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Corporate Governance, Firm Size, and Leverage on Firm Value: Panel Evidence from Construction and Infrastructure Companies Listed on the Indonesia Stock Exchange

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Abstract: *The construction and infrastructure sector is a strategic driver of the Indonesian economy, yet listed firms in this sector have faced persistent pressure on market valuation in recent years. This study examines the effect of corporate governance — proxied by board size, the proportion of independent commissioners, institutional ownership, and managerial ownership — together with firm size and leverage, on firm value measured by price to book value. Using purposive sampling of construction and infrastructure companies listed on the Indonesia Stock Exchange over 2022–2025, 24 firms were obtained, yielding a balanced panel of 96 firm-year observations. Panel data regression was conducted using Stata. The Hausman test indicates that the random effects model is appropriate, while the Modified Wald and Wooldridge tests confirm the presence of groupwise heteroscedasticity and first-order serial correlation; estimation therefore employs random effects regression with cluster-robust standard errors. The results show that leverage has a positive and significant effect on firm value at the 1% level, while institutional ownership is positively and firm size negatively associated with firm value at the 10% level. Board size, the proportion of independent commissioners, and managerial ownership have no significant effect. These findings indicate that market valuation in this sector is shaped more by capital structure than by the formal architecture of governance bodies. The study contributes by demonstrating that panel estimation which accounts for firm-level heterogeneity yields materially different conclusions from pooled cross-sectional analysis, since 63.5% of the variance in firm value is attributable to unobserved firm effects.*

INTRODUCTION

The construction and infrastructure sector is one of the principal drivers of the Indonesian economy and serves as the backbone of national development. Accordingly, the objective of firms in this sector is to maximise firm value, which reflects shareholder wealth and investors' perception of managerial success. In recent periods, however, the financial performance and market valuation of listed construction firms have come under pressure. Many construction companies listed on the Indonesia Stock Exchange (IDX) have recorded declining financial performance, and some show indications of financial distress arising from accumulated debt and a contraction in new project acquisition (Syahda & Pramudiati, 2024). This condition raises the question of which internal factors most strongly determine value creation in the construction and infrastructure sector.

One factor that receives considerable attention is leverage, that is, the extent to which debt is used in the firm's financing structure. A number of studies show that high leverage tends to exert a negative effect on firm performance and value, particularly in the construction sector, which is capital intensive and heavily dependent on external financing, because a large debt burden raises financial risk and erodes investor confidence (Fadlillah & Ferli, 2024). Other studies, however, report a positive effect consistent with trade-off and signalling reasoning, in which debt confers a tax shield and conveys management's confidence in future cash flows (Ross, 1977). This divergence constitutes a research gap worth examining further in the construction and infrastructure context.

Beyond leverage, the implementation of corporate governance and firm size are regarded as important determinants of firm value. Sound governance can serve as a positive signal to investors because it reduces information asymmetry and mitigates agency problems, while larger firms are often associated with greater capacity and financial resilience. Empirical findings on both factors nevertheless remain mixed (Aryanti et al., 2025). Evidence from Indonesia and ASEAN likewise indicates that governance structures and ownership arrangements do not uniformly translate into higher performance across sectors and periods (Pratama & Innayah, 2021; Setyani et al., 2024).

This study addresses that gap and offers two contributions. First, it decomposes corporate governance into four separate mechanisms — board size, the proportion of independent commissioners, institutional ownership, and managerial ownership — rather than treating governance as a single composite index. This decomposition allows the analysis to distinguish between board-based mechanisms, which largely reflect compliance with regulatory minimums, and ownership-based mechanisms, in which the monitoring party also bears a residual claim on firm value. Second, and methodologically, the study applies panel data estimation with model selection and diagnostic testing rather than pooled cross-sectional regression. This matters because firm value in a sector composed of heterogeneous contractors is likely to be driven substantially by time-invariant firm characteristics; ignoring that structure risks attributing firm-level heterogeneity to the explanatory variables.

Accordingly, this study asks whether corporate governance, firm size, and leverage significantly affect the firm value of construction and infrastructure companies listed on the IDX, and which of these internal factors is dominant. Theoretically, the study is expected to enrich the agency theory literature on the determinants of firm value. Practically, it is intended to inform investors and management in formulating governance policies and investment decisions.

LITERATURE REVIEW

Agency Theory and Firm Value

Agency theory explains the contractual relationship between principals as owners of capital and agents as managers, in which agents are expected to act in the principals' interests but may in practice prioritise their own (Jensen & Meckling, 1976). This divergence of interests gives rise to agency costs that reduce firm value. Corporate governance mechanisms are designed to constrain such opportunistic behaviour, either through supervisory bodies such as the board of commissioners, or through ownership structures that align the interests of managers and owners. Firm value in this study is proxied by price to book value, which reflects the market's assessment of the firm relative to the book value of its equity.

An important distinction within agency theory concerns who performs monitoring and whether that party bears the consequences of monitoring failure. Board-based mechanisms are performed by appointed officers who do not necessarily hold residual claims, whereas ownership-based mechanisms are exercised by parties whose own wealth is directly affected by firm value. Agency theory also assigns a disciplinary role to debt: fixed repayment obligations reduce the free cash flow available to management and thereby constrain discretionary spending (Jensen, 1986). This distinction underlies the hypothesis development that follows.

Hypothesis Development

Board size.

The board of commissioners oversees the board of directors and safeguards shareholders' interests. A larger board is expected to provide broader expertise and more diverse perspectives in supervising management, thereby reducing agency costs and supporting firm value.
H1: Board size has a positive effect on firm value.

Independent commissioners.

Independent commissioners are expected to provide objective oversight because they have no affiliation with management or controlling shareholders. A higher proportion of independent commissioners is therefore expected to strengthen monitoring and support firm value.
H2: The proportion of independent commissioners has a positive effect on firm value.

Institutional ownership.

Institutional investors possess the resources, expertise, and incentives to monitor management effectively, since their own wealth is directly exposed to firm performance. Higher institutional ownership is therefore expected to reduce agency conflicts and increase firm value. Evidence from ASEAN settings indicates that ownership structure meaningfully conditions the relationship between firm resources and performance (Pratama & Innayah, 2021).
H3: Institutional ownership has a positive effect on firm value.

Managerial ownership.

When managers hold shares in the firm they manage, their interests become more closely aligned with those of other shareholders, reducing the incentive for opportunistic behaviour. This alignment effect is expected to increase firm value.
H4: Managerial ownership has a positive effect on firm value.

Firm size.

Larger firms are generally associated with greater resources, easier access to funding, and stronger financial resilience, which are expected to support market valuation.
H5: Firm size has a positive effect on firm value.

Leverage.

High leverage increases interest obligations, reduces operational flexibility, and raises the likelihood of financial distress, particularly in a capital-intensive sector in which several listed firms have undergone debt restructuring. Leverage is therefore expected to have a negative effect on firm value (Fadlillah & Ferli, 2024).
H6: Leverage has a negative effect on firm value.

METHOD

Data and Sample

This study employs a quantitative approach using secondary data obtained from the financial statements and annual reports published on the official website of the Indonesia Stock Exchange. The population comprises construction and infrastructure companies listed on the IDX over the 2022–2025 period. Samples were selected through purposive sampling, yielding 24 firms and a balanced panel of 96 firm-year observations, with four observations per firm. No observations were excluded, since the panel estimator applied in this study accommodates firm-level heterogeneity and the cluster-robust standard errors used for inference do not require normally distributed residuals.

Audit committee size was considered as an additional governance proxy but was excluded from the final model because it exhibits almost no cross-sectional variation, ranging only between three and four members in line with the regulatory minimum set by the Financial Services Authority. A variable with negligible variance cannot, by construction, explain variation in firm value, and its inclusion would only inflate collinearity among the board-based variables.

Variable Measurement

Table 1. Operational Definition and Measurement of Variables

Variable	Symbol	Measurement
Firm value (Y)	PBV	Market price per share / Book value per share
Board size	DK	Number of members of the board of commissioners
Independent commissioners	KLP	Number of independent commissioners / Total board of commissioners
Institutional ownership	KI	Shares held by institutions / Total shares outstanding
Managerial ownership	KM	Shares held by management / Total shares outstanding
Firm size	SIZE	Natural logarithm of total assets
Leverage	DAR	Debt to asset ratio (Total liabilities / Total assets)

Source: developed for this study.

Analytical Model

A panel data regression model is used to examine the effect of the independent variables on firm value, estimated with Stata. The Hausman test is employed to select the more appropriate estimator between the fixed effects and random effects models (Hausman, 1978; Wooldridge, 2010). Diagnostic testing comprises the Modified Wald test for groupwise heteroscedasticity and the Wooldridge test for first-order serial correlation. Where these assumptions are violated, inference is based on cluster-robust standard errors clustered at the firm level. The regression equation is specified as follows:

$$PBV_{it} = \alpha + \beta_1 DK_{it} + \beta_2 KLP_{it} + \beta_3 KI_{it} + \beta_4 KM_{it} + \beta_5 SIZE_{it} + \beta_6 DAR_{it} + \varepsilon_{it}$$

where PBV denotes price to book value, DK board size, KLP the proportion of independent commissioners, KI institutional ownership, KM managerial ownership, SIZE firm size, DAR leverage, α the constant, β_1–β_6 the regression coefficients, ε the error term, i the firm, and t the year.

RESULT AND DISCUSSION

This analysis describes the data collected with the aim of providing an overview of the main value distribution and potential heterogeneity between companies in the research sample.

Table 2. Descriptive Statistical Analysis Test Result

Variable	Mean	Std. Deviation	Minimum	Maximum
PBV	1.4795	1.6004	0.1366	7.8212
DK	4.3438	2.6311	2.0000	15.0000
KLP	0.4583	0.1247	0.2000	0.7500
KI	0.5736	0.2865	0.0000	1.0000
KM	0.1632	0.3017	0.0000	0.9244
SIZE	29.7805	1.5629	27.4024	32.7062
DAR	0.5887	0.2688	0.1102	1.6438
Observation	96			

Source: Research Data, processed.

The descriptive statistics for the panel comprising 96 observations from 24 construction and infrastructure firms during the 2022–2025 period reveal an average price to book value of 1.4795. This indicates that, on average, the sampled firms traded above the book value of their equity, although the dispersion is considerable, ranging from 0.1366 to 7.8212 with a standard deviation of 1.6004 that exceeds the mean itself. Such dispersion signals pronounced heterogeneity in how the market values firms operating within the same sector, and provides an early indication that firm-level effects are likely to be substantial.

Board size varies widely, from two to fifteen members, whereas the proportion of independent commissioners is comparatively concentrated, with a mean of 0.4583 and a standard deviation of only 0.1247, reflecting the regulatory requirement that at least 30% of the board be independent. Institutional ownership averages 0.5736 and spans the full range from zero to one, indicating that some firms are majority institutionally held while others have none. Managerial ownership has a mean of 0.1632 but a standard deviation of 0.3017, a distribution which shows that managerial shareholding is concentrated in a small number of firms while being absent in many others.

Leverage averages 0.5887 with a maximum of 1.6438. The latter value is economically meaningful: a debt to asset ratio above unity indicates that liabilities exceed total assets, that is, negative book equity, a condition consistent with the financial distress reported for several listed contractors during the observation period.

Following the descriptive analysis, the Hausman specification test is employed to determine the appropriate econometric model for hypothesis testing, specifically whether the fixed effects model or the random effects model provides a more consistent and efficient estimator for the panel data structure.

Table 3. Hausman Test

Hausman Test	Chi2	Prob > Chi2	Result
Model	5.53	0.4779	RE

Source: Research Data, processed.

Wooldridge (2010) emphasises that the Hausman test is a fundamental diagnostic tool for determining the appropriate estimation technique in panel data analysis, specifically by comparing the consistency of the fixed effects and random effects estimators. As shown in Table 3, the chi-square probability value of 0.4779 exceeds the conventional 5% significance threshold. The null hypothesis, stating that the difference in coefficients is not systematic and that the random effects estimator is therefore consistent, cannot be rejected. Accordingly, the random effects model provides the more reliable estimation for the data structure in this study.

Subsequently, diagnostic tests were conducted to validate the robustness of the regression results, comprising an assessment of groupwise heteroscedasticity and of serial correlation in the error terms.

Table 4. Heteroscedasticity Test and Serial Correlation Test

Test	Statistic	Value	Prob
Full Sample	N	96	
Heteroscedasticity (Modified Wald)	Chi2 (24)	173,725.65	0.0000
Serial Correlation (Wooldridge)	F (1, 23)	5.345	0.0301

Source: Research Data, processed.

Table 4 presents the results of the heteroscedasticity and serial correlation tests. The presence of groupwise heteroscedasticity is confirmed by the chi-squared probability value of 0.0000, well below the 0.05 significance threshold, indicating a violation of the homoscedasticity assumption and suggesting that the variance of the error terms is not constant across firms. In addition, the Wooldridge test yields a probability value of 0.0301, also below the 5% level, indicating that the residuals are not independent across time and thereby violating the assumption of no first-order autocorrelation. Consequently, these issues must be addressed to ensure the validity of the regression estimates.

To account for the identified heteroscedasticity and serial correlation, the model is estimated using random effects regression with cluster-robust standard errors clustered at the firm level. The results of the hypothesis tests are shown in Table 5.

Table 5. Hypothesis Test Result

Hypothesis	Path	Coefficient	z value	P>|z|	Result
H1	DK → FV	0.0114	0.10	0.924	Rejected
H2	KLP → FV	−0.7045	−0.88	0.381	Rejected
H3	KI → FV	1.5465	1.74	0.083*	Accepted
H4	KM → FV	0.4706	0.52	0.606	Rejected
H5	SIZE → FV	−0.2808	−1.71	0.087*	Rejected
H6	DAR → FV	2.1895	2.89	0.004***	Rejected
Constant		7.8146	1.74	0.081*	
R-squared (within)		0.0453			
R-squared (between)		0.2676			
R-squared (overall)		0.2099			
Wald chi2 (6)		14.20			
Prob > chi2		0.0274			
Observations / Groups		96 / 24			
rho		0.6347			

**10% significance **5% significance ***1% significance. FV = firm value. Standard errors adjusted for 24 clusters at the firm level. Source: Research Data, processed.*

The Wald chi-square statistic of 14.20 with a probability value of 0.0274 confirms that the model is statistically significant at the 5% level, indicating that the independent variables jointly exert a significant influence on firm value. The overall R-squared of 0.2099 indicates that 20.99% of the variation in firm value is explained by the model. Of particular note is the rho value of 0.6347, which shows that 63.47% of the total variance in the residuals is attributable to unobserved firm-specific effects. This figure provides direct justification for the use of a panel estimator: had the data been analysed by pooled ordinary least squares, this substantial firm-level heterogeneity would have been misattributed to the explanatory variables. It also explains the low within R-squared of 0.0453, which indicates that the model accounts for only a small share of the variation in firm value over time within a given firm, a pattern to be expected where market valuation responds largely to sector-wide and macroeconomic conditions.

Discussion

Board-based governance mechanisms and firm value.

The test of Hypothesis 1 does not reveal a significant relationship between board size and firm value (β = 0.0114; z = 0.10; p = 0.924). The coefficient is close to zero, indicating that variation in the number of commissioners is essentially unrelated to market valuation even though board size varies widely across the sample, from two to fifteen members. This is consistent with the argument that beyond a certain threshold, additional board members generate coordination costs and diffusion of responsibility that offset the benefits of broader expertise. In the Indonesian construction sector, where several of the largest listed firms are state owned, board composition may additionally reflect administrative and stakeholder representation considerations rather than monitoring capability. Accordingly, H1 is rejected.

The test of Hypothesis 2 likewise finds no significant relationship between the proportion of independent commissioners and firm value (β = −0.7045; z = −0.88; p = 0.381). The descriptive statistics assist in interpreting this result: the proportion has a mean of 0.4583 with a standard deviation of only 0.1247, clustering above but close to the 30% regulatory minimum. The limited dispersion suggests that board independence in this sector operates largely as regulatory compliance. Moreover, independence in form does not necessarily imply independence in substance, since independent commissioners are in practice nominated through processes influenced by controlling shareholders. This reading is consistent with evidence from Indonesian banking, where board and ownership attributes do not uniformly translate into higher performance (Setyani et al., 2024). Accordingly, H2 is rejected.

Ownership structure and firm value.

The test of Hypothesis 3 reveals a positive association between institutional ownership and firm value that is significant at the 10% level (β = 1.5465; z = 1.74; p = 0.083). The coefficient is economically substantial, and its direction supports the argument that institutional investors possess both the analytical capacity and the economic incentive to monitor management, since their own wealth is directly exposed to firm performance. This finding is consistent with evidence that ownership structure conditions the relationship between firm resources and performance in ASEAN settings (Pratama & Innayah, 2021). It should nevertheless be interpreted with appropriate caution: significance is attained only at the 10% level, and with 24 clusters the standard errors are conservative. The evidence is therefore suggestive rather than conclusive, and H3 is accepted at the 10% level.

The test of Hypothesis 4 does not find a significant relationship between managerial ownership and firm value (β = 0.4706; z = 0.52; p = 0.606). Although the coefficient is positive as predicted, it is imprecisely estimated. The descriptive statistics offer an explanation: managerial ownership has a mean of 0.1632 but a standard deviation of 0.3017, indicating a highly skewed distribution in which managerial shareholding is concentrated in a few firms and absent in most. Such a distribution limits the statistical power available to detect an effect. Theoretically, it is also possible that the alignment effect at moderate levels of managerial ownership is offset by an entrenchment effect at high levels, where managers with substantial holdings become insulated from external discipline. Accordingly, H4 is rejected.

Firm size and firm value.

The test of Hypothesis 5 yields a negative association between firm size and firm value that is significant at the 10% level (β = −0.2808; z = −1.71; p = 0.087), contrary to the positive direction predicted. Although counterintuitive relative to the general literature, this result is interpretable in the specific context of the Indonesian construction and infrastructure sector during 2022–2025.

The largest listed firms in this sector are predominantly state-owned contractors which, during the observation period, carried substantial debt accumulated from earlier infrastructure programmes, together with receivables from delayed turnkey projects and, in several cases, ongoing financial restructuring. The market appears to have discounted scale in this setting, associating larger firms with greater exposure to legacy obligations rather than with resilience. Firm size in this sector therefore proxies for accumulated commitments rather than financial strength, which explains the inversion of the expected sign. This finding underscores that the direction of the size–value relationship is context dependent and should not be assumed uniform

across sectors. Accordingly, H5 is rejected.

Leverage and firm value.

The test of Hypothesis 6 produces the strongest result in the model: leverage exerts a positive and highly significant effect on firm value ($\beta = 2.1895$; $z = 2.89$; $p = 0.004$), in the opposite direction to that predicted. H6 is therefore rejected, but the reversal is itself the principal empirical finding of this study and warrants careful interpretation.

Three explanations may be advanced. First, from a signalling perspective, the assumption of additional debt conveys management's confidence in the firm's capacity to generate future cash flows, since only firms confident of servicing their obligations will willingly increase fixed commitments (Ross, 1977). Second, in a project-based industry such as construction, leverage is closely tied to working capital and project financing requirements, so that a higher debt ratio may proxy for a larger order book and greater business activity rather than for distress. Third, from an agency perspective, fixed repayment obligations reduce the free cash flow available for discretionary spending and thereby impose discipline on management (Jensen, 1986).

A fourth and more cautionary explanation must also be acknowledged, since it concerns the measurement of the dependent variable rather than economic behaviour. Price to book value is computed with book equity in the denominator, while the debt to asset ratio rises mechanically as the equity share of the balance sheet falls. A structural association between the two variables therefore exists independently of any valuation effect, and it is reinforced at the upper end of the distribution where the maximum debt to asset ratio of 1.6438 implies negative book equity. Part of the estimated coefficient may consequently reflect this accounting relationship rather than the market's assessment of capital structure. This possibility is acknowledged as a limitation in Section 5.3, and future work should verify the result using valuation measures that are less sensitive to book equity, such as Tobin's Q or market capitalisation scaled by total assets.

Synthesis

Taken together, the results indicate that capital structure, rather than governance structure, dominates the determination of firm value in the Indonesian construction and infrastructure sector. Leverage is the only variable significant at the 1% level; institutional ownership and firm size are significant only at the 10% level; and board size, board independence, and managerial ownership are not priced at all. Within the governance variables, the pattern nevertheless remains informative: the only mechanism showing any association with firm value is the one exercised by a party holding a residual claim, namely institutional shareholders, whereas mechanisms exercised by appointed officers show none. This supports the view that the effectiveness of a governance mechanism depends less on its formal existence than on whether the monitoring party bears the consequences of monitoring failure.

A further methodological observation deserves emphasis. The rho value of 0.6347 indicates that unobserved firm-specific effects account for nearly two-thirds of the residual variance. In a sector composed of firms with markedly different ownership backgrounds, project portfolios, and balance sheet histories, this is substantively plausible. It also implies that analyses which pool observations without accounting for firm-level heterogeneity would produce materially different and potentially misleading conclusions.

CONCLUSION

Conclusion

This study examined the effect of corporate governance, firm size, and leverage on the firm value of construction and infrastructure companies listed on the Indonesia Stock Exchange over 2022–2025, using panel data regression on 96 firm-year observations from 24 firms. The Hausman test indicated that the random effects model is appropriate, while diagnostic testing confirmed groupwise heteroscedasticity and first-order serial correlation, which were addressed through cluster-robust standard errors.

The results show that leverage has a positive and significant effect on firm value at the 1% level. Institutional ownership is positively and firm size negatively associated with firm value, both significant at the 10% level. Board size, the proportion of independent commissioners, and managerial ownership have no significant effect. Jointly, the independent variables significantly affect firm value at the 5% level. Overall, market valuation in this sector is shaped more by capital structure than by the formal architecture of governance bodies, and among governance mechanisms only ownership by institutions shows any association with firm value.

Theoretical and Practical Implications

Theoretically, the study refines the application of agency theory by showing that governance mechanisms are not interchangeable: their effectiveness appears to depend on whether the monitoring party holds a residual claim on firm value. It also demonstrates that the direction of the size–value relationship is context dependent, since in a sector where scale is associated with legacy obligations rather than resilience, size can reduce rather than enhance valuation. Methodologically, the finding that 63.47% of residual variance is attributable to firm-specific effects demonstrates the importance of panel estimation in sectors composed of heterogeneous firms.

Practically, three implications follow. For investors and analysts, capital structure carries more valuation information in this sector than structural governance indicators such as board size or board independence, and firm size should not be treated as a proxy for safety. For management, the positive association between leverage and firm value should be read with the measurement caveat discussed in Section 4.1 and does not constitute a recommendation to increase debt; the more defensible reading is that the market does not penalise leverage per se in a project-financed industry. For regulators, the finding that board-based mechanisms cluster near regulatory minimums and show no association with firm value suggests that governance requirements expressed as numerical thresholds may induce formal compliance without substantive improvement in oversight; supervisory attention could usefully shift towards the effectiveness of governance processes rather than the size or composition of governance bodies.

Limitations and Directions for Future Research

Several limitations should be acknowledged. First, and most importantly, price to book value is computed with book equity in the denominator while the debt to asset ratio rises as the equity share falls, so a structural association exists between the dependent variable and leverage independently of any valuation effect. Future research should verify the leverage result using measures less sensitive to book equity, such as Tobin's Q or market capitalisation scaled by total assets.

Second, the panel comprises only 24 firms. Cluster-robust inference relies on asymptotics in the number of clusters, and 24 clusters is modest by conventional standards, so the results

significant at the 10% level should be regarded as suggestive rather than established. Wild cluster bootstrap procedures would provide more reliable inference at this sample size. Third, the model includes no control variables such as profitability, sales growth, or firm age, which are standard in the firm value literature and whose omission may bias the estimates.

Fourth, audit committee size was excluded because it exhibits almost no variation across the sample; while this is methodologically justified, it means that one dimension of governance is not examined here, and studies with broader sectoral coverage may be able to include it. Fifth, the within R-squared of 0.0453 indicates that the model explains little of the variation in firm value over time within firms, suggesting that time-varying determinants such as macroeconomic conditions, sector sentiment, and project acquisition are not captured. Sixth, the study is confined to a single sector in one country over a four-year window, so the results should be generalised with care.

Future studies are encouraged to incorporate control variables and alternative valuation measures, extend the observation period, apply wild cluster bootstrap inference, and compare the construction and infrastructure sector with other capital-intensive sectors. Examining the moderating role of state ownership would also be valuable, given that the largest firms in this sector are predominantly state owned.

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