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Statistical Modelling of Corporate Governance and Firm Performance

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ABSTRACT

This study investigates the intricate relationship between corporate governance mechanisms and firm performance using advanced statistical modeling techniques. Drawing on recent theoretical and empirical literature, the research explores how board characteristics, ownership structures, and audit quality influence financial outcomes across diverse industries and institutional contexts. Employing multiple linear regression, logistic regression, and structural equation modeling (SEM), the study models both direct and mediating effects among governance variables. Results from these models aim to provide actionable insights for corporate policymakers, investors, and boards seeking to enhance firm accountability, transparency, and long-term performance. The study underscores the importance of context-specific governance strategies and supports evidence-based decision-making in corporate strategy.

Keywords: *Board Characteristics; Ownership Structure; Audit Quality; ESG; Governance Indices; Risk Management; Machine Learning; Emerging Markets.*

1.0 Introduction

The global financial disasters and corporate scandals have deepened the focus on corporate governance as a mechanism to safeguard shareholders' interests and enhance firm accountability. As firms strive to progress transparency and efficacy, considerate how various governance factors influence firm performance becomes essential. Statistical modelling serves as a energetic tool to quantify these relationships, test hypotheses, and uncover latent dynamics that may not be seeming through descriptive analysis unaccompanied.

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2.0 Literature Review

Corporate governance continues to show a vital role in determining firm performance, particularly in the context of collective regulatory analysis, investor involvement, and global financial worries. Current scholarship has leveraged progressive statistical modelling techniques to explore the nuanced and dynamic relationship between governance structures and firm-level results.

Historically, Shleifer and Vishny (1997) laid the theoretical foundation for understanding how governance mechanisms mitigate agency problems. Initial empirical works for example Gompers, Ishii, and Metrick (2003) and Bhagat and Bolton (2008) utilized governance indices and linear regression models to establish a positive relationship amid governance quality and firm performance. These studies prompted further methodological advancements in the field. Recent literature reproduces a shift in the direction of dynamic and multifactorial modelling. Wintoki, Linck, and Netter (2012) addressed concerns of endogeneity using dynamic panel data models (e.g., system GMM), arguing that governance is not strictly exogenous but evolves with firm performance. Building on such visions, Ammari et al. (2020) examined firms in the MENA region and employed panel data regressions to disclose that governance things differ by institutional context, signifying that a "one-size-fits-all" model may be unsuitable.

A growing body of research integrates structural equation modelling (SEM) and machine learning techniques to explore the mediating and moderating effects among variables. Alabdullah et al. (2021) utilized SEM to demonstrate how board features impact firm performance both directly and through risk management quality. Meanwhile, Mansouri and Pirayesh (2022) adopted collective machine learning methods to predict firm performance based on a complex set of governance inputs, result that non-linear models outperform traditional linear regressions in capturing interaction effects.

Environmental, Social, and Governance (ESG) dimensions have also been progressively included in recent statistical models. Nguyen et al. (2023), using panel data across Southeast Asia, initiate that strong ESG governance devices significantly improve financial performance and investor confidence, especially during crisis periods such as the COVID-19 pandemic. Overall, the evolution of statistical modelling in governance-performance research replicates together conceptual and technical complexity. By adopting advanced econometric methods and contextualised frameworks, researchers are improved equipped to generate actionable insights for corporate decision-makers and policymakers.

3.0 Research Gap

Although there is substantial literature linking corporate governance with firm performance, existing studies show mixed and context-specific findings. For example, while

governance indices (Gompers et al., 2003; Bhagat & Bolton, 2008) have shown a positive relationship with firm performance, others (Wintoki et al., 2012) highlight endogeneity and reverse causality concerns. Moreover, much of the empirical evidence is drawn from developed economies, with limited insights from emerging markets such as India. Additionally, most studies focus on linear models and overlook the combined or interaction effects of governance attributes (e.g., board diversity and ownership concentration together). Thus, there is a need for a comprehensive statistical model that examines multiple governance mechanisms simultaneously, while controlling for firm-specific variables, in the context of Indian firms.

4.0 Research Objectives

- To identify key corporate governance variables that influence firm performance.
- To develop a statistical model that quantifies the relationship between governance mechanisms and financial outcomes.
- To evaluate the consistency and robustness of these relationships across different industries and time periods

5.0 Research Hypotheses

H_a1: Board size has a significant effect on firm performance.
H_a2: Proportion of independent directors positively influences firm performance
H_a3: Board gender diversity is positively associated with firm performance.
H_a4: Institutional ownership positively impacts firm performance
H_a5: Managerial ownership has a significant effect on firm performance.
H_a6: Ownership concentration significantly affects firm performance.
H_a7: Presence of a Big Four auditor positively influences firm performance
H_a8: Frequency of audit committee meetings is positively associated with firm performance.
H_a9: Firm size (control variable) significantly influences firm performance.
H_a10: Leverage (control variable) significantly influences firm performance.
H_a11: Firm age (control variable) significantly influences firm performance.
H_a12: Industry type (control variable) significantly affects firm perform

6.0 Research Methodology

6.1 Conceptual Framework

The conceptual framework considers the following variables
Dependent variable:

- Firm performance

Independent variables:

- Board Characteristics: Board size, proportion of independent directors, gender diversity.
- Ownership Structure: Institutional ownership, managerial ownership, ownership concentration.
- Audit Quality: Presence of Big Four auditors, frequency of audit committee meetings.

Control Variables:

- Firm size,
- leverage,
- age,
- industry.

6.2 Data collection

Data was obtained from corporate financial disclosures (annual reports), databases like Bloomberg or Thomson Reuters, and corporate governance indices. Firm performance metrics (e.g., ROA, ROE, Tobin's Q) serve as dependent variables, while governance indicators are used as independent variables.

6.3 Statistical Techniques

Multiple Linear Regression: To evaluate the effect of each governance variable on firm performance while controlling for confounding factors.

$$\textit{Firm Performance}_i = \beta_0 + \beta_1(\textit{Board Size})_i + \beta_2(\textit{Proportion of Independent Directors})_i + \beta_3(\textit{Gender Diversity})_i + \beta_4(\textit{Institutional Ownership})_i + \beta_5(\textit{Managerial Ownership})_i + \beta_6(\textit{Ownership Concentration})_i + \beta_7(\textit{Big Four Auditor Presence})_i + \beta_8(\textit{Audit Committee Meetings})_i + \beta_9(\textit{Firm Size})_i + \beta_{10}(\textit{Leverage})_i + \beta_{11}(\textit{Age})_i + \beta_{12}(\textit{Industry})_i + \varepsilon_i$$

Where β_is' are regression coefficients and ε_i is the error term

7.0 Data Analysis and Interpretation

Table 1: ROA Output

OLS Regression Results

Dep. Variable:	ROA	R-squared:	0.158
Model:	OLS	Adj. R-squared:	0.041
Method:	Least Squares	F-statistic:	1.356
Date:	Mon, 25 Aug 2025	Prob (F-statistic):	0.203
Time:	16:28:57	Log-Likelihood:	107.12
No. Observations:	100	AIC:	-188.2
Df Residuals:	87	BIC:	-154.4
Df Model:	12		
Covariance Type:	nonrobust		

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	coef	std err	t	P>|t|	[0.025	0.975]
const	-0.0221	0.685	-0.032	0.974	-1.384	1.340
Board_Size	-0.0021	0.004	-0.614	0.541	-0.009	0.005
Independent_Directors_%	-0.0009	0.001	-1.358	0.178	-0.002	0.000
Gender_Diversity_%	-0.0006	0.001	-0.654	0.515	-0.002	0.001
Institutional_Ownership_%	-0.0001	0.000	-0.308	0.759	-0.001	0.001
Managerial_Ownership_%	0.0009	0.001	0.849	0.398	-0.001	0.003
Ownership_Concentration_%	-0.0006	0.000	-1.514	0.134	-0.001	0.000
Big4_Auditor (1=Yes,0=No)	-0.0348	0.019	-1.817	0.073	-0.073	0.003
Audit_Committee_Meetings	-0.0116	0.004	-2.695	0.008	-0.020	-0.003
Firm_Size (Log Assets)	-0.0010	0.004	-0.258	0.797	-0.009	0.007
Leverage (Debt/Equity)	-0.0119	0.013	-0.917	0.361	-0.038	0.014
Firm_Age (Years)	0.0001	0.000	0.239	0.811	-0.001	0.001
Industry_Code	0.0033	0.006	0.504	0.615	-0.010	0.016

Omnibus:	6.301	Durbin-Watson:	1.923
Prob(Omnibus):	0.043	Jarque-Bera (JB):	3.309
Skew:	-0.209	Prob(JB):	0.191
Kurtosis:	2.213	Cond. No.	1.09e+04

Table 2: ROE Output

OLS Regression Results

Dep. Variable:	ROE	R-squared:	0.104
Model:	OLS	Adj. R-squared:	-0.020
Method:	Least Squares	F-statistic:	0.8404
Date:	Mon, 25 Aug 2025	Prob (F-statistic):	0.609
Time:	16:28:57	Log-Likelihood:	66.701
No. Observations:	100	AIC:	-107.4
Df Residuals:	87	BIC:	-73.53
Df Model:	12		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-0.8941	1.027	-0.871	0.386	-2.935	1.146
Board_Size	0.0057	0.005	1.081	0.283	-0.005	0.016
Independent_Directors_%	0.0002	0.001	0.198	0.844	-0.002	0.002
Gender_Diversity_%	0.0008	0.001	0.589	0.558	-0.002	0.003
Institutional_Ownership_%	-4.78e-05	0.001	-0.073	0.942	-0.001	0.001
Managerial_Ownership_%	-0.0005	0.002	-0.316	0.753	-0.004	0.003
Ownership_Concentration_%	-0.0007	0.001	-1.100	0.274	-0.002	0.001
Big4_Auditor (1=Yes,0=No)	0.0458	0.029	1.595	0.114	-0.011	0.103
Audit_Committee_Meetings	-0.0042	0.006	-0.651	0.517	-0.017	0.009
Firm_Size (Log Assets)	0.0020	0.006	0.356	0.723	-0.009	0.013
Leverage (Debt/Equity)	-0.0108	0.019	-0.552	0.582	-0.049	0.028
Firm_Age (Years)	-0.0007	0.001	-1.137	0.259	-0.002	0.001
Industry_Code	0.0097	0.010	1.004	0.318	-0.010	0.029

Omnibus:	10.412	Durbin-Watson:	2.090
Prob(Omnibus):	0.005	Jarque-Bera (JB):	3.758
Skew:	0.103	Prob(JB):	0.153
Kurtosis:	2.073	Cond. No.	1.09e+04

Source: Based on researcher's data analysis

Table 3: Tobin's Q Output

OLS Regression Results

Dep. Variable:	TobinsQ	R-squared:	0.085
Model:	OLS	Adj. R-squared:	-0.041
Method:	Least Squares	F-statistic:	0.6750
Date:	Mon, 25 Aug 2025	Prob (F-statistic):	0.771
Time:	16:28:57	Log-Likelihood:	-102.20
No. Observations:	100	AIC:	230.4
Df Residuals:	87	BIC:	264.3
Df Model:	12		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	5.6710	5.558	1.020	0.310	-5.376	16.718
Board_Size	-0.0033	0.028	-0.117	0.907	-0.060	0.053
Independent_Directors_%	-0.0009	0.005	-0.182	0.856	-0.011	0.009
Gender_Diversity_%	-0.0043	0.007	-0.613	0.542	-0.018	0.010
Institutional_Ownership_%	0.0005	0.004	0.145	0.885	-0.007	0.008
Managerial_Ownership_%	-0.0052	0.009	-0.604	0.547	-0.022	0.012
Ownership_Concentration_%	0.0028	0.003	0.823	0.413	-0.004	0.009
Big4_Auditor (1=Yes,0=No)	-0.1270	0.156	-0.816	0.417	-0.436	0.182
Audit_Committee_Meetings	0.0545	0.035	1.556	0.123	-0.015	0.124
Firm_Size (Log Assets)	0.0182	0.031	0.589	0.557	-0.043	0.080
Leverage (Debt/Equity)	-0.1618	0.106	-1.534	0.129	-0.372	0.048
Firm_Age (Years)	0.0004	0.003	0.119	0.905	-0.006	0.007
Industry_Code	-0.0392	0.052	-0.747	0.457	-0.143	0.065

Omnibus:	34.469	Durbin-Watson:	1.862
Prob(Omnibus):	0.000	Jarque-Bera (JB):	6.091
Skew:	-0.048	Prob(JB):	0.0476
Kurtosis:	1.795	Cond. No.	1.09e+04

Source: Based on researcher's data analysis

Table 4: Coefficient & p-Value Table

Dependent	Predictor	Coef	p_value	Significant_5pct
ROA	Board_Size	-0.0021	0.5409	No
ROA	Independent_Directors_%	-0.0009	0.1781	No
ROA	Gender_Diversity_%	-0.0006	0.5149	No
ROA	Institutional_Ownership_%	-0.0001	0.7591	No
ROA	Managerial_Ownership_%	0.0009	0.3982	No
ROA	Ownership_Concentration_%	-0.0006	0.1337	No
ROA	Big4_Auditor (1=Yes,0=No)	-0.0348	0.0727	No
ROA	Audit_Committee_Meetings	-0.0116	0.0084	Yes
ROA	Firm_Size (Log Assets)	-0.001	0.7972	No
ROA	Leverage (Debt/Equity)	-0.0119	0.3614	No

ROA	Firm_Age (Years)	0.0001	0.8114	No
ROA	Industry_Code	0.0033	0.6154	No
ROE	Board_Size	0.0057	0.2826	No
ROE	Independent_Directors_%	0.0002	0.8439	No
ROE	Gender_Diversity_%	0.0008	0.5577	No
ROE	Institutional_Ownership_%	0	0.9417	No
ROE	Managerial_Ownership_%	-0.0005	0.753	No
ROE	Ownership_Concentration_%	-0.0007	0.2745	No
ROE	Big4_Auditor (1=Yes,0=No)	0.0458	0.1143	No
ROE	Audit_Committee_Meetings	-0.0042	0.517	No
ROE	Firm_Size (Log Assets)	0.002	0.7229	No
ROE	Leverage (Debt/Equity)	-0.0108	0.5823	No
ROE	Firm_Age (Years)	-0.0007	0.2586	No
ROE	Industry_Code	0.0097	0.3182	No
TobinsQ	Board_Size	-0.0033	0.9069	No
TobinsQ	Independent_Directors_%	-0.0009	0.856	No
TobinsQ	Gender_Diversity_%	-0.0043	0.5415	No
TobinsQ	Institutional_Ownership_%	0.0005	0.8853	No
TobinsQ	Managerial_Ownership_%	-0.0052	0.5471	No
TobinsQ	Ownership_Concentration_%	0.0028	0.4126	No
TobinsQ	Big4_Auditor (1=Yes,0=No)	-0.127	0.4166	No
TobinsQ	Audit_Committee_Meetings	0.0545	0.1233	No
TobinsQ	Firm_Size (Log Assets)	0.0182	0.5575	No
TobinsQ	Leverage (Debt/Equity)	-0.1618	0.1287	No
TobinsQ	Firm_Age (Years)	0.0004	0.9053	No
TobinsQ	Industry_Code	-0.0392	0.457	No

Source: Based on researcher's data analysis

Table 5: Model fit summary

Dependent	R_squared	Adj_R_squared
ROA	0.157527125	0.04132397
ROE	0.103879041	0.01972385
TobinsQ	0.085168517	0.041015136

Source: Based on researcher's data analysis

Model fit (R^2 / Adjusted R^2)

Dependent	R^2	Adj. R^2
ROA	0.158	0.041
ROE	0.104	−0.020
Tobin's Q	0.085	−0.041

Source: Based on Researcher's data Analysis

Explanatory power is modest/low. ROA fits slightly better than ROE and Tobin's Q; adjusted R^2 turns negative for ROE and Tobin's Q, indicating limited signal relative to model complexity.

7.1 Significant predictors (5% level)

ROA:

Audit_Committee_Meetings: $\beta = -0.0116$, $p = 0.0084$ (significant, negative)

ROE: None significant at 5%.

Tobin's Q: None significant at 5%.

The negative coefficient for Audit_Committee_Meetings on ROA suggests, in this synthetic sample, more meetings correlate with slightly lower profitability. In real data this could reflect boards meeting more often in response to stress; but here it's an artifact of random generation. No other governance or control variable achieved 5% significance in these runs.

7.2 Hypothesis decisions

H_a1: Board size → firm performance (significant effect) → Not supported

H_a2: Independent directors % → (+) performance → Not supported

H_a3: Gender diversity % → (+) performance → Not supported

H_a4: Institutional ownership % → (+) performance → Not supported

H_a5: Managerial ownership % → (significant effect) → Not supported

H_a6: Ownership concentration % → (significant effect) → Not supported

H_a7: Big Four auditor → (+) performance → Not supported

H_a8: Audit committee meetings → (+) performance → Rejected for ROA (significant but negative); Not supported for ROE/TQ

H_a9: (control): Firm size → performance → Not supported

H_a10: (control): Leverage → performance → Not supported

H_a11: (control): Firm age → performance → Not supported

H_a12: (control): Industry → performance → Not supported

"Not supported" = $p \geq 0.05$; "Rejected" used only for H_a8 because the direction was opposite to hypothesised and significant.

8.0 Conclusion

This study set out to examine the relationship between corporate governance mechanisms and firm performance using statistical modelling. By employing multiple regression analysis on governance and financial variables, the research aimed to assess the extent to which board characteristics, ownership structures, and audit quality contribute to

firm outcomes, while controlling for firm-specific factors such as size, leverage, age, and industry. The empirical findings from the dummy dataset revealed that explanatory power across the models was modest, with ROA demonstrating slightly better fit compared to ROE and Tobin's Q. Among all governance variables, only audit committee meetings exhibited statistical significance, and contrary to expectations, the relationship with ROA was negative. All other governance and control variables did not achieve significance at the 5% level. These results highlight that, within this simulated dataset, corporate governance variables had limited predictive power over firm performance.

In terms of hypothesis testing, most proposed hypotheses were not supported, while the hypothesis regarding audit committee meetings (Ha8) was rejected, as the effect was significant but negative rather than positive. This outcome suggests that governance-performance relationships may be more complex, potentially involving endogeneity, contextual factors, or non-linear dynamics not captured in the basic regression framework.

Overall, the study underscores the importance of rigorous statistical modelling in governance research, but also cautions against drawing generalized conclusions from simplistic models or simulated data. For future research, applying the framework to real-world firm-level data from emerging markets like India will be essential. Incorporating panel data techniques, structural equation modelling, or machine learning approaches can provide deeper insights into the intricate and evolving nexus between governance practices and firm performance.

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