
HETEROGENEOUS GOVERNANCE EFFECTS ON FIRM PERFORMANCE: PANEL QUANTILE EVIDENCE ON BOARD STRUCTURES, GENDER DIVERSITY, AND GROUP AFFILIATION IN INDIAN FIRMS

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Abstract:

This study examines the association between corporate governance mechanisms and firm performance using a panel of 754 Indian listed non-financial firms over the period 2000–2020. Specifically, we analyze how board size, board independence, CEO duality, board committee intensity, gender diversity, and business group affiliation are associated with firm performance across different points of the performance distribution. The analysis employs multiple estimation approaches, including firm fixed-effects panel regression, instrumental-variable estimation, and panel quantile regression methods following Powell (2020, 2022). The findings reveal substantial heterogeneity in governance–performance relationships across quantiles. Board independence and the number of board committees show positive associations with firm value, particularly among higher-performing firms. Board size exhibits heterogeneous associations across the performance distribution, with positive associations among lower-performing firms but negative associations at higher performance levels. CEO duality is associated with lower firm performance. Gender diversity shows mixed associations across performance levels, with post-reform interactions suggesting that changes following the Companies Act 2013 were largely compliance-driven. Overall, the results highlight the distributional nature of governance–performance relationships and underscore the role of institutional reforms in shaping governance outcomes in emerging markets.

Key words: *Corporate Governance, Board Gender Diversity, Firm Performance, Panel Quantile Regression, Group Affiliation, Indian Firms*

1. Introduction

Business operations are governed by corporate governance (CG) regulations and supervision (Yahya & Thurasamy, 2014; World Bank, 1995). It safeguards stakeholders, adheres to legal and ethical standards, and fosters accountability, transparency, and legitimacy in business decisions (Krishnan & Teo, 2012). Corporate governance safeguards investors from insiders and enhances resource efficiency (Claessens, 2007; Shleifer & Vishny, 1997). Governance includes rules for negotiating corporate quasi-rent (Zingales, 1998). Governance must be taken into account in corporate finance and strategic management.

According to institutional theory, a country's rules, enforcement, and incentives can affect how businesses act (Shinkle & Kriauciunas, 2012). A lot of research has been done

on corporate governance and the growth of economies in industrialized countries. Emerging markets face challenges related to enforcement, concentrated ownership, and complex organizational structures (Hoskisson et al., 2013). Strict laws help enterprises get into markets that are already there (Peng, 2003). Businesses in underdeveloped nations are often owned by a small number of people, are hard to assess, and are rarely governed by other countries (Mishra, 2018; Rajagopalan & Zhang, 2008). These economies are mostly run by big business groups (Peng, 2003).

Most Indian businesses are run by promoters, indicating that the largest investors have the most power (Chakrabarti et al., 2009). Businesses have a significant impact on Asia's economy (Gómez-Mejía et al., 2007). Governance is difficult because of weak institutional frameworks, agency issues (Khanna and Palepu, 2000), and complicated ownership links (Singh and Gaur, 2009). Sometimes, conglomerates have extensive networks of companies, which make them less powerful and flexible (Granovetter, 2001). Even though these things are true, not much study has looked into how corporate governance and being part of a business group affect the performance of organizations in developing countries (Singh et al., 2018). India is a developing country with a government that is moving in the right direction, which gives it a strong base to fight inequality (Singh and Mittal, 2019).

The boards of directors (BoDs) of companies keep an eye on management and do what is best for shareholders. The board's size, independence, the fact that the CEO has two jobs, and the number of committees all affect how well it makes strategic decisions and keeps an eye on things. According to agency theory, having two CEOs may make it harder for the board to do its job since it gives one individual too much influence. Gender diversity on corporate boards is a political issue around the world. A lot of countries have regulations that make it easier for women to get on business boards (Kyaw et al., 2015). The rules say that bigger boards are better at making choices, following rules, and keeping an eye on things (Terjesen et al., 2015). But empirical data is not always reliable. Companies with more women do better and make more money (Barua et al., 2010; Srinidhi, 2011; Thiruvadi and Huang, 2011). Another study, on the other hand, reveals that women don't have much of an impact on boards that are mostly men.

The Indian Companies Act of 2013 says that every company must include at least one woman on its board. The law decides if modifications to procedures are real or made to meet certain standards. Operational efficiency is affected by how the organization is set up, how performance is measured, and how people interact with each other. Most studies utilize mean-based estimates and presume that all companies have the same governance. Not paying attention to the differences in governance frameworks between successful and unsuccessful firms could hide valuable information.

To examine the relationship between corporate governance mechanisms and the performance of Indian firms, we consider board size, board independence, CEO duality, number of board committee, board gender diversity, and business group affiliation. Organizational size, group affiliation, and the regulatory changes introduced under the Companies Act 2013 are incorporated as moderating factors. Using a panel dataset of publicly listed Indian firms from 2000 to 2020, we analyze performance across the distribution employing firm fixed-effects estimation and extended panel quantile regression techniques.

The empirical findings indicate that governance–performance relationships are not uniform across firms. Board size exhibits heterogeneous associations across the performance distribution. Board independence shows a consistently positive association with firm performance, with stronger associations among higher-performing firms, while number of board committee is positively associated with performance in lower- and middle-performing segments. CEO duality exhibits a negative association at higher performance levels, consistent with agency theory concerns regarding concentrated leadership. Board gender diversity displays predominantly negative associations across performance levels; however, post-regulatory interaction results suggest some improvement following the Companies Act 2013, indicating that earlier board appointments may have been driven more by regulatory compliance than by intrinsic governance considerations. Business group affiliation shows limited direct associations with firm performance but moderates several governance–performance relationships, highlighting the importance of organizational context in shaping governance outcomes.

This study contributes to the existing literature in several ways. First, it extends corporate governance research by providing evidence from an emerging economy characterized by concentrated ownership and institutional transitions. Second, it highlights heterogeneous governance effects across the performance distribution using quantile-based methods, addressing limitations of mean-based approaches. Third, it evaluates the moderating role of business group affiliation and regulatory reforms in influencing governance effectiveness. Finally, the findings offer policy implications regarding board structure, leadership design, and gender diversity regulations in emerging markets

2. Literature review

2.1. Board size and firm performance

Opinion is divided regarding the impact of board size on firm performance. One group of research posits that smaller boards are more effective (Conyon and Peck, 1998; Garg, 2007; Guest, 2009; Shakir, 2008b). Larger boards lead to weaker administration as they tend to develop slow decision-making processes, weaker communication and information asymmetry, whereas smaller boards lead to better firm performance because of close monitoring by the management (Azeez, 2015; Shakir, 2008b). Another stream of research reveals the opposite. Lesser the strength of the board, higher the agency cost. A large BoD with wide proficiency is suited for better risk management than smaller boards and thus increases firm performance (Elzahar and Hussainey, 2012; Haldar and Raithatha, 2017, Luo, 2005,). Therefore, based on this, the hypothesis is formulated as:

H1: Board size is positively associated with a high firm performance.

2.2. Board independence and performance

Board independence is critical for ensuring board effectiveness because of the strategic supervision provided by independent BoD (Berghe and Baelden, 2005). The most important factor for board independence is having several directors on the board, who are independent from management and contribute with their independent view of policies (PeiZhi and Ramzan, 2020) and impartial business decisions and opinions (Fuji, Halim, & Julizaerma, *et al.*, 2016). Board independence is an important corporate governance

mechanism that can lead to a better supervision and board effectiveness (Said *et al.*, 2009). Independent directors protect shareholder's interests by showing greater compliance with the law (PeiZhi and Ramzan, 2020) and show greater concern for corporate social responsibility (Zahra and Stanton, 1988). Moreover, based on Agency Theory, having more of independent directors on the board is beneficial since they help monitoring the agents' decisions effectively (Naciti 2019, Fama, 1980; Jensen and Meckling, 1976; Netti, 2018). Independent directors potentially have lower conflict of interest with shareholders (Clemente and Labat, 2009; Felo, 2001; Petra, 2005), and serve as a mechanism that links external stakeholders to the firms (Dalton *et al.*, 1998, Mishra *et al.*, 2018). Various researchers have revealed that monitoring by independent directors who do not engage actively in the administration of the firm, can enhance financial announcing, thereby increasing overall firm performance (Higgs 2003; Ronald *et al.*, 2012). Based on the above, we hypothesise that:

H2: Board independence is positively associated with a high firm performance.

2.3. CEO duality and firm performance

CEO duality exists when CEO of the firm is also chairman of the board (Sanan *et al.*, 2021). The evidence from literature on the impact of CEO duality on firm performance is divided in its conclusion. One strand of research suggests that it leads to the misuse of administrative power, diminishes firm value (Chen *et al.*, 2008; Singh *et al.*, 2018) and increases fraudulent financial disclosure (Sarkar *et al.*, 2008). Another research thread points out that there is insufficient evidence of CEO duality's impact of firm performance in the long term (Baliga *et al.*, 1996; Elsayed, 2007). A study based on 5-year data from 145 non-financial firms in India found negligible negative impact of CEO duality on firm performance (Shrivastav and Kalsie, 2016). CEO duality can lead to strong centralised leadership but reduces the management role of the BoD (Finkelstein and D'Aveni, 1994). This is especially true of business groups where controlling shareholders exercise final authority. This can be avoided by isolating the work of the CEO and the board. This will facilitate a distribution of organizational authority (Goyal and Park, 2002; Hashim and Devi, 2009). Given that our examination concerns an emerging economy, where centralization of organizational authority can lead to conflict within the board, the hypothesis is formulated as:

H3: CEO duality is negatively associated with a high firm performance.

2.4. Board committees and firm performance

Fama and Jensen (1983) argued that the boards of directors have the fiduciary responsibility of acting on behalf of the shareholders wherein the boards of directors (BoD) embody the various shareholders that allots the majority of its obligations to numerous committees (Guo *et al.*, 2015). The function of these committees varies from specific to combined and narrowly defined roles (Colin *et al.*, 2018). As mentioned by Adams (2003), these committees (which includes nomination, audit, compensation etc.) create a conducive environment for "effective organizational governance." The board of directors exercise the control mechanism which observes the managerial opportunism. This monitoring role can help improvise and enable the directors' to "rigorously discharge" their duties (Lam and Lee, 2012; Higgs, 2003). In 2004, Abbott *et al.* investigated about the

benefits of having an audit committee and suggested that the existence of such committee reduces anomalies and illicit acts, lessen errors, and financial interpretations. Nonetheless, there is a lack of explicit policies on the required number, and makeup of these committees as they tend to vary across firms. Klein (1998) along with Lam and Lee (2012) established the positive association between the existence of oversight board committees and the corporate performance. We find evidence that the expertise of the BoD matters (Dass *et al.*, 2014, Goldman *et al.*, 2013, Güner *et al.*, 2008), but there is little statistical evidence in an emerging market to support the role and significance of oversight board committees and the firm performance (Ararat and Yurtoglu, 2021). Thus, based on the above-mentioned literature, we hypothesize the following:

H4: The number of board committees is positively associated with a high firm performance.

2.5. Group affiliation and firm performance

Business groups are a composition of legitimately independent firms connected by informal and formal connections (Khanna and Yafeh 2005) with similar corporate governance structures (Ararat *et al.*, 2017). These are owned either by a family or the state (Cuervo-Cazurra, 2006). Family firms have unique ownership structures as they represent a distinctive category of shareholders having undiversified portfolios. They view the firms as an asset to pass on to their future progeny, and frequently exercise control over the top management ranks (Anderson *et al.*, 2003). They exhibit better organizational check owing to the accessibility of information to owners and thus, better all-inclusive understanding (Yu-Thompson *et al.*, 2016) which leads to reduced information asymmetry between the shareholders and management. Family firms also exhibit a larger investment bracket (Anderson and Reeb, 2003; Brenes *et al.*, 2011; Zahra, 2010) and are generally risk averse (Anderson *et al.*, 2012). Contrary research suggests that group affiliation can cause disruption on firm performance as well (Gaur *et al.*, 2009, Khanna *et al.*, 2005, Singh and Gaur, 2009). As per the study conducted by Mursitama (2006) on Indonesian business groups, the group affiliation has an adverse impact on the overall firm performance. However, firm ownership has an overriding effect on the BoD and its concentration has a moderating impact on governance (Singh *et. al* 2018). Group affiliation for family-owned businesses may reduce board independence (Chen and Jaggi, 2000) and can negatively impact the BoD decision making process. Based on extant literature we submit that ownership has a moderating effect on corporate governance and hypothesise that:

H5: The relationship between firm's corporate governance structures (board structure and related directing factors) and business performance varies across firm's ownership structures.

2.6. Board gender diversity and firm performance

Recently, a lot of emphasis is being done on gender diversity in executive boards (Green and Homroy, 2018) which is a topic of debate among the academic and business fraternity. The term diversity on the board accounts for age, nationality, experience, qualification, and gender of the members of the BoD (Mahadeo *et al.*, 2012; Haldar *et al.*, 2020). Diversity as an integral concept has serious implications on the firm decision-making (Carter *et al.*, 2003; Vander-Walt *et al.*, 2003). As per the study conducted by Kim

and Starks (2016) the gender diversity in the corporate board can improve overall firm performance and value owing to the input of women director via two broad means. Firstly, in terms of the diversity as homogenous teams are less efficient than heterogenous or diverse teams (Kahane *et al.*, 2013). In addition, the female directors add to human capital stock of boards that leads to efficient supervision and better decision making (Hermalin and Weisbach, 2003). Secondly, the reduction in discrimination i.e., the female representation on the BoD can have positive effect on firm performance by lessening discrimination and replacing incompetent male directors by improving the overall decision-making process (Adams *et al.*, 2009; Nielsen *et al.*, 2010; Hermalin *et al.*, 2003, Kim *et al.*, 2017). The existing literature examines the effect of board gender diversity on firm value and performance which is predominantly explored in developed markets and found inconclusive results (Adams *et al.*, 2009, Gul *et al.*, 2011, Torchia, Calabrò, Huse, 2011). Further, there is very little evidence of the same from emerging economies like India. Thus, we hypothesize the following:

H6: The board gender diversity is positively associated with a high firm performance.

2.7 Moderating Effects of Ownership Structure and Institutional Reform

Business environment and institutions determine corporate governance. Institutional theory (Shinkle and Kriauciunas, 2012) states that ownership and regulatory governance impact corporate performance through monitoring. Emerging markets with concentrated ownership and business-group dominance may adopt specialized governance frameworks.

Affiliated enterprises use internal capital markets, shared governance frameworks, and promoter-led decision-making, thereby reducing business-group linkage. Joining a group might help you share risks and resources, but overlapping control rights and potential conflicts of interest may make formal organisation harder (Gaur *et al.*, 2009). Ownership concentration affects governance and firm performance, say Singh *et al.* (2018). Companies, whether in groups or alone, may run their boards, committees, and leadership differently.

H7: Business group affiliation moderates the relationship between corporate governance mechanisms and firm performance.

Another contextual factor affecting governance is corporate size. Due to agency concerns, complexity, and external scrutiny, larger organizations may benefit from the presence of independent directors and specialist committees (Dalton *et al.*, 1999; Boone, 2007). Smaller companies may behave differently due to limited resources and concentrated ownership. The size of a business might affect its performance.

H8: Firm size moderates the relationship between corporate governance mechanisms and firm performance.

Institutional changes affect government efficiency. The Companies Act 2013 mandated women on boards in India, changing company management. Institutional theory suggests that regulation changes may first lead to compliance-driven behaviour rather than governance gains (Peng, 2003). Adams *et al.* (2009) suggest that forced diversity policies may affect performance differently than voluntary ones. A diverse board of directors may affect a company's performance before and after the law is passed. s.

H9: The relationship between board gender diversity and firm performance differs between the pre- and post-Companies Act 2013 period

3. Research Methodology

3.1 Data and Sample Selection

This study examines the association between corporate governance mechanisms, board gender diversity, business group affiliation, and firm performance. We have collected data from the CMIE (Centre for Monitoring Indian Economy) Prowess database, which provides publicly available information on Indian corporate firms, to examine our hypotheses. Our sample comprises all non-financial Bombay Stock Exchange (BSE)-listed firms during the period 2000-2020. We excluded all financial firms because of their difference in approach in balance sheet preparation. Broadly, our sample comprises 754 firms with 11,945 firm-year observations, each with data on all variables used in the study for at least 10 years. Consistent with prior corporate governance studies, extreme values of continuous variables were winsorized at the 1st and 99th percentiles to reduce the influence of outliers.

3.2 Empirical model

This research employs standard panel data, fixed-effects regression, and generalized panel quantile regression to examine the relationship. However, governance methods might exert disparate effects on enterprises contingent upon their performance levels, even though conventional mean-based models suggest uniform effects across firms. Quantile regression allows for the estimation of diverse relationships within the conditional distribution of company performance, thereby providing more thorough insights than mean-based approaches.

We use firm fixed-effects models to estimate the baseline specification. These models take into account unobserved heterogeneity between firms that doesn't vary over time, as well as year-fixed effects to account for macroeconomic and regulatory changes. All fixed-effects models include year dummy variables to account for changes in regulations and macroeconomic shocks that may happen over time. Standard errors are clustered at the firm level to account for serial correlation and heteroskedasticity within firms.

The research uses generalized panel quantile regression, developed by Powell (2020, 2022), to address distributional heterogeneity. This method allows estimation of quantile-specific coefficients while accounting for unobserved individual heterogeneity, without imposing stringent distributional assumptions. The Powell estimator is suitable for panel data contexts characterized by firm-specific heteroskedasticity, as it accounts for heteroskedastic errors and nonadditive fixed effects, unlike traditional quantile regression.

The empirical specification is given as:

$$Q_{\tau}(TQ_{it} | X_{it}, \alpha_i, \lambda_t) = \alpha_i + \lambda_t + \beta_1 ND_{it} + \beta_2 INED_{it} + \beta_3 CD_{it} + \beta_4 NBC_{it} + \beta_5 BorDiv_{it} + \beta_6 Size_{it} + \beta_7 Leverage_{it} + \beta_8 Age_{it} + \beta_9 GroupAff_{it} + \varepsilon_{it}$$

where i and t denote firm and year, respectively, TQ represents firm performance measured by Tobin's Q, and α_i captures firm-specific fixed effects while λ_t represents year effects.

3.3 Interaction Models

To examine moderating effects suggested by institutional theory and ownership structure literature, interaction terms are incorporated into the empirical models. Specifically, governance variables are interacted with business group affiliation and firm size to examine whether governance effectiveness differs across ownership structures and organizational complexity. In addition, board gender diversity interacts with a post-2013 regulatory indicator to capture the potential impact of the Companies Act 2013, which mandated female board representation for certain firms.

The interaction specification is represented as:

$$Q_{\tau}(TQ_{it}) = \beta_1 Governance_{it} + \beta_2 Moderators_{it} + \beta_3 (Governance \times Moderators)_{it} + Controls + FixedEffects + \varepsilon_{it}$$

These interaction models allow the study to assess whether governance–performance associations vary across business group affiliation, firm size, and regulatory periods.

3.4 Addressing Endogeneity Concerns

Corporate governance variables may be subject to reverse causality or simultaneity, as firm performance can influence board structure decisions. To mitigate these concerns, the empirical analysis incorporates firm fixed effects, which control for unobserved time-invariant heterogeneity across firms. In addition, robustness checks using lagged governance variables and endogeneity diagnostics were conducted. The results indicate no systematic endogeneity bias in the governance variables, supporting the use of the adopted estimation approach. Therefore, the findings are interpreted as associations rather than causal effects.

3.5 Rationale for Quantile Regression

Quantile regression is particularly relevant in the corporate governance context because governance mechanisms may have asymmetric effects across firms. For example, governance improvements may have stronger associations among poorly performing firms due to monitoring benefits, or among high-performing firms due to strategic advisory roles. By estimating multiple quantiles (0.10 to 0.90), the study captures heterogeneous governance–performance relationships across the distribution of firm outcomes.

4. Results and Findings

Table 1 shows descriptive statistics for study variables. Tobin's Q (TQ), a metric of corporate performance, averages 1.055, indicating that firms' market valuations slightly exceed their book value. The sample's maximum TQ value is 5.61, indicating significant variation in firm performance. In terms of corporate governance, the average board size (ND) is 8.33 directors, with a maximum of 16, indicating substantial variation across organizations. Independent directors (INED) average 42.4%, showing Indian corporate governance's increased emphasis on independent scrutiny. CEO duality (CD) is detected in 25.8% of firm-year data, demonstrating collective leadership systems persist in some organizations. Governance arrangements vary between organizations, with an average of

1.76 board committees (NBC) and a maximum of five. Board gender diversity (Bor_Div) has a very low mean of 0.003 and a maximum of 0.667, indicating that most firms have little female board presence. Firm size (LNSA) is dispersed, while leverage averages 30.5% of assets. Firms average 19 years and peak at 37 years. A 65.4% business group affiliation indicates the dominance of group-affiliated enterprises in the Indian corporate sector.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
TQ	11,946	1.055	0.926	0.167	5.610
ND	11,949	8.328	2.767	1.000	16.000
INED	11,949	0.424	0.234	0.000	1.000
CD	11,949	0.258	0.438	0.000	1.000
NBC	11,949	1.762	1.056	0.000	5.000
Bor_Div	11,949	0.003	0.029	0.000	0.6667
LNSA	11,949	7.256	1.969	1.459	10.754
leverage	11,949	0.305	0.205	0.001	0.873
Age	11,949	19.096	7.764	5.000	37.000
Grou Aff	11,949	0.654	0.476	0.000	1.000

Note: TQ=(Total Market Value of the Company + Liabilities) / Total Asset Value), ND= which is analyzed using the Total Number of Directors in each company for the years from 2000 to 2019, INED= which is analyzed by taking percentage share of the Number of Independent Non-Executive Directors to the Total Number of Directors in every company for the years 2000 to 2019, CD= takes value 1 if person hold both CEO and Chairperson of the company, 0 otherwise, NBC: which is analyzed by taking the List of Board Committee in every company for the years 2000 to 2019, Bor_Div = which is analyzed by taking percentage share of the Number of Women Directors to the Total Number of Directors in every company for the years 2000 to 2019, Age = The number of years the company is listed on the stock exchange, LNSA = Natural logarithm of total sales of the company, Leverage = (Total Debt/Total Assets) Group_Aff=The firm which take value 1 if it is a Group Firm , 0 for standalone firms

Table 2 presents the Pearson correlation matrix and variance inflation factors (VIF) for the explanatory variables. The pairwise correlations among the independent variables are generally low to moderate, suggesting no severe multicollinearity. The highest correlation is between board size and firm size (0.463), consistent with the expectation that larger firms tend to have larger boards. The correlations between governance variables and firm performance are modest, suggesting that multivariate analysis is required to examine conditional relationships. The VIF values for all variables are close to one and well below conventional thresholds, confirming that multicollinearity does not pose a concern for the regression analysis.

Table 2: Pearson correlation

	TQ	ND	INED	CD	NBC	Bor_Div	LNSA	leverage	age	Group_Aff	VIF
TQ	1.000										
ND	0.130	1.000									1.29
INED	0.075	0.052	1.000								1.20
CD	0.012	0.012	0.001	1.000							1.01
NBC	0.074	0.143	0.406	0.013	1.000						1.23
Bor_Div	0.015	0.031	0.009	0.023	0.008	1.000					1.00

LNSA	0.164	0.463	0.078	0.014	0.146	0.008	1.000				1.29
leverage	0.137	0.053	0.012	0.005	0.018	0.010	0.068	1.000			1.01
Age	0.005	0.011	0.048	0.042	0.045	0.000	0.024	-0.005	1.000		1.01
Group Aff	0.009	0.019	0.041	0.087	0.038	-0.048	0.011	0.010	0.003	1.00	1.01

Note: TQ=(Total Market Value of the Company + Liabilities) / Total Asset Value), ND= which is analyzed using the Total Number of Directors in each company for the years from 2000 to 2019, INED= which is analyzed by taking percentage share of the Number of Independent Non-Executive Directors to the Total Number of Directors in every company for the years 2000 to 2019, CD= takes value 1 if person hold both CEO and Chairperson of the company, 0 otherwise, NBC: which is analyzed by taking the List of Board Committee in every company for the years 2000 to 2019, Bor_Div = which is analyzed by taking percentage share of the Number of Women Directors to the Total Number of Directors in every company for the years 2000 to 2019, Age = The number of years the company is listed on the stock exchange, LNSA = Natural logarithm of total sales of the company, Leverage = (Total Debt/Total Assets) Group_Aff=The firm which take value 1 if it is a Group Firm , 0 for standalone firms.

4.1 Fixed-effects regression results

Table 3 presents baseline panel-data regression estimates from firm-fixed-effects models on corporate governance mechanisms and firm performance. All parameters include year dummy variables to control for macroeconomic and regulatory shocks over time, and standard errors are clustered at the firm level for heteroskedasticity and within-firm serial correlation. This specification controls for unobserved time-invariant firm characteristics and identifies within-firm variance.

Board size is positively correlated with firm performance across model specifications, showing that larger boards may offer greater advisory capacity and diverse experience in Indian corporations. According to the resource reliance perspective, larger boards offer stronger knowledge networks and more strategic resources. The magnitude and statistical significance vary between parameters, suggesting that board size effectiveness may rely on institutional and firm-specific factors.

The fixed-effects models show no consistent link between board independence and firm performance, suggesting that independent directors may not always increase performance. In emerging markets, promoter domination, limited influence, and compliance-driven appointments may limit independent directors. CEO duality is negatively correlated in numerous specifications, supporting agency theory that leadership concentration may degrade monitoring and governance quality. Firm performance is uneven but sometimes beneficial with board committee size. Specified oversight arrangements may improve governance effectiveness, but their impact depends on the quality and function of the committees.

Board gender diversity is weak or uneven between specifications. However, models with a post-2013 regulatory indicator show minor improvements after the Companies Act 2013. Subsample analyses of pre- and post-regulatory eras show structural changes, suggesting institutional reforms affected governance–performance linkages. Firm size has a positive, statistically significant relationship across models, indicating that larger enterprises have higher market valuations. Performance is consistently negative with leverage, suggesting that greater financial risk lowers corporate valuation. Firm age is inconsistent across specifications. The fixed-effects results suggest that institutional context and regulatory conditions affect governance–performance linkages, prompting a distributional study.

Table 3: Results of the Baseline Fixed-Effects Regression Results

Variables	FE Baseline	Bro_Div	Bro_Div post 2013	FE Baseline – Interaction	Pre-2013	Pre-2013 FE-Interaction	Post 2013	Post 2013 FE-Interaction
ND	0.0197***			-0.0533***	0.0226***	-0.0474***	0.0182**	-0.0635**
	-0.00349			-0.0155	-0.00414	-0.0179	-0.00728	-0.0312
INED	-0.0289			0.145	-0.00076	0.192	-0.0559	0.245
	-0.0425			-0.172	-0.0513	-0.189	-0.0897	-0.379
CD	0.0215			0.0582	0.0313	0.0793	-0.0835	-0.0635
	-0.0249			-0.093	-0.0365	-0.111	-0.0708	-0.222
NBC	0.00968			-0.00738	0.00464	-0.00896	0.0116	-0.0309
	-0.0104			-0.018	-0.0122	-0.0224	-0.0205	-0.0355
Bro_Div	-0.0792	-0.146	-0.127	0.324	-0.219	-0.876	0.00402	1.282
	-0.297	-0.29	-0.421	-0.789	-0.563	-1.199	-0.424	-1.116
ND_Group				0.00112		0.00422		-0.014
				-0.0068		-0.00771		-0.0135
CD_Group				0.0422		0.063		-0.0954
				-0.0531		-0.0776		-0.147
NBC_Group				0.0265		0.0208		0.064
				-0.0219		-0.0265		-0.0436
INED_Group				-0.071		-0.0886		-0.0158
				-0.0882		-0.107		-0.19
ND_Size				0.00937***		0.00874***		0.0117***
				-0.0019		-0.0022		-0.0038
CD_Size				-0.00817		-0.0116		0.00503
				-0.0115		-0.0138		-0.0248
INED_Size				-0.0168		-0.018		-0.0392
				-0.0225		-0.0248		-0.0472
ND_BroDiv				-0.00332		0.02		0.0629
				-0.153		-0.221		-0.186

Variables	FE Baseline	Bro_Div	Bro_Div post 2013	FE Baseline – Interaction	Pre-2013	Pre-2013 FE-Interaction	Post 2013	Post 2013 FE-Interaction
CD_BroDiv				-0.724		-0.875		-1.875
				-0.738		-1.168		-1.151
NBC_BroDiv				-0.0714		0.430*		-0.516
				-0.28		-0.239		-0.412
LNSA	0.0677***	0.0809***	0.0690***	0.00438	0.0717***	0.014	0.0573***	-0.0151
	-0.00605	-0.00566	-0.0112	-0.0168	-0.00695	-0.0182	-0.0125	-0.0392
Leverage	-0.596***	-0.589***	-0.511***	-0.568***	-0.595***	-0.569***	-0.508***	-0.472***
	-0.0502	-0.0502	-0.0905	-0.0502	-0.0576	-0.0582	-0.0906	-0.0896
Age	0.00142	0.00132	0.0049	0.00143	0.00113	0.00124	0.00492	0.00456
	-0.00132	-0.00132	-0.00298	-0.00132	-0.00169	-0.00168	-0.00301	-0.00303
Constant	0.591***	0.667***	0.607***	1.057***	0.531***	0.954***	0.563***	1.108***
	-0.0702	-0.0647	-0.0907	-0.125	-0.0807	-0.139	-0.108	-0.279
Observations	11,945	11,945	3,523	11,945	8,422	8,422	3,523	3,523
Number of firm_id	754	754	691	754	754	754	691	691
R-squared	0.049	0.046	0.036	0.053	0.054	0.057	0.04	0.048
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: : $TQ = (\text{Total Market Value of the Company} + \text{Liabilities}) / \text{Total Asset Value}$), $ND =$ which is analyzed using the Total Number of Directors in each company for the years from 2000 to 2019, $INED =$ which is analyzed by taking percentage share of the Number of Independent Non-Executive Directors to the Total Number of Directors in every company for the years 2000 to 2019, $CD =$ takes value 1 if person hold both CEO and Chairperson of the company, 0 otherwise, $NBC =$ which is analyzed by taking the List of Board Committee in every company for the years 2000 to 2019, $Bor_Div =$ which is analyzed by taking percentage share of the Number of Women Directors to the Total Number of Directors in every company for the years 2000 to 2019, $Age =$ The number of years the company is listed on the stock exchange, $LNSA =$ Natural logarithm of total sales of the company, $Leverage = (\text{Total Debt} / \text{Total Assets})$ $Group_Aff =$ The firm which take value 1 if it is a Group Firm, 0 for standalone firms. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Result of Endogeneity Test of Board Characteristics in the Tobin's Q Model

Variables	Baseline Model TQ	First stage: ND	First stage: INED	First stage: CD	First stage: NBC	Second stage: Endogeneity test	Joint endogeneity test
ND	-0.167					-0.167	-0.167
	-0.341					-0.341	-0.341
INED	1.854					1.854	1.854
	-1.217					-1.217	-1.217
CD	0.0492					0.049	0.049
	-0.0346					-0.035	-0.035
NBC	-0.128					-0.128	-0.128
	-0.206					-0.206	-0.206
Bor_Div	-0.92	-3.576***	0.04	0.197***	-0.512	-0.92	-0.92
	-1.286	-1.075	-0.082	-0.076	-0.389	-1.286	-1.286
LNSA	0.195	0.652***	0.004***	0.004***	0.056***	0.195	0.195
	-0.221	-0.015	-0.001	-0.001	-0.006	-0.221	-0.221
Leverage	-0.625***	0.295**	0.029***	0.001	-0.011	-0.625***	-0.625***
	-0.118	-0.13	-0.01	-0.009	-0.046	-0.118	-0.118
Age	0.00164	0	0	-0.001**	-0.003*	0.002	0.002
	-0.0016	-0.004	0	0	-0.002	-0.002	-0.002
r_nd	0.187					0.187	0.187
	-0.341					-0.341	-0.341
r_ined	-1.882					-1.882	-1.882
	-1.22					-1.22	-1
r_cd	-0.0295					-0.029	-0.029
	-0.0632					-0.063	-0.063
Variables	Baseline Model TQ	First stage: ND	First stage: INED	First stage: CD	First stage: NBC	Second stage: Endogeneity	Joint endogeneity

						test	test
r_nbc	0.141					0.141	0.141
	-0.208					-0.208	-0.208
iv_nd		-0.009					
		-0.009					
iv_ined			-0.035***				
			-0.011				
iv_cd				0.798***			
				-0.009			
iv_nbc					-0.053***		
					-0.01		
Constant	0.585	3.543***	0.421***	0.033**	1.612***	0.585	0.585
	-1.255	-0.204	-0.015	-0.014	-0.071	-1.255	-1.255
Observations	10,149	10,152	10,152	10,152	10,152	10,149	10,149
R-squared	0.055	0.219	0.007	0.644	0.02	0.055	0.055
Number of firm_id	744	744	744	744	744	744	744
Joint endogeneity test F-value							0.74
Joint endogeneity test p-value							0.5679
Year FE			Yes	Yes	Yes	Yes	Yes
Firm FE			Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2 Endogeneity tests

Table 4 presents Tobin's Q model endogeneity diagnostics for key board characteristics. Concerns about endogeneity may arise when governance arrangements and business performance are established together, potentially leading to reverse causality or omitted-variable bias. Board size, independence, CEO duality, and committees were tested using instrumental variables to address this issue.

Governance variable residual terms are statistically negligible, and combined endogeneity tests fail to reject the null hypothesis of exogeneity. These data show governance variables are not strongly systematically endogenous in the sample. Thus, fixed-effects and panel quantile regression are used for empirical analysis, which yields conditional relationships rather than causal effects.

4.3 Panel quantile regression-Powell (2022)

Table 5 displays Powell's (2022) panel quantile regression estimates of the fundamental governance–performance link across the conditional performance distribution, highlighting the notable variation that mean regressions conceal. ND (board size) Positive and significant across all quantiles, suggesting larger boards add more value in stronger firms. INED (board independence) has diverse but mostly positive effects, significant at low to mid and certain upper quantiles, with impacts varying. NBC (board committees) is positive across mid-quantiles but less so at extremes, showing that ordinary achievers benefit most from supervision. In CEO duality (CD), results are mostly mixed or trivial, with a negative trend at $\tau=0.7$ and a positive trend at $\tau=0.9$, suggesting variable outcomes. Gender diversity on the board results show a strong negative correlation at $\tau=0.1$, a positive correlation at the median quantile, and a weak correlation at the upper quantile, with significant heterogeneity.

The U-shaped pattern of business group membership—detrimental for low performers (tunneling risk) but beneficial for mid- to upper quantiles (internal market benefits)—provides evidence of performance-dependent ownership effects. Leverage (positive low, negative high) and LNSA (firm size, positive and strengthening) follow expected patterns. These trends support H1 (board size) and H4 (committees), conflict with H2 (independence) and H3 (duality), and challenge H6 (gender diversity), corresponding with the different effects expected in emerging markets after the Companies Act 2013.

4.4 Panel quantile regression with interaction effects -Powell (2022)

Table 6 extends the Powell (2022) panel quantile framework with interactions for business group affiliation, firm size, and post-2013 regulatory period, revealing how ownership and institutional context moderate governance–performance links. Main effects confirm board size benefits weak or mid performers but harms top ones, independence strengthens throughout, and group affiliation is mostly positive; critically, group interactions (e.g., INED_Group, Woman Group negative across quantiles) show governance mechanisms work less effectively in affiliates, size interactions amplify board benefits in large firms, and post-period terms indicate uneven gains for diversity or independence

post-Companies Act. Leverage maintains its low-quantile benefits or high-quantile penalties, while baseline heterogeneity persists. These patterns provide direct evidence supporting H5, H7 (group moderation), H8 (size moderation), and partial support for H9 (post-reform diversity effects).

4.5 Generalized panel quantile regression-Powell (2020)

Table 7 presents baseline estimates from Powell (2020)'s generalized panel quantile regression framework, which accommodates nonadditive fixed effects and reveals marked heterogeneity in governance–performance linkages across the conditional performance distribution. Board independence exhibits robustly positive coefficients that strengthen monotonically from lower to higher quantiles, while board size shows consistently positive effects that also intensify at the top, and board committees maintain small but significant positive associations throughout; in contrast, CEO duality is significantly negative across most quantiles, and board diversity switches from positive at the lowest quantile to negative at higher ones. Leverage follows the familiar pattern of strong benefits for weak performers and sharp penalties for strong performers, and firm size (LNSA) becomes increasingly positive at higher quantiles. These baseline patterns provide strong support for H1 (board size), H2 (board independence), and H4 (board committees), confirm H3 (CEO duality), reject H6 (gender diversity), and set the stage for ownership moderation in H5.

4.6 Generalized panel quantile regression with interaction effects -Powell (2020)

Table 8 extends the generalized quantile analysis by incorporating interaction terms, confirming that the impact of board structures on performance is strongly contingent on ownership context, business size, and the post-reform period. The interaction effects show that group-affiliated and larger firms exhibit stronger, and often non-linear, links between board independence, board committees, and firm performance across the quantiles, while leverage and diversity variables switch from beneficial at lower quantiles to detrimental at higher quantiles. Moreover, the interaction between gender diversity and the post-regulatory period indicates a gradual but uneven improvement in governance quality, reinforcing that the governance–performance relationship is highly heterogeneous across firms and performance levels. Board size exhibits heterogeneous associations across the performance distribution, showing positive associations among lower-performing firms but negative associations at higher quantiles. These findings provide empirical support for H7 and H8 on the moderating roles of business group affiliation and firm size, and partial support for H9 regarding the differential effects of board gender diversity in the pre-- and post-Companies Act 2013 periods

Table 5 Results of Panel Quantile Regression - Powell 2022

Variables	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
ND	0.0057*** -0.0001	0.0067*** -0.0002	0.0079*** -0.0004	0.0100*** -0.0007	0.0132*** -0.0006	0.0169*** -0.0007	0.0229*** -0.0006	0.0362*** -0.0011	0.0435*** -0.0024
INED	0.0037** -0.0016	0.0047 -0.0054	0.0043 -0.0039	0.0184** -0.0082	-0.0063 -0.0065	0.0209*** -0.0078	0.0269*** -0.0061	-0.0105 -0.0196	-0.0316 -0.0346
CD	0.001 -0.0006	0.0052*** -0.0017	0.0032*** -0.0011	-0.0017 -0.002	0.0017 -0.0043	0.0023 -0.0046	-0.0264*** -0.0056	0.0053 -0.0083	0.0748*** -0.019
NBC	0.0006* -0.0004	0.0071*** -0.0006	0.0050*** -0.001	0.0171*** -0.0008	0.0097*** -0.0017	0.0107*** -0.0021	0.0196*** -0.0016	0.0092*** -0.003	0.0027 -0.0067
Bor_Div	-0.3899*** -0.0111	0.0811*** -0.0076	0.0392*** -0.015	0.2541*** -0.0261	0.0146 -0.0577	0.1983 -0.1324	0.1268*** -0.0354	-0.1495* -0.0904	-0.0626 -0.1949
Grou_Aff	-0.0185*** -0.0007	0.0063*** -0.001	-0.0059*** -0.0022	0.0131*** -0.0027	-0.0138 -0.0089	0.0903*** -0.0195	0.0015 -0.0023	0.0487*** -0.0088	-0.0157 -0.0181
LNSA	0.0008*** -0.0002	0.0072*** -0.0006	0.0108*** -0.0016	0.0117*** -0.0001	0.0198*** -0.0006	0.0284*** -0.0012	0.0459*** -0.0005	0.0620*** -0.0013	0.0952*** -0.0029
Leverage	0.7650*** -0.0009	0.6143*** -0.0026	0.5031*** -0.0037	0.3628*** -0.0036	0.1898*** -0.0065	-0.0325*** -0.0089	-0.3124*** -0.0159	-0.7282*** -0.0135	-1.5376*** -0.0215
Age	0.0002*** 0.0001	-0.0003*** -0.0001	-0.0002 -0.0002	0.0010*** -0.0002	0.0011*** -0.0002	0.0006*** -0.0002	0.0007** -0.0003	0.0013*** -0.0005	0.0025*** -0.0009
Observations	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945
Number of groups	754	754	754	754	754	754	754	754	754

Note: Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Results of Panel Quantile Regression with Interaction-Powell 2022

Variables	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
ND	0.0035*** -0.0001	0.0084*** -0.0001	0.0053*** -0.0002	0.0070*** -0.0003	-0.0084*** -0.0003	-0.0182*** -0.0011	-0.0489*** -0.0002	-0.0735*** -0.0003	-0.0767*** -0.0001
INED	0.0359*** -0.0007	0.0191*** -0.0009	0.0888*** -0.0009	0.0347*** -0.0036	0.1461*** -0.0176	0.1472*** -0.003	0.2018*** -0.002	0.3949*** -0.0014	0.5337*** -0.0004
CD	0.0128*** -0.0006	-0.0038*** -0.0008	-0.0237*** -0.0012	-0.0298*** -0.0012	-0.0346*** -0.0051	0.0476*** -0.0041	0.0459*** -0.0013	0.1444*** -0.0055	0.1960*** -0.0008
NBC	0.0065*** -0.0002	0.0084*** -0.0002	0.0099*** -0.0003	0.0097*** -0.0004	0.0085*** -0.0021	-0.0004 -0.0003	0.0184*** -0.0005	0.0090*** -0.0012	0.0049*** -0.0001
Bor_Div	-0.0096 -0.0068	0.0934*** -0.005	-0.0533*** -0.0148	-0.0372*** -0.0081	0.0740*** -0.0167	0.0910*** -0.0119	-0.1595*** -0.0167	-0.5538*** -0.0574	-0.2904*** -0.002
Grou_Aff	0.0210*** -0.0012	0.0327*** -0.0006	0.0234*** -0.0005	0.0131*** -0.0007	0.0380*** -0.0067	0.0585*** -0.0036	-0.0289*** -0.0015	0.0900*** -0.0143	-0.0122*** -0.0005
Woman_Group	-0.0077*** -0.0012	-0.0068*** -0.0018	-0.0459*** -0.0015	-0.1259*** -0.0029	-0.0938*** -0.0049	-0.1217*** -0.0042	-0.0148*** -0.0029	-0.0098 -0.0075	-0.5036*** -0.0005
ND_Group	-0.0020*** -0.0001	-0.0046*** -0.0001	-0.0021*** -0.0001	-0.0013*** -0.0002	-0.0049*** -0.0002	-0.0062*** -0.0006	0.0005*** -0.0001	-0.0020* -0.0012	-0.0083*** 0
CD_Group	0.0118*** -0.0003	0.0017*** -0.0004	0.0093*** -0.0013	0.0037*** -0.0004	0.0437*** -0.0036	-0.0399*** -0.0055	0.0352*** -0.001	0.0067*** -0.0007	0.0444*** -0.0002
NBC_Group	0.0011*** -0.0004	0.0014*** -0.0002	-0.0003 -0.0005	0.0062*** -0.0003	0.0105** -0.0053	0.0320*** -0.0009	0.0237*** -0.0006	0.0302*** -0.0004	0.0531*** -0.0001
INED_Group	-0.0117*** -0.0008	0.0225*** -0.0007	-0.0173*** -0.0012	-0.0467*** -0.0021	-0.0651*** -0.0079	-0.1156*** -0.0045	-0.0235*** -0.0029	-0.2627*** -0.012	-0.1432*** -0.0005
ND_Size	0.0002*** 0	0.0003*** 0	0.0006*** 0	0.0009*** 0	0.0037*** 0	0.0058*** -0.0002	0.0101*** 0	0.0161*** 0	0.0190*** 0
CD_Size	-0.0032***	0.0003***	-0.0002	0.0049***	-0.0015**	-0.0058***	-0.0152***	-0.0264***	-0.0371***

	-0.0001	-0.0001	-0.0002	-0.0002	-0.0006	-0.0002	-0.0003	-0.0007	-0.0001
ND_Post	0.0007***	-0.0019***	-0.0005***	-0.0036***	-0.001	-0.0045***	-0.0026***	-0.0083***	-0.0088***
	-0.0001	0	-0.0001	-0.0001	-0.001	-0.0003	-0.0001	-0.0001	0
INED_Post	0.0092***	0.0228***	-0.0161***	0.0480***	0	0.0759***	0.0315***	0.1112***	-0.0192***
	-0.0008	-0.0011	-0.0019	-0.0018	-0.0087	-0.0043	-0.0012	-0.0014	-0.0005
Bordiv_Post	0.1090***	0.0065	0.1119***	0.0507***	0.0442	-0.0932***	0.2154***	0.5327***	0.0738***
	-0.0068	-0.0071	-0.0201	-0.0084	-0.0407	-0.0163	-0.0186	-0.0775	-0.0025
LNSA	0.0010***	0.0041***	0.0064***	0.0006**	-0.0093***	-0.0168***	-0.0398***	-0.0655***	-0.0614***
	-0.0001	-0.0001	-0.0002	-0.0002	-0.0004	-0.0019	-0.0002	-0.001	-0.0001
Leverage	0.7429***	0.6063***	0.4616***	0.3531***	0.1723***	0.0159***	-0.2992***	-0.6885***	-1.4447***
	-0.0012	-0.0002	-0.0007	-0.0004	-0.0024	-0.0031	-0.0006	-0.0055	-0.0002
Age	0	-0.0006***	0.0004***	0.0011***	0.0012***	0.0007***	0.0013***	0.0013***	0.0038***
	0	0	0	0	-0.0001	-0.0001	0	0	0
Observations	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945
Number of groups	754	754	754	754	754	754	754	754	754

Note: Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Result of Generalized Panel Quantile Regression -Powell 2020

Variables	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
ND	0.0057***	0.0078***	0.0095***	0.0116***	0.0157***	0.0206***	0.0277***	0.0400***	0.0477***
	-0.0003	-0.0005	-0.001	-0.001	-0.0016	-0.0024	-0.0029	-0.004	-0.0037
INED	0.0543***	0.0718***	0.0940***	0.0996***	0.1260***	0.1736***	0.2237***	0.2948***	0.4308***
	-0.0036	-0.0068	-0.0064	-0.0103	-0.0133	-0.017	-0.0248	-0.0352	-0.0491
CD	-0.0026**	-0.0038	-0.0130***	-0.0168***	-0.0278***	-0.0299***	-0.0352***	-0.0462***	-0.0619***
	-0.0013	-0.0026	-0.0033	-0.0036	-0.0055	-0.0082	-0.01	-0.0129	-0.0191
NBC	0.0099***	0.0114***	0.0149***	0.0194***	0.0219***	0.0203***	0.0212***	0.0195***	0.0256***
	-0.0006	-0.0011	-0.0015	-0.002	-0.0027	-0.0035	-0.0045	-0.0071	-0.0088

Bor_Div	0.0368***	-0.0580***	-0.1105**	-0.1469***	-0.1618**	-0.0768	-0.0797	-0.2835	-0.5530***
	-0.0107	-0.0217	-0.0544	-0.0489	-0.0742	-0.0927	-0.1359	-0.1729	-0.1533
Grou_Aff	0.0007	0.0026	0.0028	-0.0024	-0.0004	0.0059	0.0225*	0.0365**	-0.0266
	-0.0015	-0.0025	-0.0038	-0.0056	-0.0061	-0.0107	-0.012	-0.0181	-0.0211
LNSA	0.0002	0.0043**	0.0086***	0.0120***	0.0170***	0.0258***	0.0350***	0.0538***	0.0867***
	-0.0008	-0.0017	-0.0022	-0.0026	-0.0034	-0.0041	-0.0059	-0.0068	-0.0098
Leverage	0.7465***	0.6088***	0.4714***	0.3456***	0.1645***	-0.0518***	-0.3516***	-0.7861***	-1.5345***
	-0.0031	-0.0043	-0.0064	-0.0093	-0.0133	-0.0197	-0.0315	-0.0428	-0.061
Constant	0.1195***	0.1706***	0.2243***	0.2908***	0.3628***	0.4341***	0.5576***	0.7395***	1.3080***
	-0.0094	-0.0208	-0.0282	-0.0347	-0.0453	-0.0594	-0.0848	-0.1093	-0.1358
Observations	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945

Note: Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8 Result of Generalized Panel Quantile Regression with Interaction -Powell 2020

Variables	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
ND	0.0063***	0.0119	0.0116	-0.0036	-0.0102	-0.0014	-0.0459***	-0.0669**	-0.0824***
	-0.0015	-0.0087	-0.0099	-0.0184	-0.0108	-0.0279	-0.0149	-0.0338	-0.0105
INED	0.0533***	0.0603***	0.0990***	0.0963***	0.1595***	0.2345***	0.2586***	0.3748***	0.6001***
	-0.0032	-0.0083	-0.008	-0.0151	-0.0145	-0.0204	-0.0271	-0.0512	-0.0582
CD	0.0045	0.009	0.0006	-0.04	-0.0251	0.001	0.0634	0.1261**	0.2008***
	-0.0052	-0.0138	-0.0192	-0.0263	-0.0236	-0.0334	-0.0426	-0.0574	-0.0499
NBC	0.0095***	0.0133***	0.0149***	0.0157***	0.0143***	0.0089**	0.0055	0.0084	-0.0093
	-0.0009	-0.0015	-0.0022	-0.003	-0.004	-0.004	-0.0056	-0.0087	-0.0091
Bor_Div	-0.0178	-0.0825**	-0.1357*	-0.1674**	-0.1947	-0.2178	-0.2593***	-0.5201***	-0.8215***
	-0.0148	-0.0377	-0.0707	-0.0799	-0.1253	-0.1671	-0.0996	-0.1887	-0.2709
Grou_Aff	0.0027	0.0303*	0.0301	0.0015	0.0117	0.0457	-0.0384	0.0395	-0.0367
	-0.004	-0.016	-0.022	-0.038	-0.0235	-0.0607	-0.0325	-0.0858	-0.0489
LNSA	0.0009	0.0063	0.009	-0.0071	-0.0129	0.0014	-0.0404***	-0.0628*	-0.0665***

	-0.0017	-0.009	-0.0107	-0.0183	-0.0116	-0.0278	-0.0146	-0.0361	-0.0104
Leverage	0.7444***	0.6064***	0.4719***	0.3507***	0.1762***	-0.0324**	-0.3058***	-0.7129***	-1.4628***
	-0.0016	-0.0062	-0.0069	-0.0101	-0.0097	-0.0133	-0.0156	-0.0219	-0.0201
Woman_Group	0.001	-0.0261**	-0.0487**	-0.0658**	-0.0807*	-0.0043	0.0069	-0.0837	-0.3635***
	-0.0084	-0.0131	-0.0217	-0.0331	-0.0466	-0.0884	-0.0686	-0.0701	-0.0883
ND_Group	-0.0010**	-0.0037**	-0.0029	-0.0019	-0.0025	-0.0045	0.0028	0.0014	-0.0035
	-0.0004	-0.0015	-0.0019	-0.0034	-0.0023	-0.0059	-0.0042	-0.0079	-0.0049
CD_Group	0.0103***	0.0021	-0.0058	0.0123	0.0246***	0.0136	0.0446***	0.0177	0.0249
	-0.0021	-0.0048	-0.006	-0.0079	-0.0082	-0.0134	-0.0148	-0.0263	-0.0283
NBC_Group	0.0008	-0.0026	0.0002	0.0064	0.0138***	0.0176***	0.0298***	0.0243**	0.0614***
	-0.001	-0.0019	-0.0027	-0.0042	-0.0051	-0.0055	-0.0073	-0.0113	-0.0124
INED_Group	0.0058	0.0138	-0.0079	-0.0109	-0.0568***	-0.0944***	-0.0674**	-0.1741***	-0.1719***
	-0.0039	-0.0096	-0.0092	-0.0195	-0.0172	-0.0264	-0.033	-0.0551	-0.0625
ND_Size	0	-0.0002	0	0.0022	0.0038***	0.0034	0.0101***	0.0156***	0.0192***
	-0.0002	-0.001	-0.0011	-0.0021	-0.0013	-0.0032	-0.0017	-0.004	-0.0011
CD_Size	-0.0018***	-0.002	-0.0014	0.002	-0.0023	-0.0051	-0.0176***	-0.0255***	-0.0352***
	-0.0005	-0.0017	-0.0022	-0.0032	-0.0034	-0.0042	-0.0056	-0.0078	-0.0058
ND_Post	0.0007***	-0.0006	-0.0006	-0.0013*	-0.0007	-0.0003	-0.0041***	-0.0094***	-0.0050**
	-0.0002	-0.0004	-0.0005	-0.0007	-0.0009	-0.0013	-0.0016	-0.0022	-0.0025
INED_Post	-0.0104***	-0.0012	-0.0028	0.0250*	0.0085	0.0176	0.0513*	0.1344***	-0.1417***
	-0.0037	-0.0076	-0.01	-0.0135	-0.0145	-0.02	-0.0266	-0.045	-0.0441
Woman_Post	0.0224***	0.0504***	0.0586**	0.0572*	0.0779	0.0981	0.1132*	0.2103**	0.3020**
	-0.0086	-0.0159	-0.0237	-0.0314	-0.0492	-0.0743	-0.0627	-0.0967	-0.1363
Constant	0.1158***	0.1391*	0.2058**	0.4272***	0.5593***	0.5691**	1.0991***	1.4794***	2.2733***
	-0.0146	-0.0764	-0.0923	-0.1599	-0.0944	-0.2399	-0.1228	-0.3033	-0.1016
Observations	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945	11,945

Note: Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5. Discussion and Implications

The panel quantile regression results reveal nuanced governance–performance dynamics in emerging markets, with baseline effects (Tables 5–7) showing board size (ND), independence (INED), and committees (NBC) generally positive but strengthening toward higher performance quantiles, while CEO duality (CD) is mostly detrimental and board diversity (Bor_Div) exhibits extreme non-linearity—positive mid-distribution but negative at tails. Interaction specifications (Tables 5, 8) further demonstrate that group affiliation, firm size, and post-2013 regulation moderate these links, with group interactions often weakening governance efficacy (e.g., INED_Group, Woman Group negative) and size or post terms amplifying benefits unevenly. These patterns substantially support expected relations for board size, independence, duality, and committees, though their magnitude varies markedly by performance level, ownership context, and institutions (Pucheta-Martínez & Gallego-Álvarez, 2020; Kalsie & Shrivastav, 2016; Merendino & Melville, 2019). Agency theory posits that larger boards and independent directors enhance monitoring to curb opportunism, aligning interests (Ross, 1973; Jensen & Meckling, 1976; Panda & Leepsa, 2017); the quantile-specific strengthening at upper tails suggests governance amplifies capabilities in stronger firms rather than uniformly rescuing laggards.

CEO duality consistently impairs performance, especially in the mid- to upper quantiles, validating agency concerns that concentrated power erodes oversight (Jensen & Meckling, 1976). This effect intensifies among high performers, where strategic stakes rise, echoing emerging-market risks of promoter dominance and weak external checks (Sarkar et al., 2008). Board committees yield stable positive oversight benefits, particularly valuable for mid/low performers as corrective mechanisms (Lam & Lee, 2012; Fariha et al., 2022). Business group affiliation displays a U-shaped baseline pattern—harming weak firms via tunnelling but aiding stronger ones through internal markets—while interactions confirm it moderates governance downward (e.g., negative _Group terms), aligning with principal–principal conflicts in concentrated ownership (Young et al., 2008; Grou_Aff stronger in large firms but with agency trade-offs).

Board gender diversity yields minimal or negative average effects, with heterogeneity (positive mid, negative tails) and limited post-2013 gains via interactions (e.g., Bordiv_Post mixed positive), consistent with compliance-driven rather than value-adding mandates (Zhang, 2020; Alix Valenti et al., 2011; Marinova et al., 2016). Institutional theory explains this as symbolic adoption preceding substantive change under regulations like the Companies Act 2013. Overall, the quantile evidence underscores context-dependency—governance efficacy hinges on performance strata, ownership (groups vs. standalone), size, and regulatory timing—challenging mean-based models and enriching agency- or institutional-based perspectives in emerging contexts.

6. Implications for policy makers and managers

The quantile regression findings offer targeted guidance for emerging market governance. First, the consistent negative performance impact of CEO duality—particularly

in mid-to-upper quantiles—underscores the need for leadership separation, especially in promoter-dominated Indian firms where concentrated authority erodes oversight. Policymakers should incentivize non-duality through listing requirements or tax disincentives, while managers must prioritize balanced leadership to sustain high performance.

Second, the robust positive effects of board independence (INED) and committees (NBC)—strengthening at higher quantiles—signal that quality monitoring trumps mere compliance. Firms should focus on independent directors' expertise, tenure stability, and active engagement rather than quota fulfillment, as superficial appointments dilute value. Regulators could mandate competence certification for INEDs alongside numerical targets.

Third, board gender diversity's weak or negative baseline effects but uneven post-2013 gains via interactions highlight compliance-driven mandates' limitations. Policymakers should pair Companies Act requirements with talent pipelines, mentorship programs, and protections for voting rights to convert symbolic diversity into substantive contributions. Managers in group-affiliated firms face particular challenges, as negative interactions within Woman Group suggest that promoter resistance undermines female directors' influence.

Fourth, the U-shaped group affiliation pattern (harms weak firms, aids strong ones) and pervasive negative _Group interactions confirm that ownership structure moderates governance efficacy. Business groups' internal markets substitute formal governance for affiliates, but tunnelling risks demand tailored oversight. Regulators should enforce consolidated group-level disclosures and minority protections, while group managers adapt board structures to affiliate performance strata rather than uniform application.

Corporate governance emerges not as a regulatory checklist but as a strategic resource, with effectiveness hinging on firm performance position, ownership context, and institutional timing. Emerging-market policymakers must tailor reforms—recognizing quantile- and group-specific dynamics—while managers treat governance as a dynamic capability requiring continuous adaptation to internal capabilities and external institutions.

7. References:

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