To this end, the study considers three candidate models: the common-effects model (CEM), the fixed-effects model (FEM), and the random-effects model (REM). The most appropriate specification is selected through a sequence of formal tests, summarized in table 4, in which the Chow test, the Hausman test, and the Lagrange-Multiplier test are applied in turn to compare the three models against one another. This staged procedure ensures that the chosen estimator reflects the underlying structure of the data rather than an arbitrary modelling assumption. Advanced dynamic panel estimators (such as Difference or System GMM) were not considered due to the small panel size (N=24, T=6). In such micro-panels, GMM estimators suffer from the "instrument proliferation" problem, which overidentifies the model and severely biases standard errors. Similarly, conditional variance models (such as univariate or panel GARCH) are not feasible because they require high-frequency time-series data (e.g., daily or weekly observations over hundreds of periods) and cannot be estimated on a short annual panel. To control for potential serial and cross-sectional correlation within firms, the baseline regressions are also estimated using clustered standard errors by firm and sector dummy variables as robust sensitivity checks.

Table 4. Panel model selection tests and decision rules

Test	Models compared	Decision rule
Chow test	CEM vs FEM	If $p < 0.05$ choose FEM; otherwise CEM
Hausman test	FEM vs REM	If $p < 0.05$ choose FEM; otherwise REM
Lagrange-Multiplier test	CEM vs REM	If $p < 0.05$ choose REM; otherwise CEM

Before the results are interpreted, the selected model is subjected to a series of classical-assumption diagnostics, which are summarized in table 5. These checks cover the normality of the residuals, the presence of multicollinearity among the explanatory variables, the existence of autocorrelation, and the possibility of heteroskedasticity. Confirming that these assumptions hold is essential, because violations could otherwise bias the coefficient estimates or distort the standard errors on which the hypothesis tests depend. Only once the model has passed these diagnostics is it considered suitable for inference. To ensure that the results are not driven by extreme outliers in the micro-fundamental financial ratios (such as ROE and ROA) which could stem from highly distressed SOEs, we conducted a robustness sensitivity analysis by winsorizing the variables at the 1% and 5% levels, as well as trimming distressed observations. The results proved highly stable across all treatments, confirming that outliers do not bias the main estimates.

The overall performance of the model is then assessed in two complementary ways. The coefficient of determination indicates how much of the variation in stock volatility the model can explain, while the F-test establishes whether the explanatory variables are jointly significant. In interpreting the explanatory power, the study follows the guidance that moderate values of R-squared are acceptable in social-science modelling, given the complex and multidimensional nature of the phenomena involved [49]. The individual hypotheses are subsequently examined through t-tests, with statistical significance evaluated at the 5% level, so that the contribution of each determinant can be assessed separately.

Finally, the moderating role of firm size is evaluated through the statistical significance and the sign of the firm-size interaction terms. Where an interaction term is significant, its sign reveals the direction of the moderating effect: a positive sign indicates that firm size amplifies the influence of the underlying determinant, whereas a negative sign indicates that it attenuates that influence [42]. This approach allows the analysis to determine not only whether firm size conditions the effect of a given determinant, but also in which direction and to what extent it does so. To address the potential for severe multicollinearity introduced by the inclusion of 14 interaction terms, all independent variables and the moderator (firm size) were mean-centered prior to generating the interaction products. This mean-centering approach significantly reduces structural multicollinearity, keeping the Variance Inflation Factors (VIFs) well within acceptable limits. The full VIF diagnostics including all interaction terms are reported alongside the baseline model in Section 4.2.

Table 5. Classical-assumption diagnostic tests

Assumption	Test	Criterion (assumption satisfied if)
Normality	Shapiro-Wilk	p-value > 0.05
Multicollinearity	Variance inflation factor (VIF)	VIF < 10
Autocorrelation	Runs test	p-value > 0.05
Heteroskedasticity	Breusch-Pagan	p-value > 0.05

4. Results and Discussion

4.1. Descriptive Statistics

Table 6 summarizes the descriptive statistics for all variables included in the model, reporting the minimum, maximum, mean, and standard deviation for each across the 144 firm-year observations. Taken together, these figures provide an initial picture of the financial and market conditions of Indonesian state-owned enterprises over the 2019–2024 period, and they reveal a substantial degree of heterogeneity among the firms in the sample.

The dependent variable, stock volatility (Y), has a mean of 0.367 with a standard deviation of 0.160 and ranges from 0.000 to 0.966. This indicates a moderate but non-trivial level of price dispersion across the listed SOEs, and the spread between the lowest and highest values shows that some firms experienced periods of pronounced price instability while

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others remained comparatively calm. Such variation is consistent with the study's premise that the volatility of state-owned shares is shaped by a combination of forces rather than by any single factor.

The macroeconomic variables are comparatively stable over the observation window, as would be expected given that they describe economy-wide conditions common to all firms in a given year. The exchange rate averages 0.0197, inflation 0.0266, the interest rate 0.0496, and economic growth 0.0367, and each of these series exhibits a relatively small standard deviation. The narrow range of economic growth, which moves between −0.0207 and 0.0531, nonetheless captures an important episode, reflecting the contraction associated with the COVID-19 shock and the subsequent recovery during the period studied.

Table 6. Descriptive statistics

Variable	Min	Max	Mean	SD
Exchange rate (X1.1)	-0.0346	0.0923	0.0197	0.0407
Inflation (X1.2)	0.0157	0.0551	0.0266	0.0135
Interest rate (X1.3)	0.0350	0.0600	0.0496	0.0101
Economic growth (X1.4)	-0.0207	0.0531	0.0367	0.0263
Current ratio (X2.1)	0.0530	2.7729	1.1809	0.5142
Debt-to-equity ratio (X2.2)	-50.6163	16.7651	2.8474	5.7432
Total asset turnover (X2.3)	0.0077	1.5541	0.4509	0.3637
Net profit margin (X2.4.1)	-3.1227	2.3973	0.0431	0.5269
Return on assets (X2.4.2)	-94.8900	57.2000	0.3883	13.0518
Return on equity (X2.4.3)	-496.1400	131.5200	-2.7163	55.0372
Market-to-book ratio (X2.5)	-2.3317	41.2762	2.3334	5.4283
Government funding (X3.1)	-0.0193	0.6326	0.1339	0.1376
JCI (X4.1)	0.0775	0.2323	0.1262	0.0494
Trading volume (X5.1)	0.5466	3261.7839	637.7900	606.4054
Market capitalization (Z1)	12.8752	20.5813	16.5713	1.7247
Stock volatility (Y)	0.0000	0.9662	0.3671	0.1596

The micro fundamentals, by contrast, display markedly wider ranges, underscoring the diverse financial conditions of the sampled firms. Return on equity spans an especially broad interval, from −496.14 to 131.52, and the debt-to-equity ratio ranges from −50.62 to 16.77, while return on assets moves between −94.89 and 57.20. These extreme values, together with the large standard deviations that accompany them, indicate that the sample includes firms in sound financial health alongside others operating under considerable stress, including some with negative equity or heavy losses. Liquidity and activity measures are more contained, with the current ratio averaging 1.18 and total asset turnover averaging 0.45, suggesting more moderate variation in short-term solvency and asset efficiency across firms.

The remaining variables further illustrate the diversity of the sample. Government funding averages 0.1339 with values ranging up to 0.6326, reflecting differences in the degree of state financial support across enterprises. The market-based measures vary considerably as well: trading volume ranges from 0.55 to 3,261.78 with a mean of 637.79, and market capitalization, expressed in natural-log form, spans 12.88 to 20.58 with a mean of 16.57. This wide dispersion in both liquidity and firm size confirms that the sample combines large, heavily traded enterprises with smaller, less actively traded ones, which is precisely the kind of variation needed to examine firm size as a moderating influence in the analysis that follows.

4.2. Classical-Assumption Tests

Before the regression results can be interpreted with confidence, the model must be shown to satisfy the classical assumptions that underpin ordinary least-squares estimation. Any serious violation of these assumptions could distort the coefficient estimates or the standard errors and, in turn, undermine the validity of the hypothesis tests. For this reason, four diagnostic checks were carried out, covering the normality of the residuals, autocorrelation, heteroskedasticity, and multicollinearity, and their results are reported in table 7 and table 8.

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The first three assumptions are confirmed by the tests summarized in table 7. The Shapiro–Wilk test yields a p-value of 0.79051, which exceeds the 0.05 threshold and therefore indicates that the residuals are normally distributed. The runs test returns a p-value of 0.62, providing no evidence of autocorrelation and suggesting that the observations are independent of one another over time. The Breusch–Pagan test produces a p-value of 0.6607, confirming that the variance of the residuals is constant and that the model does not suffer from heteroskedasticity. Together, these outcomes show that the model meets the core assumptions required for unbiased and efficient estimation.

Table 7. Results of classical-assumption tests

Assumption	Test	p-value	Conclusion
Normality	Shapiro-Wilk	0.79051	Residuals normally distributed
Autocorrelation	Runs test	0.62	No autocorrelation
Heteroskedasticity	Breusch-Pagan	0.6607	Homoskedastic (no heteroskedasticity)

The fourth assumption, the absence of harmful multicollinearity, is assessed using the variance inflation factor (VIF), with the results presented in table 8. The values for all of the main determinants fall within the conventionally accepted bound of 10, which indicates that the explanatory variables are not so strongly correlated as to destabilize the estimates. The highest values among the direct determinants are observed for return on assets (8.21) and economic growth (7.94), yet both remain below the critical threshold. Several of the firm-size interaction terms reach somewhat higher values, but this is a known and expected characteristic of interaction specifications, in which a moderator is multiplied by the variables it conditions. Importantly, such elevated VIFs on the interaction terms do not bias the direct effects that are of primary interest, so the model can be regarded as free from problematic multicollinearity.

Table 8. Multicollinearity diagnostics (VIF) for main determinants

Variable	VIF	Variable	VIF
Exchange rate	2.25	Return on assets	8.21
Inflation	3.59	Return on equity	5.95
Interest rate	4.38	Market-to-book ratio	2.80
Economic growth	7.94	Government funding	3.63
Current ratio	1.73	JCI (market volatility)	3.82
Debt-to-equity ratio	2.91	Trading volume	3.07
Total asset turnover	2.90	Market capitalization	-
Net profit margin	2.56		

4.3. Panel Model Selection

Because the data combine a cross-section of firms with repeated observations over time, the analysis must identify which panel specification best represents their structure before the coefficients can be interpreted. To this end, three candidate models, the common-effects model (CEM), the fixed-effects model (FEM), and the random-effects model (REM), were compared through a sequence of formal tests, the results of which are reported in table 9. This staged comparison ensures that the final estimator is chosen on statistical grounds rather than by assumption.

The Chow test, which compares the common-effects and fixed-effects models, returns a p-value of 0.065. Since this exceeds the 0.05 threshold, the test favours the common-effects model over the fixed-effects alternative. The Hausman test, which weighs the fixed-effects model against the random-effects model, yields a p-value of 1.000 and therefore provides no support for the fixed-effects specification. Likewise, the Lagrange-Multiplier test, which compares the common-effects and random-effects models, returns a p-value of 1.000 and offers no evidence in favour of random effects. Read together, these three outcomes consistently point away from both the fixed- and random-effects specifications.

Based on this evidence, the common-effects model is selected as the most appropriate estimator for the data. The result implies that, once the full set of determinants is included in the model, there are no significant unobserved firm-specific effects that would require a fixed- or random-effects treatment. In practical terms, the explanatory variables themselves capture the relevant differences across firms, which makes the common-effects model both statistically justified and parsimonious for the analysis that follows.

Table 9. Panel model selection results

Test	Models compared	p-value	Selected model
Chow	CEM vs FEM	0.065	CEM
Hausman	FEM vs REM	1.000	REM
Lagrange-Multiplier	CEM vs REM	1.000	CEM
Conclusion	-	-	Common Effect Model (CEM)

4.4. Regression Results: Direct Effects

The estimated common-effects model performs well in overall terms, and its results provide the basis for testing the study's hypotheses. The model is jointly significant, with a probability value for the F-statistic of 0.0001, which confirms that the explanatory variables, taken together, are meaningfully related to stock volatility. Its coefficient of determination of 0.4037 indicates that the model accounts for 40.37% of the variation in the volatility of SOE shares. Although a substantial portion of the variation remains unexplained, a value of this magnitude is regarded as acceptable in cross-firm social-science research, where the phenomenon under study is shaped by many factors that cannot all be observed or measured [49]. The direct effects of the fourteen determinants, together with the main effect of firm size, are reported in table 10.

Table 10. Direct-effect regression results (dependent variable: stock volatility)

Variable	Coef.	t-stat	p-value
Exchange rate (X1.1)	2.9836	0.90	0.370
Inflation (X1.2)	-29.4111	-2.33	0.022
Interest rate (X1.3)	-3560.1180	-0.09	0.930
Economic growth (X1.4)	134.8599	1.76	0.082
Current ratio (X2.1)	-0.0261	-0.11	0.910
Debt-to-equity ratio (X2.2)	-0.0580	-2.16	0.033
Total asset turnover (X2.3)	0.1085	0.26	0.798
Net profit margin (X2.4.1)	0.3333	1.22	0.226
Return on assets (X2.4.2)	-0.0587	-2.96	0.004
Return on equity (X2.4.3)	0.0023	0.57	0.568
Market-to-book ratio (X2.5)	0.0347	1.25	0.214
Government funding (X3.1)	-3.5410	-2.84	0.005
JCI / market volatility (X4.1)	-0.0416	-0.94	0.349
Trading volume (X5.1)	0.0004	1.47	0.145
Firm size (Z1)	0.2010	2.30	0.023
Constant	-5.2986	-2.94	0.004

Note: significant at the 5% level. R-squared = 0.4037; Prob. F = 0.0001; n = 144 firm-year observations.

Four of the determinants exert a statistically significant and negative influence on volatility. Inflation has the largest coefficient in absolute terms (b = −29.41, p = 0.022), indicating that higher inflation is associated with lower share-price dispersion among these firms. The debt-to-equity ratio is likewise significant and negative (b = −0.058, p = 0.033), as is return on assets (b = −0.059, p = 0.004), suggesting that stronger solvency and greater asset efficiency both coincide with calmer pricing. Government funding records a sizeable negative coefficient as well (b = −3.541, p = 0.005), implying that greater state financial support is linked to reduced volatility. The consistently negative sign across these four variables points to a common theme: domestic price stability, sound financial structure, and state backing each appear to dampen the volatility of state-owned shares.

The main effect of firm size, by contrast, is positive and significant (b = 0.201, p = 0.023), indicating that larger SOEs tend to exhibit somewhat greater volatility in their direct relationship with the dependent variable. The remaining determinants, including the exchange rate, the interest rate, economic growth, the current ratio, total asset turnover, net profit margin, return on equity, the market-to-book ratio, market-wide volatility as captured by the JCI, and trading volume, do not reach significance at the 5% level. This pattern suggests that, for this population of firms, volatility is

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driven by a relatively small and specific set of fundamental and policy-related signals rather than by the full range of macroeconomic and firm-level factors considered.

These results are reinforced visually in figure 2, which plots the t-statistic of each determinant against the 5% significance threshold of ±1.96. Five variables clearly cross this boundary: return on assets, government funding, inflation, and the debt-to-equity ratio extend beyond the threshold on the negative side, while firm size does so on the positive side. The remaining determinants fall within the non-significant band between the two threshold lines. The figure thus offers an immediate and intuitive confirmation of the numerical results in table 10, making plain both which determinants matter and the direction in which each of them operates.

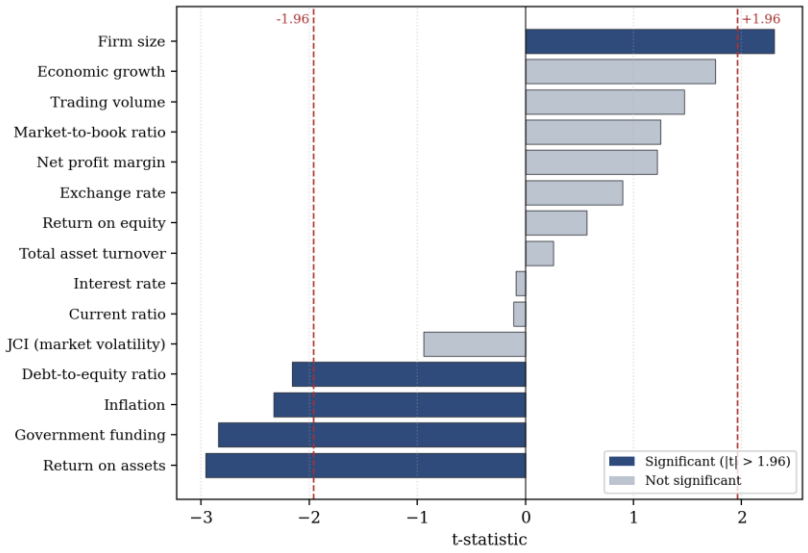

Figure 2. t-statistics of the determinants of stock volatility (5% threshold = +/-1.96)

4.5. Moderation Analysis

The second part of the analysis examines whether firm size conditions the influence of the determinants on stock volatility, thereby testing the moderation hypothesis. The relevant evidence comes from the firm-size interaction terms reported in table 11, in which the moderator is multiplied by each determinant to reveal whether its effect strengthens or weakens as firms grow larger. Of the fourteen interaction terms estimated, only two are statistically significant, which indicates that the moderating influence of firm size is selective rather than pervasive.

Table 11. Moderation (firm-size interaction) results

Interaction term	Coef.	t-stat	p-value	Effect
Z1 x Exchange rate	5.1933	3.07	0.003	Strengthens
Z1 x Inflation	4.2880	0.76	0.447	n.s.
Z1 x Interest rate	-3376.1460	-0.24	0.809	n.s.
Z1 x Economic growth	-0.2158	-1.71	0.091	n.s.
Z1 x Current ratio	0.0505	0.26	0.794	n.s.
Z1 x Debt-to-equity ratio	-0.0761	-1.75	0.083	n.s.
Z1 x Total asset turnover	-0.1909	-0.50	0.619	n.s.
Z1 x Net profit margin	-0.1020	-0.69	0.490	n.s.
Z1 x Return on assets	-0.0240	-2.23	0.027	Strengthens
Z1 x Return on equity	-0.0027	-0.80	0.427	n.s.
Z1 x Market-to-book ratio	0.0038	0.11	0.916	n.s.
Z1 x Government funding	-1.9639	-1.96	0.053	n.s.
Z1 x JCI / market volatility	-0.1468	-0.81	0.420	n.s.
Z1 x Trading volume	0.0002	0.96	0.341	n.s.

Note: significant at the 5% level; n.s. = not significant.

The first significant interaction concerns the exchange rate. Its positive and significant coefficient (Z1 × X1.1, b = 5.193, p = 0.003) shows that firm size amplifies the influence of currency movements on volatility, so that larger SOEs transmit exchange-rate fluctuations into their share prices more strongly than smaller ones do. This pattern is consistent with the greater external and trade-related exposure that typically accompanies scale among state-owned enterprises. The second significant interaction concerns return on assets, whose negative and significant coefficient (Z1 × X2.4.2, b = −0.024, p = 0.027) indicates that firm size strengthens the negative (stabilizing) effect of asset efficiency. In other words, the calming influence that profitability exerts on volatility becomes more pronounced in very large firms, where high asset efficiency is valued by the market as a strong signal of operational resilience and stability.

All the remaining interaction terms fail to reach significance at the 5% level, and several, such as the interactions with economic growth, the debt-to-equity ratio, and government funding, approach but do not cross the threshold. Taken as a whole, this evidence suggests that firm size does not act as a general conditioner of volatility across the full set of determinants. Instead, it operates narrowly, shaping only the exchange-rate and return-on-assets channels, which implies that the moderating role of scale in this population is real but limited in scope.

4.6. Summary of Hypothesis Testing

Drawing together the direct effects and the moderation results, table 12 summarizes the outcome of the six hypotheses that guided the study. The table records, for each hypothesis, the principal finding and whether it is supported, partially supported, or not supported, providing a concise overview of the empirical evidence.

Table 12. Summary of hypothesis testing

Hypothesis	Finding	Status
H1: Macro fundamentals affect volatility	Inflation significant (negative); others not significant	Partially supported
H2: Micro fundamentals affect volatility	DER and ROA significant (negative); others not significant	Partially supported
H3: Government funding affects volatility	Significant (negative)	Supported
H4: Stock-market volatility affects volatility	Not significant	Not supported
H5: Market liquidity affects volatility	Not significant	Not supported
H6: Firm size moderates the determinants	Significant for exchange rate and ROA only	Partially supported

The results are mixed but interpretable. H3, which concerns the effect of government funding, is fully supported, since government funding has a significant and negative influence on volatility. H1 and H2 are partially supported, because only some of the indicators within each group prove significant: inflation drives the result for macro fundamentals, while the debt-to-equity ratio and return on assets drive the result for micro fundamentals, with the remaining indicators in both groups falling short of significance. H6 is likewise partially supported, as firm size moderates only the exchange-rate and return-on-assets effects rather than the determinants. By contrast, H4 and H5 are not supported, since neither market-wide volatility nor market liquidity exerts a significant direct effect on the volatility of SOE shares. Overall, the pattern indicates that the volatility of Indonesian state-owned enterprises is governed by a focused set of domestic, firm-specific, and policy-related factors, with firm size playing only a limited conditioning role.

4.7. Discussion

4.7.1. Significant Determinants of SOE Stock Volatility

The results portray SOE volatility as driven more by domestic price stability, solvency, and asset efficiency than by broad market movements. The significant negative inflation effect is consistent with evidence that inflation conditions equity volatility [34]. However, while standard economic theory suggests that inflation increases macroeconomic uncertainty and stock volatility, in the Indonesian SOE context, this negative relationship reflects price-regulation and subsidy buffer mechanisms. The Indonesian government actively shields strategically important SOEs (in utilities, energy, and infrastructure) from inflationary price pressures by deploying subsidies and retail price caps. This government buffering stabilizes BUMNs' cash flows and revenues, lowering corporate risk during inflationary periods. Behavioral finance also suggests that investors perceive state-backed SOEs as "safe havens" during inflation; the implicit state guarantee anchors expectations and suppresses panic selling, reducing stock price dispersion. The negative debt-to-equity ratio (DER) effect suggests that, contrary to a simple leverage-risk narrative, higher relative debt among these firms is associated with lower volatility. This pattern is explained by the implicit state support that backs SOE liabilities, which dampens the perceived probability of default and softens the market's reaction to leverage

[28], [29]. However, this reliance carries a hidden risk: if the government's fiscal capacity weakens (e.g., rising national debt-to-GDP ratio or sovereign downgrades), these implicit guarantees lose credibility, which could trigger a sudden, non-linear repricing of SOE equity and debt. The negative return-on-assets (ROA) effect indicates that more asset-efficient SOEs experience steadier prices, aligning with micro-fundamental evidence that performance quality reduces return dispersion [13]. Robustness checks (winsorization at 1% and 5% levels, along with trimming) confirm that these micro-fundamental effects are highly stable and not driven by distressed outliers. By contrast, the exchange rate, interest rate, economic growth, and the remaining financial ratios are individually insignificant, suggesting that for this population investors privilege a small set of domestic price, solvency, and efficiency signals over the broader fundamental set.

4.7.2. The Distinctive Role of Government Funding

The strong negative government-funding effect is the study's most distinctive finding: state funding behaves as a stabilizing component of SOE capital structure, lowering volatility rather than raising it. A one-unit increase in GF is associated with a decline of about 3.54 points in volatility, indicating that the market interprets state financial support as risk-reducing. This is best understood through the soft-budget-constraint perspective on state ownership, in which firms can rely on government support under financial stress, lowering distress risk and stabilizing valuations in normal conditions [29]. The result extends capital-structure and trade-off reasoning beyond the conventional debt-equity dichotomy [26], [27], [30]: for government-controlled firms the financing mix that the market prices include a state-funding element that ordinary leverage theory does not capture. However, this stabilizing effect carries major policy implications and structural trade-offs. The safety net provided by state capital injections (PMN) is a double-edged sword; it can induce moral hazard, where BUMN managers engage in operational inefficiencies or excessive risk-taking, assuming the government will bail them out (Kornai, 1986). Furthermore, this state-funded cushion distorts market competition, crowding out private-sector competitors who must secure funding at market interest rates without sovereign protection. SOE shares may be repriced sharply when the market perceives a withdrawal of government support, a rising debt burden, or weakening financial discipline, so the stabilizing effect is conditional on the credibility of state backing.

4.7.3. Why Market Volatility and Liquidity Are Muted

That broad market volatility (the JCI) and trading volume are individually insignificant suggests that, for majority state-owned firms, investors weight firm- and policy-specific information above general market movement when pricing these shares. This finding directly contradicts standard asset pricing models, such as the Capital Asset Pricing Model (CAPM), where systematic market risk is the primary driver of stock returns and volatility. In the presence of strong state ownership, idiosyncratic sovereign guarantees and policy signals override systematic market forces, indicating that investors price BUMN shares based on state commitment rather than general market movements. For portfolio construction, this means that state-linked equities can serve as policy-hedged defensive assets that decouple from market trends during broad liquidations. However, mixing highly regulated utility SOEs (with guaranteed revenues and regulated tariffs) and commercial competitive SOEs (like banks and mining) in a single panel averages out sector-specific dynamics. Regulated utilities are insulated from micro-fundamental shifts but highly sensitive to policy changes, whereas commercial SOEs are exposed to direct market competition and performance quality. Future research should segment these groups to isolate their distinct volatility profiles.

4.7.4. The Selective Moderation of Firm Size

The moderation results refine these conclusions. FS significantly conditions only two relationships out of those tested. It amplifies exchange-rate exposure, as larger SOEs, often with greater external or trade linkages, transmit currency movements more strongly into volatility [33]. Conversely, it strengthens the stabilizing role of asset efficiency, implying that in very large SOEs, strong asset efficiency becomes an even more powerful signal of stability for market investors. The direct effect of FS, however, is positive and significant ($b = 0.201$, $p = 0.023$), indicating that larger SOEs exhibit higher baseline volatility. This is because larger listed BUMNs (like Telkom, Bank Mandiri, BRI, and BNI) are high-liquidity blue-chip stocks heavily traded by institutional and foreign investors, making them highly sensitive to global capital flows and macroeconomic shocks, whereas smaller SOEs are insulated due to low trading volume. The general insignificance of FS as a moderator for the other 12 relationships is partly due to the small sample size ($n=144$), which limits the statistical power of the moderation tests and increases the risk of Type II errors (false

negatives). Conversely, the two significant interactions (Exchange Rate and ROA) are backed by strong economic theory and are highly significant, minimizing the risk of Type I errors (false positives). An agency-theoretic reading reinforces this: because the government pursues non-commercial objectives alongside profit, the market does not uniformly treat scale or state funding as an unambiguous risk signal, and the moderating influence of size remains weak and inconsistent [27].

4.7.5. Overall Explanatory Power and Theoretical Synthesis

The model explains 40.37% of the variation in SOE volatility, a level that is moderate by the conventional thresholds used in social-science and finance research and acceptable given the multidimensional nature of volatility [49]. The remaining variation reflects factors outside the model, an outcome anticipated by the efficient-market hypothesis, under which prices respond to the full information set, including non-fundamental information such as investor sentiment, political risk, and external shocks [23]. Behavioural finance similarly attributes part of the unexplained variation to investor psychology, overreaction, and herd behaviour, which can move prices beyond fundamentals [24], [25], while the dynamic, heteroskedastic character of volatility means that linear models capture its central tendencies rather than its full time-varying behaviour [22]. The jointly significant F-test nonetheless confirms that macro, micro, capital-structure, market, and liquidity factors together explain SOE volatility, supporting the efficient-market premise that investors integrate multiple information sources simultaneously [23]. Taken as a whole, the study supports the efficient-market view while qualifying it for state ownership, is consistent with behavioural finance in the muted role of market sentiment, and most distinctively extends trade-off and capital-structure theory by identifying GF as a risk-reducing component of SOE financing, contributions that prior sector-by-sector studies could not deliver.

5. Conclusion

This research examined the determinants of stock volatility among Indonesian state-owned enterprises listed on the IDX over 2019-2024 and tested firm size as a moderator within a single integrated, data-driven panel model. The findings suggest that inflation, the debt-to-equity ratio, return on assets, and government funding each significantly and negatively shape volatility, whereas broad market volatility and liquidity do not, and that firm size moderates only the exchange-rate and return-on-assets effects; the model is jointly significant and explains 40.37% of the variation in volatility. Domestic price stability, solvency, asset efficiency, and state funding therefore emerge as the principal levers of SOE volatility, underscoring that SOE capital structure must account for the government's role as owner, funder, and stabilizer.

From a practical perspective, policymakers and SOE managers should prioritize maintaining domestic price stability, strengthening solvency and asset efficiency, and managing government funding transparently and predictably. For the Ministry of SOEs (Kementerian BUMN), we provide three concrete, actionable recommendations regarding Penyertaan Modal Negara (PMN) and capital injections to minimize market distortions and contain stock volatility: (1) Strict Separability of Accounts: Clearly separate public service obligations (PSO) funding from commercial operations to prevent cross-subsidization and promote fair competition. (2) Performance-Linked PMN: Implement a milestone-based capital allocation model where funding is disbursed only upon the SOE meeting audited operational efficiency and debt-reduction benchmarks. (3) Mandated Private Co-funding: Require SOEs to secure syndicated financing or co-investments from private and foreign institutional partners alongside PMN, bringing market discipline and reducing moral hazard.

The study also acknowledges important limitations. First, stock volatility is analyzed on an annual frequency to match audited financial ratios, which represents a low frequency that smooths out key short-term volatility events and spikes. Second, the small panel size (n = 144) limits the statistical power of moderation tests and restricts the use of dynamic models. Finally, the strictly linear specification may not capture time-varying volatility dynamics. These limitations highlight the need for future studies to extend the time horizon, replicate the model across markets to test the generality of the government-funding effect, and incorporate high-frequency data (daily or weekly) using conditional-variance (GARCH) or dynamic panel (GMM) approaches to volatility forecasting. Overall, this study contributes to the literature by integrating macro, micro, capital-structure, market, and liquidity determinants into a unified framework for the full population of listed SOEs, offering new insight into how state ownership reshapes the drivers of stock volatility while emphasizing the need for continued refinement of measurement and modelling.

6. Declarations

6.1. Author Contributions

Conceptualization, I.D.M.T.M., I.G.K.A.U., and A.H.M.; methodology, A.H.M. and I.G.K.A.U.; software, I.D.M.T.M.; validation, I.G.K.A.U. and A.H.M.; formal analysis, I.D.M.T.M. and A.H.M.; investigation, I.D.M.T.M.; resources, I.D.M.T.M.; data curation, I.D.M.T.M.; writing (original draft preparation), I.D.M.T.M.; writing (review and editing), I.G.K.A.U., A.H.M., and I.D.M.T.M.; visualization, I.D.M.T.M.; supervision, I.G.K.A.U. and A.H.M. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data supporting the findings are available from public sources (Indonesia Stock Exchange and official national statistics) and from the author on reasonable request.

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The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] G. Fan and N. C. Hope, "The role of state-owned enterprises in the Chinese economy," in *US-China 2022: Economic Relations in the Next 10 Years*. China–United States Exchange Foundation, 2013, ch. 16, pp. 1–16.

[2] T. J. Putniņš, "Economics of state-owned enterprises," *International Journal of Public Administration*, vol. 38, no. 11, pp. 815–832, 2015. doi: 10.1080/01900692.2014.982289.

[3] H. Marrez, "The role of state-owned enterprises in Romania," *European Economy Country Focus*, vol. 12, no. 1, pp. 1–8, 2015. doi: 10.2765/76618.

[4] W. L. Megginson and J. M. Netter, "From state to market: A survey of empirical studies on privatization," *Journal of Economic Literature*, vol. 39, no. 2, pp. 321–389, 2001. doi: 10.1257/jel.39.2.321.

[5] F. Rakhman, "Can partially privatized SOEs outperform fully private firms? Evidence from Indonesia," *Research in International Business and Finance*, vol. 45, no. October, pp. 285–292, 2018. doi: 10.1016/j.ribaf.2017.07.160.

[6] H. Rossieta, "Good governance mechanism, agency problems and privatized SOEs performance: Empirical evidences from Indonesian Stock Exchange," *International Journal of Economics and Management*, vol. 11, no. 2, Special Issue, pp. 287–307, 2017.

[7] W. Apriyantopo, A. Aprianingsih, and M. L. Kitri, "State-owned enterprises' performance in Indonesia: A strategic typology perspective," *Competitiveness Review: An International Business Journal*, vol. 33, no. 4, pp. 759–786, 2023. doi: 10.1108/CR-01-2021-0019.

[8] S. J. Taylor, *Asset Price Dynamics, Volatility, and Prediction*. Princeton, NJ, USA: Princeton University Press, 2011. doi: 10.1515/9781400839254.

[9] B. B. Mandelbrot, "The variation of certain speculative prices," *The Journal of Business*, vol. 36, no. 4, pp. 394–419, 1963. doi: 10.1086/294632.

[10] E. Kirui, N. H. W. Wawire, and P. O. Onono, "Macroeconomic variables, volatility and stock market returns: A case of Nairobi Securities Exchange, Kenya," *International Journal of Economics and Finance*, vol. 6, no. 8, pp. 214–228, 2014. doi: 10.5539/ijef.v6n8p214.

[11] L. Nikmanesh and A. H. S. Mohd Nor, "Macroeconomic determinants of stock market volatility: An empirical study of Malaysia and Indonesia," *Asian Academy of Management Journal*, vol. 21, no. 1, pp. 161–180, 2016.

[12] N. Thampanya, J. Wu, M. A. Nasir, and J. Liu, "Fundamental and behavioural determinants of stock return volatility in ASEAN-5 countries," *Journal of International Financial Markets, Institutions and Money*, vol. 65, no. March, Art. no. 101193, pp. 1-16, 2020. doi: 10.1016/j.intfin.2020.101193.

[13] R. Abaidoo and E. K. Agyapong, "Corporate performance volatility: A micro-level perspective," *Journal of Money and Business*, vol. 1, no. 1, pp. 42–63, 2021. doi: 10.1108/JMB-05-2021-0013.

[14] G. Bekaert and C. R. Harvey, "Emerging equity market volatility," *Journal of Financial Economics*, vol. 43, no. 1, pp. 29–77, 1997. doi: 10.1016/S0304-405X(96)00889-6.

[15] A. Kraus and H. R. Stoll, "Price impacts of block trading on the New York Stock Exchange," *The Journal of Finance*, vol. 27, no. 3, pp. 569–588, 1972. doi: 10.1111/j.1540-6261.1972.tb00985.x.

[16] A. Agapova and M. Kaprielyan, "Stock volatility and trading," *The North American Journal of Economics and Finance*, vol. 54, no. November, Art. no. 101242, pp. 1-19, 2020. doi: 10.1016/j.najef.2020.101242.

[17] H. Handayani, H. Muharam, W. Mawardi, and Robiyanto, "Determinants of the stock price volatility in the Indonesian manufacturing sector," *International Research Journal of Business Studies*, vol. 11, no. 3, pp. 179–193, 2018. doi: 10.21632/irjbs.11.3.179-193.

[18] H. Chuliá and H. Torró, "Firm size and volatility analysis in the Spanish stock market," *The European Journal of Finance*, vol. 17, no. 8, pp. 695–715, 2011. doi: 10.1080/1351847X.2011.554286.

[19] A. Astakhov, T. Havranek, and J. Novak, "Firm size and stock returns: A quantitative survey," *Journal of Economic Surveys*, vol. 33, no. 5, pp. 1463–1492, 2019. doi: 10.1111/joes.12335.

[20] H. Markowitz, "Portfolio selection," *The Journal of Finance*, vol. 7, no. 1, pp. 77–91, 1952. doi: 10.1111/j.1540-6261.1952.tb01525.x.

[21] Z. Bodie, A. Kane, and A. J. Marcus, *Investments*, 11th ed. New York, NY, USA: McGraw-Hill Education, 2018.

[22] T. Bollerslev, "Generalized autoregressive conditional heteroskedasticity," *Journal of Econometrics*, vol. 31, no. 3, pp. 307–327, 1986. doi: 10.1016/0304-4076(86)90063-1.

[23] E. F. Fama, "Efficient capital markets: A review of theory and empirical work," *The Journal of Finance*, vol. 25, no. 2, pp. 383–417, 1970. doi: 10.1111/j.1540-6261.1970.tb00518.x.

[24] N. Barberis, A. Shleifer, and R. Vishny, "A model of investor sentiment," *Journal of Financial Economics*, vol. 49, no. 3, pp. 307–343, 1998. doi: 10.1016/S0304-405X(98)00027-0.

[25] I. Akin and M. Akin, "Behavioral finance impacts on US stock market volatility: An analysis of market anomalies," *Behavioural Public Policy*, vol. 10, no. 2, pp. 337–361, 2026. doi: 10.1017/bpp.2024.13.

[26] S. C. Myers, "The capital structure puzzle," National Bureau of Economic Research, Cambridge, MA, USA, Working Paper 1393, vol. 1984, no. July, pp. 1-35, 1984, doi: 10.3386/w1393.

[27] M. C. Jensen and W. H. Meckling, "Theory of the firm: Managerial behavior, agency costs and ownership structure," *Journal of Financial Economics*, vol. 3, no. 4, pp. 305–360, 1976. doi: 10.1016/0304-405X(76)90026-X.

[28] G. Borisova, V. Fotak, K. V. Holland, and W. L. Megginson, "Government ownership and the cost of debt: Evidence from government investments in publicly traded firms," *Journal of Financial Economics*, vol. 118, no. 1, pp. 168–191, 2015. doi: 10.1016/j.jfineco.2015.06.011.

[29] W. L. Megginson, B. Ullah, and Z. Wei, "State ownership, soft-budget constraints, and cash holdings: Evidence from China's privatized firms," *Journal of Banking & Finance*, vol. 48, no. November, pp. 276–291, 2014. doi: 10.1016/j.jbankfin.2014.06.011.

[30] Q. Li, C. Lin, and L. Xu, "Political investment cycles of state-owned enterprises," *The Review of Financial Studies*, vol. 33, no. 7, pp. 3088–3129, 2020. doi: 10.1093/rfs/hhz090.

[31] M. A. Touny, M. A. Radwan, and M. M. H. Alayis, "Macro determinants of stock market volatility: Evidence from Middle East region," *Afro-Asian Journal of Finance and Accounting*, vol. 11, no. 3, pp. 376–391, 2021. doi: 10.1504/AAJFA.2021.115672.

[32] S. Damiran, O. Dorjdagva, B. Sukhee, and T. Myagmarsuren, "Macroeconomic determinants of stock market volatility: Evidence from post-socialist countries," *Journal of Eastern European and Central Asian Research*, vol. 9, no. 4, pp. 569–580, 2022. doi: 10.15549/jeecar.v9i4.966.

ISSN 2723-6471

[33] K. Jebran and A. Iqbal, "Dynamics of volatility spillover between stock market and foreign exchange market: Evidence from Asian countries," *Financial Innovation*, vol. 2, Art. no. 3, pp. 1-20, 2016. doi: 10.1186/s40854-016-0021-1.

[34] Y.-F. Chen, T. C. Chiang, and F.-L. Lin, "Inflation, equity market volatility, and bond prices: Evidence from G7 countries," *Risks*, vol. 11, no. 11, Art. no. 191, pp. 1-22, 2023. doi: 10.3390/risks11110191.

[35] W. Donzwa, R. Gupta, and M. E. Wohar, "Volatility spillovers between interest rates and equity markets of developed economies," *Journal of Central Banking Theory and Practice*, vol. 8, no. 3, pp. 39–50, 2019. doi: 10.2478/jcbtp-2019-0023.

[36] A. Mehmood, M. H. Ullah, and N. U. Sabeeh, "Determinants of stock price volatility: Evidence from the cement industry," *Accounting*, vol. 5, no. 4, pp. 145–152, 2019. doi: 10.5267/j.ac.2019.2.002.

[37] N. T. Hung, "Return and volatility spillover across equity markets between China and Southeast Asian countries," *Journal of Economics, Finance and Administrative Science*, vol. 24, no. 47, pp. 66–81, 2019. doi: 10.1108/JEFAS-10-2018-0106.

[38] T. Chordia, A. Subrahmanyam, and V. R. Anshuman, "Trading activity and expected stock returns," *Journal of Financial Economics*, vol. 59, no. 1, pp. 3–32, 2001. doi: 10.1016/S0304-405X(00)00080-5.

[39] Y. Amihud, H. Mendelson, and L. H. Pedersen, *Market Liquidity: Asset Pricing, Risk, and Crises*. Cambridge, U.K.: Cambridge University Press, 2012. doi: 10.1017/CBO9780511844393.

[40] M. H. Shakil, "Environmental, social and governance performance and stock price volatility: A moderating role of firm size," *Journal of Public Affairs*, vol. 22, no. 3, Art. no. e2574, pp. 1-15, 2022. doi: 10.1002/pa.2574.

[41] G. T. H. Vuong, P. V. Nguyen, W. Bakry, and M. H. Nguyen, "Stock return volatility and financial distress: Moderating roles of ownership structure, managerial ability, and financial constraints," *International Review of Economics & Finance*, vol. 91, no. March, pp. 634–652, 2024. doi: 10.1016/j.iref.2024.01.054.

[42] S. Sharma, R. M. Durand, and O. Gur-Arie, "Identification and analysis of moderator variables," *Journal of Marketing Research*, vol. 18, no. 3, pp. 291–300, 1981. doi: 10.2307/3150970.

[43] J. M. Wooldridge, *Introductory Econometrics: A Modern Approach*, 7th ed. Boston, MA, USA: Cengage Learning, 2020.

[44] D. N. Gujarati and D. C. Porter, *Basic Econometrics*, 5th ed. New York, NY, USA: McGraw-Hill/Irwin, 2009.

[45] Indonesia Stock Exchange, "Market Data." [Online]. Available: https://www.idx.co.id/en/market-data. [Accessed: Jan. 17, 2026].

[46] N. J. van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010. doi: 10.1007/s11192-009-0146-3.

[47] J. Kaur and K. Dharni, "Data mining-based stock price prediction using hybridization of technical and fundamental analysis," *Data Technologies and Applications*, vol. 57, no. 5, pp. 780–800, 2023. doi: 10.1108/DTA-04-2022-0142.

[48] N. N. Hamadneh, J. J. Jaber, and S. Sathasivam, "Estimating volatility of the Saudi stock market using hybrid dynamic evolving neural fuzzy inference system models," *Journal of Risk and Financial Management*, vol. 17, no. 8, Art. no. 377, pp. 1-22, 2024. doi: 10.3390/jrfm17080377.

[49] P. K. Ozili, "The acceptable R-square in empirical modelling for social science research," *Social Research Methodology and Publishing Results*, SSRN, vol. 2022, no. June, pp. 1-22, 2022. doi: 10.2139/ssrn.4128165.