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NON-LINEAR AND DUMMY EFFECTS OF BOARD SIZE ON SHARE PRICE AMONG LISTED FIRMS IN GHANA USING SEEMINGLY UNRELATED REGRESSION

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ABSTRACT:

Purpose-This study seeks to determine the specific number on a board that gives the highest share value for listed companies in Ghana.

Design/methodology/approach- Non-linear and dummies for board size of 7, 8, 9, and 10 were used in seemingly unrelated regression to determine the optimum board size. Listed firms in Ghana were used in a panel data with 144 firm-year observations.

Findings- The study reveals that larger board size is positively and significantly associated with firm valuation. Further examinations to check for the presence of non-linear associations reveal statistically significant inverted U-shaped association for board size. The study shows that an "efficient limit" to board size should be nine (9) members. Financial firms are associated with higher level of investor confidence and higher market valuation than non-financial firms and larger board size offers less benefit to investors of financial firms relative to those in the non-financial sector. Practical implications – Investors and firms should appreciate that different board size affect share price differently and the

optimum number that should constitute a board in Ghana is nine (9).

Originality/value- firm value has been determined using five different measures to determine optimal board size (9).

Keywords: *optimum board size, share price, seemingly unrelated regression*

1 Introduction

Many studies report either a positive or a negative association between large board size and firm performance (Adams & Mehran, 2012; Kyereboah-Coleman & Biekpe, 2006a; Pucheta-Martínez & Gallego-Álvarez, 2020). Conversely, other studies find positive or negative relationships for small boards (e.g., Beasley, 1996; Karamanou & Vafeas, 2005; Musallam, 2020; Kyere & Ausloos, 2021; Puni & Anlesinya, 2020; Yermack, 1996). In Ghana, however, few investigations have pinpointed the board size that maximises shareholder value. This study therefore employs linear, non-linear, and dummy-variable specifications estimated with seemingly unrelated regression (SUR) to resolve the inconclusive evidence on the "optimal" board size and to test whether the appropriate board configuration differs between financial and non-financial firms.

Investors are typically willing to pay a premium for equity stakes in companies that exhibit robust governance structures (Renders & Gaeremynck, 2012; Andoh, Abugri, & Anarfo, 2023). Extensive empirical evidence from both developed and emerging markets confirms that well-designed boards command positive market valuations (Gompers, Ishii, & Metrick, 2003; Cremers & Sepe, 2016; Orazalin, 2020).

In Ghana, weak governance has repeatedly eroded market confidence. For example, in 2011 share prices at Ghana Commercial Bank and Standard Chartered Bank fell sharply after employees protested the perceived insensitivity of board members. Similarly, minority shareholders of CAL Bank voiced concerns that directors were not acting in shareholders' best interests (News Ghana, 2012). Such episodes highlight the Ghanaian market's sensitivity to board structure.

The literature on board size and firm value remains inconclusive. While small boards can mitigate free-rider, cohesion, and communication problems (Hermalin

& Weisbach, 1991; Jensen, 1993; Merendino & Melville, 2019), subsequent studies have not produced uniform results (Adams & Mehran, 2012). In Ghana and Nigeria, Kyereboah-Coleman and Biekpe (2006a) and Sanda, Mukaila, and Garba (2005) report superior performance for firms with larger boards. Several studies also identify a non-linear (inverted-U) relationship (De Andrés & Vallelado, 2008; Sharma, Mehta, & Goel, 2023).

Prior Ghanaian research suffers from design limitations. Existing empirical studies in Ghana on how board characteristics affect firm value have focused mostly on examining only linear relationship and not non-lineal relationship and either non-financial firms (e.g., Alex, 2021; Kyereboah-Coleman & Biekpe, 2006a) or financial firms (e.g., Amoah, 2019; Aboagye & Otieku, 2010; Tornyeva & Wereko, 2012), thereby restricting generalisability. Because regulated industries may need distinct board attributes (Adams & Mehran, 2003; Aebi et al., 2012; Li, 2020), a single design that compares both sectors can provide richer insights. Furthermore, Ghana's board practices rooted in British and American corporate-law traditions (Agyemang & Castellini, 2013; Mbewe, 2020) warrant context-specific evaluation.

The study is among the first in Ghana to test both linear and non-linear board-value relationships and to identify a specific board size that maximises share price. By analysing financial and non-financial firms simultaneously, the study helps regulators decide whether differentiated governance guidelines are needed on the Ghana Stock Exchange (GSE). Board size is matched with market-value metrics which are year-end share price, three-and six-month post-year-end share price, market-to-book ratio, and market capitalisation. Control variables include leverage, firm size, return on equity, and firm age. SUR estimation captures linear, quadratic, and interaction effects. Section 2 reviews the literature and develops the hypotheses. Section 3 details the methodology. Section 4 presents and discusses the empirical results. Section 5 concludes with policy recommendations and avenues for future research.

2. Literature Review

This section reviews related institutional, theoretical and empirical literature on board mechanisms, empirical evidence to formulate the study hypotheses and concludes by summarizing the study into a sketched conceptual framework.

Ghana Institutional and Economic Setting

Institutional Setting

Ghana is considered a transitional Sub-Saharan economy (Acquaah, 2013; Ragab, 2022). Its corporate governance structures are arguably less developed than those in advanced economies such as the Anglo-American countries, France, Germany, or Japan. Emerging markets, in general, differ substantially from developed economies in terms of institutional, regulatory, and legal frameworks (Prowse, 1999; Ragab, 2022).

In their historical analysis of corporate governance in Bangladesh, Al Farooque, Zijl, Dunstan, and Karim (2007), along with Ciampi (2015), suggest that a jurisdiction's governance mechanisms are shaped more by political, cultural, and historical factors than by economic logic alone. Ghana's governance schemes, similar to those of Bangladesh, are largely based on British principles—unsurprising given its legacy of over a century of British colonial rule (see Assenso-Okofo, Ali, & Ahmed, 2011). One notable influence of colonization is how the English Companies Act of 1948 shaped Ghana's Companies Code, now updated to the Companies Act, 2019—regarded as the foundation of corporate governance in Ghana (Adegbite, 2012; Tawiah, Oyewo, Doorgakunt, & Zakari, 2022).

With the entry of major corporate players such as Tullow Oil, AngloGold Ashanti, and Ecobank Transnational Inc. into Ghana's capital market, local investor interest has significantly increased. Participants in the Ghana Stock Exchange are expected to factor differences in corporate governance—particularly board strength—into share price valuation. One key area of interest is the structure of corporate boards.

Board Size in Ghana

Substantial theoretical and empirical support exists in favor of smaller board sizes (see Yermack, 1996; Singh, Tabassum, Darwish, & Batsakis, 2018) due to the potential drawbacks of larger boards (Jensen, 1993; Pucheta-Martínez & Gallego-Álvarez, 2020). In Ghana, the Companies Act, 2019 (Section 171) and the SEC Regulations, 2003 (Section 3) stipulate a minimum of two and three directors respectively, but they do not impose a maximum limit. There is documented variation in board size across Ghanaian firms. For instance, Abor (2007) reports a mean board size of 8.81 with a standard deviation of 2.11. Darko, Aribi, and Uzonwanne (2016) found minimum and maximum board sizes of 6 and 14, respectively.

Previous Empirical Findings and Hypothesis Development

Board Size and Firm Value

Various arguments have been made against large boards, with studies indicating that smaller boards perform better (Yermack, 1996; Baysinger & Butler, 2019). Larger boards are often associated with coordination and cohesion challenges, along with slower decision-making (Jensen, 1993; Donaldson & Davis, 2019). However, this perspective is not universally accepted. Other scholars (e.g., Beasley, 1996; Karamanou & Vafeas, 2005; Merendino & Melville, 2019) contend based on resource dependency theory that larger boards provide diverse expertise, leading to improved monitoring and strategic advice.

In Ghana, most studies support the performance benefits of larger boards (Kyereboah-Coleman & Biekpe, 2006a, 2006b; Isshaq, Bokpin, & Onumah, 2009). Only when SMEs are examined (see Kyereboah-Coleman & Amidu, 2008), or when less common performance indicators like sales growth (Kyereboah-Coleman & Biekpe, 2006a) or changes in interest income (Kyereboah-Coleman & Biekpe, 2006b) are used, does a negative association between board size and performance emerge. In line with this, the following hypothesis is proposed:

H1: Board size is positively associated with firm value.

Scholars have also explored the idea of an upper limit for board size beyond which additional members may have no benefit or even harm performance (Lipton & Lorsch, 1992; Sanda, Mikailu, & Garba, 2005; Coles, Daniel, & Naveen, 2008). Up to a point, additional members may improve performance, but past that threshold, the costs outweigh the benefits. Thus, it is hypothesized that:

H2: Board size has a negatively non-linear association with firm value.

Following this, the study also tests whether a specific "optimum" board size exists that maximizes share price using dummy variables:

H3: Optimum board size can be determined using dummies.

Conditioning the Board Size–Firm Value Association on Financial Firms

According to optimal contracting theory, different industries may require different governance configurations (Belkhir, 2006). Financial institutions, though facing governance challenges similar to other sectors, are uniquely regulated and operate under greater complexity and information asymmetry (Macey & O'Hara, 2003; Adams & Mehran, 2003; John, De Masi, & Paci, 2016; Aguilera & Crespi-Cladera, 2016). De Andrés and Vallelado (2008) point out that financial firms are more regulated, face intense competition, and are exposed to greater market risks. In such settings, regulators are major stakeholders, but their interests may conflict with those of other stakeholders (Stubbs & Higgins, 2018). While regulation ensures financial stability, it can also introduce conflicting demands, intensifying agency problems.

De Andrés et al. (2008) suggest that larger boards with more insider representation may be optimal for financial firms. Under resource dependency theory, such boards offer better supervision, more advisory capacity, and wider networks. Adams and Mehran (2002) found that banking firms with larger boards perform better. Similarly, Agrawal & Knoeber (1996) and Bennouri et al. (2018) suggest that firms operating in complex information environments may benefit from larger boards.

Based on this, the following hypotheses are proposed:

H4: Financial firms are likely to have higher firm value than non-financial firms.

H5: The relationship between board size and firm value is moderated by whether a firm operates in the financial sector.

Conceptual Framework and Guiding Theories

This section presents the conceptual framework underpinning the study. It integrates how board size and firm type interact through theoretical lenses such as agency theory, resource dependency theory and signalling to influence firm market valuation. Figure 1 below illustrates the proposed relationships in diagrammatic form, which are explained subsequently:

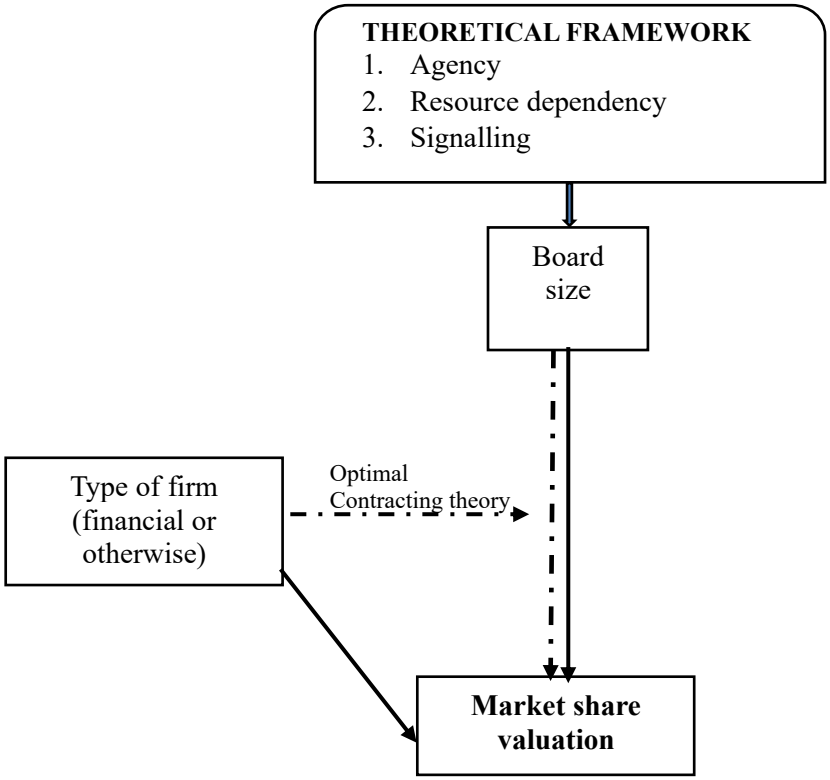

Figure 1: Conceptual Framework
Source: Aauthor's' own work

The number of directors on a corporate board matter for effective governance. This study examines board size through the lenses of agency theory, signalling theory, and resource-dependence theory. Agency theorists (e.g., Jensen, 1993; Yermack, 1996; Shogren, Wehmeyer, & Palmer, 2017) argue that lean boards are more agile and monitor management more effectively. In contrast, resource-dependence scholars

(Haniffa & Hudaib, 2006; Hillman, Withers, & Collins, 2009; Kiel & Nicholson, 2003; Ararat, Aksu, & Tansel Cetin, 2015) contend that larger boards provide wider expertise and broader networks. Signalling theory (Spence, 1973; Certo, 2003; Merendino et al., 2019) adds that board size itself can transmit information about firm quality to outside investors.

External regulation may further shape investors' perceptions of board effectiveness. Proponents of optimal-contracting theory (Markarian & Parbonetti, 2007; Tran, 2020) caution that "one-size-fits-all" governance prescriptions rarely work; different industries may require different board structures. Accordingly, the framework (illustrated in Figure 1) allows board size to interact with firm type financial versus non-financial under the premise that financial firms face stricter oversight and information asymmetry.

3 Methodology

Research Design

This is a quantitative, panel-data study covering firms listed on the Ghana Stock Exchange (GSE) from 2014 to 2023. Banks and insurance companies are grouped as financial firms because they face heavier regulation and different risk characteristics (Adams & Mehran, 2003; Kimani, 2023). Using panel data mitigates the weaknesses of pure cross-sectional or time-series designs and exploits the advantages of both (Gujarati, 2003; Xu, 2023). The study estimates linear, quadratic, and interaction effects to identify whether an "optimal" board size exists and whether the board-value relationship differs between financial and non-financial firms.

Sample and Data

Thirty-seven firms were listed as of year-end 2023, but twenty-nine had suitable data available for the period; these constitute the final sample. Annual-report information (governance variables, financials, share counts) was hand-collected, while daily share-price data were sourced from Databank Ghana. Because share prices three and six months after fiscal year-end may better reflect the market's assimilation of annual-report disclosures, incorporating lags in firm-value measures.

Variable Measurement

Dependent variables (firm value)

1. Natural log of share price at fiscal year-end.
2. Natural log of share price three months post year-end.
3. Natural log of share price six months post year-end.
4. Natural log of market-to-book value of equity.
5. Natural log of market capitalisation.

Using multiple market-based metrics follows Barth, Landsman, Young, & Zhuang (2014) and Gupta, Sami, & Zhou (2018), and reduces sensitivity to any single valuation proxy.

Explanatory variables

- **BOARDSZ**: Total number of directors (Kyereboah-Coleman & Amidu, 2008; Fiador, 2013).
- **BOARDCOM**: Proportion of non-executive directors (Kyereboah-Coleman & Biekpe, 2006a).
- **CEODUAL**: 1 = CEO is also board chair; 0 otherwise (Fiador, 2013).
- **BOARDOWN**: Directors' shareholding as a percentage of outstanding shares (Shleifer & Vishny, 1997).
- **FINSECTOR**: 1 = bank or insurance firm; 0 otherwise.

Control variables

Top shareholder stake, government stake, listing age (years), firm size (log total assets), leverage, and return on equity—selected on the basis of Greif (2012), Liu & Lu (2007), and Brown & Caylor (2006).

Model Specification

Panel data regression has been used for the purpose of the analysis. This approach has been adopted as data have been collected to cover multiple time periods across multiple firms. Thus, there is a combination of cross-sectional data and time series data which allows behavioural differences across firms and over different time periods to be modelled. Multiple regression models are employed to determine the association between board characteristics and firm valuation.

The basic model is specified as: $Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$

where;

Y_{it} = share/market valuation of the *i*th firm at time period *t*

α = Intercept

X_{it} = board characteristics and firm-specific characteristics of *i*th firm at time period *t*

β = coefficient of the independent variables

ε_{it} = error/noise/disturbance term

Three different equations – named as Equation 1, Equation 2 and Equation 3 – are built out of the above model as follows:

Equation 1

$$\boldsymbol{FV_{it}} = a_0 + a_1\boldsymbol{BOARDCOM_{it}} + a_2\boldsymbol{CEODUAL_{it}} + a_3\boldsymbol{BOARDSZ_{it}} + a_4\boldsymbol{BOARDOWN_{it}} + \boldsymbol{a_5FINSECTOR_{it}} + a_6TOPSHARES_{it} + a_7GOVSHARES_{it} + a_8LISTINGAGE_{it} + a_9FSIZE_{it} + a_{10}LEV_{it} + a_{11}ROE_{it} + \varepsilon_{it}$$

Where;

FV = Firm value measured in five different ways: natural log of share price at the year-end, natural log of share price 3 months after year-end, natural log of share price 6 months after year-end, natural log of market-to-book value of equity, and natural log of

market capitalization

BOARDCOM = proportion of non-executive members on the board

CEODUAL = 1 if positions of CEO and board chair are held by one person, else 0

BOARDSZ = total number of board members at year-end

BOARDOWN = proportion of ordinary shares held by board members at year-end

FINSECTOR = 1 if a firm is either a bank or insurance firm, else 0

TOPSHARES = proportion of ordinary shares held by the largest shareholder at year-end

GOVSHARES = proportion of ordinary shares held by government and its institutions at year-end

LISTINGAGE = the number of years a firm has been listed on the GSE at year-end

FSIZE = natural log of book value of total assets at year-end

LEV = total liabilities divided by total assets at year-end

ROE = profit after tax and any preference dividends divided by book value of equity at year-end

Equation 2

Now, the equation 1 is modified with the inclusion of squared term for board size. After incorporating the squared term for board size, equation 2 is generated as follows:

$$\boldsymbol{FV}_{it} = a_0 + a_1 BOARDCOM_{it} + a_2 CEODUAL_{it} + a_3 BOARDSZ_{it} + a_4 BOARDOWN_{it} + a_5 \boldsymbol{BOARDCOM^2_{it}} + a_6 \boldsymbol{BOARDSZ^2}_{it} + a_7 \boldsymbol{BOARDOWN^2_{it}} + a_8 \boldsymbol{FINSECTOR_{it}} + a_9 TOPSHARES_{it} + a_{10} GOVSHARES_{it} + a_{11} LISTINGAGE_{it} + a_{12} FSIZE_{it} + a_{13} LEV_{it} + a_{14} ROE_{it} + \varepsilon_{it}$$

Equation 3

Equation 3 treats the first equation (equation 1) as the base and then modifies it by incorporating interaction of financial sector dummy with board size in order to separate the effects of the board measures between financial and non-financial firms. This then yields equation 3 which is given as below:

$$\boldsymbol{FV}_{it} = a_0 + a_1 BOARDCOM_{it} + a_2 CEODUAL_{it} + a_3 BOARDSZ_{it} + a_4 BOARDOWN_{it} + a_5 FINSECTOR_{it} + a_6 \boldsymbol{FINSECTOR*BOARDCOM}_{it} + a_7 \boldsymbol{FINSECTOR*BOARDSZ}_{it} + a_8 \boldsymbol{FINSECTOR*BOARDOWN}_{it} + a_9 TOPSHARES_{it} + a_{10} GOVSHARES_{it} + a_{11} LISTINGAGE_{it} + a_{12} FSIZE_{it} + a_{13} LEV_{it} + a_{14} ROE_{it} + \varepsilon_{it}$$

Data Analysis and Estimation Techniques

The primary estimation procedure is **seemingly unrelated regression (SUR)**. Five alternative measures of firm value serve as dependent variables, each regressed on the same set of right-hand-side variables specified in Equations 1 – 3. SUR is well-suited because the disturbance terms across these equations are likely contemporaneously correlated; ignoring that correlation would render ordinary least squares (OLS) inefficient. Following Zellner (1962) and the recent application by Zarei, Ariff, and Bhatti (2019), SUR yields consistent and more efficient coefficient estimates.

Hansen (2003) and Zhang, Jiang, Gao, Jiang, and Jiang (2023) note that, under intra-cluster correlation, many researchers still rely on OLS with White's heteroskedasticity-consistent errors, even though feasible generalised least squares (FGLS) or SUR provide asymptotically superior estimates. Consistent with this advice, Mac an Bhaird and Lucey (2010) and Reis and Guzman (2023) report smaller standard errors and stronger test statistics when replacing OLS with SUR to address autocorrelation. Within the Ghanaian context, Bokpin and Isshaq (2009) use SUR to mitigate endogeneity between foreign share ownership and corporate disclosure, while Bokpin (2013a) employs it to control for multi-collinearity among governance

variables. Accordingly, SUR permits simultaneous estimation of the five-equation system, enhancing efficiency in line with Choi and Prasad (1995), Baltagi (2005), and Isshaq et al. (2009).

4. Results of Hypotheses Tests

The results of the three primary equations: Equation 1, Equation 2 and Equation 3 based on seemingly unrelated regression (SUR) approach are presented in Table 1, Table 2, Table 3 and Table 4 (Appendix 1). The results reported include the estimated coefficients, t-statistic of the coefficients, R-squared and the overall (joint) significance of the models. Each table consists of five columns, Columns 1 to 5, which report regression results respectively for five different measures of firm value.

Table 1 evaluates the linear specification (Equation 1) and primarily tests H1 and H4.

- Table 2 adds quadratic terms (Equation 2) and tests H2.
- Table 3 introduces interaction terms between board size and the financial-sector dummy (Equation 3) and tests H5.
- Table 4 replaces the continuous board-size variable with four dummy cuts-offs ($\leq 7, \leq 8, \leq 9, \leq 10$) to identify an optimal board size to test H3.

Hypothesis 1 proposes that by holding all else constant, board size is positively associated with firm value. From Table 1 regarding board size, all the five regressions report positive and statistically significant coefficients. The results imply that after holding other variables constant, for every one increase (decrease) in the number of board members there is an associated rise (fall) in firm value. This positive association is in line with predictions made in this study under Hypothesis 1. The results support the notion that larger board size leads to enhanced financial performance. The finding implies that the GSE interprets the use of larger board size to be of higher benefits in terms of access to diverse range of expertise and human capital in line with resource dependency argument rather than larger size being more costly due to increased cohesion problems.

Hypothesis 2 states that by holding all else constant, board size has negatively non-linear association with firm value. From Table 2, board size and board size squared carry significantly positive coefficient and significantly negative coefficient respectively across nearly all of the five regressions. The results suggest that board size bears an inverted U-shaped relationship with firm's equity valuation implying that the market reacts positively when the size of the board is low but at a higher level of board size the market discounts the share value. Lipton and Lorsch (1992), Jensen (1993), Anand (2019) and Merendino & Melville (2019) advocate that as board size rises beyond a certain point, inefficiencies resulting from free-riding and difficulties in coordination outweigh advantages from having more directors to draw on, leading to lower firm performance. The results lend support to the study Hypothesis 2.

Specifically, testing for non-linearity in relationships is to introduce dummies to test

Hypothesis 3 by using empirically suggested thresholds of 7, 8, 9 or even 10 board size depending on the context (Lipton and Lorsch, 1992; Jensen, 1993; (Adegbite, et al., 2019 and Kamarudin et al., 2024). Modification is made to the primary Equation 1 with the addition of four dummy variables (BOARD≤7, BOARD≤8, BOARD≤9 and BOARD≤10) to replace BOARDSZ. Value of 1 is given if the board size is up to 7 and zero assigned if otherwise. The same procedure is followed for board size up to 8, 9 or 10. The results are presented in Table 4. The results show that firms with up to either seven (7) or eight (8) board members achieve lower share values holding other factors constant as both BOARD≤7 and BOARD≤8 have negative coefficient estimates. The estimate is strongly significant when a firm has up to eight (8) directors. The coefficient estimate becomes significantly positive if a firm puts at most nine (9) members on its board but turns negative again or insignificantly positive if the upper ceiling is adjusted to ten (10) by referring to the coefficients on BOARD≤9 and BOARD≤10. The implication is that an average firm is likely to be at optimal point with a board size of nine (9).

Hypothesis 4 states that by holding all else constant, financial firms are likely to have higher value than non-financial firms. From Table 1, the coefficient of financial sector dummy has been significantly positive across the regressions except for the

log of market to book value ratio regression which reports a rather significantly negative figure. The figures imply that firms within financial sector relative to those in the non-financial sector have higher firm value. More specifically, ceteris paribus, financial firms are associated with higher equity value. This offers support to Hypothesis 4**.** Better valuation of financial firms relative to non-financial firms is likely to be due to market's perception of stronger oversight levelled over the affairs of banks and insurance firms. Coles at al. (2008) are of the view that banks are subject to many other regulations (for their role in a country's financial system) than the internal governance measures.

Hypothesis 5 proposes that by holding all else constant the relationship between board size and firm value is moderated by whether or not the firm is within the financial sector. The results for the interaction terms are reported in Table 3. Larger board size seems to offer less benefit to investors of financial firms as they attach negative value to their shares. FINSECTOR*BOARDSZ carries negative coefficient (instead of positive) in all the regression columns but not significant in three (1, 2 and 3) out of the five. This suggests that more board members are viewed to be cost-ineffective by the market if the firm is either a bank or an insurance business.

5 Discussion and Implications of the Results

Existing empirical studies in Ghana on how board characteristics affect firm value or performance have focused mostly on examining only linear relationship and for either non-banks or banks or insurance firms to test arguments made for the agency theory. In this study however, a few modifications are made as the study investigates not only linear but quadratic relationships as well as the use of dummies to determine optimum board size using both financial and non-financial firms even though the differential impacts of board structure are also examined for the two groups of firms. The study also looks at whether board size is moderated by type of firm. The test results are discussed in the contexts of the four theories used in the study namely agency, signalling, resource dependency, and optimal contracting theory and the institutional setting of Ghana.

The results of this study indicate that firms with larger board size have higher share

valuation. This finding is discussed in the contexts of agency theory, resources dependence theory and institutional setting of Ghana. Preponderance of evidence bordering on board–valuation link suggests that larger board size leads to governance difficulties and lower performance (Yermack, 1996) even though few have found that small size is not always recipe for better valuations. The implication of the results is that the market agrees that larger board size permits greater and stronger monitoring in line with agency theory and increased access to good resources of external networks and internal capacities consistent with resource dependence theory. In relation to this, the market accordingly responds positively by putting higher value on shares of firms with larger board size relative to those with smaller board size in line with Sanda et al. (2005) and Mishra, et al (2018). The results provide consistence to findings reported by Kyereboah-Coleman (2006a and 2006b), Isshaq et al. (2009) and Darko et al., (2016,) who show that there is a positive association between board size and performance from Ghana's context.

The findings, however, do not agree with those found by Kyereboah-Coleman and Amidu (2008) who employ SMEs in their study. Of course, the affairs of small firms are not likely to be wider in scope and so complex that the costs of putting members on board would be out-paid by the benefits of strong monitoring (Coles et al., 2008 and Pak, 2017) that might be attached to larger board size. Smaller firms also tend to have their ownership not so divergent from management to make use of bigger board size (Berle and Means, 1932).

Further analyses in this study reveal that board size has a non-linear relationship with firm value. Specifically, a negative association is reported for the quadratic term of board size indicating that the market only rewards a firm if it operates with a board size up to a certain threshold and discounts its value after increasing the number of directors beyond that point. The implication is that the market realizes that the costs of poor coordination, ineffective communication and unnecessary delay in decision making tend to outwit the benefits of divergent professional profiles and increased exposure to wider resources when boards get excessively big. This agrees with Sanda et al. (2005) who find similar evidence using Nigerian firms. The existence of the inverted U-shaped relationship finds tally with the predictions of Khanchel El Mehdi

(2007) and Li, & Chen, (2018) who after reporting a positive effect of board size on firm value argues that the positive coefficient might turn negative at very high level of board size because his Tunisian sample's board size of 9 is different from Yermack's (1996) American average size of 12. The upper limit associated with the benefits that larger boards create for their firms sees synchrony with the contemplations of agency theorists such as Jensen (1993) who suggests 8 to be an appropriate upper ceiling to board size.

Board size with cut-offs ranging from 7 to 10 board members shows that firms stand to benefit at board number of no less or more than 9. Thus, contrary to previous findings in Ghana such as those by Kyereboah-Coleman and Biekpe (2006a; 2006b) and Bokpin et al. (2013a) and Tunyi (2019) that board size "infinitively" leads to higher performance, this study finds that there is limit (9 members) to which a firm would obtain valuation benefits from larger boards. The results also indicate that even though large board size is likely to lead to alignment of interest or managerial disciplining, a very large number of board members is likely to cause coordination problems.

Literature exists to indicate that the governance requirements of more regulated firms like banks, insurance firms and utility firms are not necessarily identical with those of other firms (Claessens and Yurtoglu, 2012). More so, it is found that the strong regulatory oversights on these firms provide further governance control so that a sector which is deemed to hold the heart of a nation's financial system is kept under constant checks (Adams and Mehran, 2003 and Stulz, 2022). The study reports that financial firms are associated with higher level of investor confidence and higher market valuation. First, banks and insurance firms are subject to higher level of regulatory oversights. The finding is likely to agree with those of La Porta, Lopez-De-Silanes, Shleifer and Vishny (2002) and Leuz, Nanda and Wysocki (2003) who respectively report higher performance and lower earnings management for firms domiciled in strong investor protection environment. Second, as argued by Adams and Mehran (2003), financial institutions, probably, do see more of product market competition than other firms. Specifically, as reported by Apanga, Appiah and Arthur (2016; p.165), the number of branches of Ghanaian banks has risen from 450 to 892

branches between 2006 and 2013. Firms exposed to higher level of competition often perform better (Khemani and Leechor, 2001 and Rajapathirana, & Hui, (2018).

In testing the applicability of the optimal contracting theory and Ghana's institutional setting to the sampled firms, the study seeks to check whether the stock market expects different firms (financial and non-financial) to have different board attributes.

Contrary to expectation to some extent, the results obtained indicate that board size does not as much accrue valuation premium to financial firms as it does to non-financial firms. This perhaps may be driven by the relatively higher destructive impact of having outside directors if a financial firm. Outside directors performing worse in financial firms relative to other firms could be driven by their ineptness in understanding the nature of banking and insurance business operations and the sectorial regulations. As Armstrong et al. (2010) argue, complex businesses usually fair better by using more "knowledgeable" and information-advantaged inside members.

6 Conclusion

The findings of the study have specific implications and recommendations for listed firms (and even others) in Ghana, the investing public, regulators and policy makers.

Given that larger board size, leads to higher valuations, listed companies, generally, should fix more members into their boards but up to a maximum of 9 and regulators such as Ghana's SEC should encourage them to do so. Second, investors and other financiers of Ghanaian quoted firms are advised to consider differences in board structures that exist within their potential or existing firms. Third, Bank of Ghana and Insurance Commission of Ghana should require or encourage their subjects, especially quoted firms, to use small board members as financial firms tend to benefit more or loss less when they are structured as such. Fourth, the government of Ghana and policy makers might find it appropriate to do due assessment of the local needs to recommended relevant economy-wide policies as corporate governance requirements.

The following limitations, which have the potential to constrict the value of the study findings, are discussed and areas identified for further investigations. The study, by using dummy variable to separate financial from non-financial firms, assumes that all units within each of the two categories are similar in terms of governance needs. Researchers should consider applying numerous dummies to capture possibly the smallest grouping of firms in order to recommend more specific and appropriate board mechanisms. It is important to note that the positive relationship between valuation and board size would be more insightful if a research design is proposed to model out the whys for the said relationship in Ghana just as Faleye (2007) makes for why staggered boards destroy value in the US. This study uses only firms listed on the Ghana Stock Exchange. Future study could expand the sample to cover other markets in the sub-Saharan region as in Kyereboah-Coleman (2007) who studies the relationship between governance and performance of Ghanaian, Nigerian, Kenyan and South African firms.

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Ethics approval and consent to participate

This study was approved, and ethical clearance was obtained from the Presbyterian University, Ghana. Department of Business Administration and Agribusiness.

Ethics Statement

This study was conducted in accordance with ethical standards set by the Presbyterian University, Ghana.

Competing interests

The authors declare no competing interests.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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APPENDICES A1: Seemingly Unrelated Regression

Table 1: Results of Board Size and Firm Value using Seemingly Unrelated Regression

	1	2	3	4	5
	LSHAREPX	**LSHAREPX3**	**LSHAREPX6**	**LMTB**	**LMV**
BOARDCOM	-1.277**	-1.373**	-1.232**	-0.496	-1.709***
	(-2.27)	(-2.37)	(-2.08)	(-1.02)	(-2.69)
CEODUAL	-0.720***	-1.194***	-1.167***	-0.0246	-1.072***
	(-2.72)	(-4.38)	(-4.20)	(-0.11)	(-3.58)
BOARDSZ	0.194***	0.191***	0.204***	0.145***	0.274***
	(4.42)	(4.21)	(4.42)	(3.80)	(5.53)
BOARDOWN	-2.072***	-1.939***	-1.877***	0.606*	-0.195
	(-5.50)	(-5.00)	(-4.74)	(1.86)	(-0.46)
FINSECTOR	1.205***	1.226***	1.209***	-0.722***	1.659***
	(6.96)	(6.89)	(6.65)	(-4.82)	(8.49)
TOPSHARES	0.960***	1.094***	0.992***	1.407***	2.536***
	(2.64)	(2.92)	(2.60)	(4.48)	(6.18)
GOVSHARES	-1.935***	-1.835***	-1.778***	-0.851***	0.591
	(-5.37)	(-4.95)	(-4.70)	(-2.73)	(1.45)
LISTINGAGE	0.0789***	0.0823***	0.0823***	-0.0252**	0.0581***
	(6.24)	(6.33)	(6.20)	(-2.31)	(4.08)
FSIZE	-0.0741**	-0.0741*	-0.0763*	0.0131	0.114***
	(-1.97)	(-1.92)	(-1.93)	(0.40)	(2.69)
LEV	-0.101	-0.134	-0.117	1.690***	-0.366
	(-0.30)	(-0.39)	(-0.33)	(5.79)	(-0.96)
ROE	3.164***	3.694***	4.056***	1.635***	3.750***
	(5.64)	(6.41)	(6.89)	(3.37)	(5.93)
INTERCEPT	-1.129	-1.143	-1.319	-1.452*	12.16***
	(-1.32)	(-1.29)	(-1.46)	(-1.96)	(12.55)
R^2	64.2%	65.1%	64.3%	34.7%	66.2%
CHI^2	415.3	432.8	417.4	123.0	455.2
OVERALL SIGNIFICANCE	0.00000	0.00000	0.00000	0.00000	0.00000

NOTE: *t*-statistics are reported in parentheses; ***, **, and * denote significance at 1%, 5% and 10% levels, respectively

LSHAREPX = log of share price at year end, LSHAREPX3 = log of share price three months after year end, LSHAREPX6 = log of share price six months after year end, LMTB = log of market to book value of equity, LMV = log of market capitalisation, BOARDCOM = board composition, CEODUAL = CEO duality,

BOARDSZ = board size, BOARDOWN = board ownership, FINSECTOR = financial sector dummy, TOPSHARES = top shareholder, GOVSHARES = government ownership, FSIZE = firm size, LISTINGAGE = listing age, LEV = leverage, ROE = return on equity.

Table 2: Results of the Squared Terms of Board Size and Firm Value using Seemingly Unrelated Regression.

	1 LSHAREPX	**2 LSHAREPX3**	**3 LSHAREPX6**	**4 LMTB**	**5 LMV**
BOARDCOM	-5.663	-2.415	-1.133	-6.653	0.278
	(-1.26)	(-0.51)	(-0.24)	(-1.63)	(0.05)
CEODUAL	-0.715***	-1.190***	-1.163***	-0.0186	-1.105***
	(-2.85)	(-4.55)	(-4.35)	(-0.08)	(-3.92)
BOARDSZ	0.923***	0.942***	1.003***	-0.00925	0.628**
	(3.51)	(3.44)	(3.58)	(-0.04)	(2.13)
BOARDOWN	-5.564***	-5.050***	-4.967***	1.059	-5.901***
	(-5.24)	(-4.57)	(-4.40)	(1.10)	(-4.95)
$BOARDCOM^2$	3.251	0.749	-0.106	4.606	-1.469
	(0.97)	(0.22)	(-0.03)	(1.52)	(-0.39)
$BOARDSZ^2$	-0.0443***	-0.0458***	-0.0486***	0.00970	-0.0233
	(-2.87)	(-2.85)	(-2.96)	(0.69)	(-1.35)
$BOARDOWN^2$	5.455***	4.829***	4.789***	-0.565	8.358***
	(3.79)	(3.22)	(3.13)	(-0.43)	(5.18)
FINSECTOR	1.213***	1.212***	1.185***	-0.688***	1.705***
	(7.21)	(6.92)	(6.62)	(-4.50)	(9.03)
TOPSHARES	0.825**	1.049***	0.982**	1.312***	2.139***
	(2.16)	(2.64)	(2.42)	(3.79)	(5.00)
GOVSHARES	-1.842***	-1.716***	-1.646***	-0.941***	0.812**
	(-5.31)	(-4.75)	(-4.46)	(-2.99)	(2.09)
LISTINGAGE	0.0866***	0.0906***	0.0911***	-0.0284**	0.0684***
	(7.10)	(7.13)	(7.01)	(-2.57)	(4.99)
FSIZE	-0.0693*	-0.0656*	-0.0661*	0.00450	0.123***
	(-1.92)	(-1.74)	(-1.72)	(0.14)	(3.03)
LEV	-0.295	-0.282	-0.252	1.677***	-0.739**
	(-0.89)	(-0.82)	(-0.71)	(5.57)	(-1.98)
ROE	2.845***	3.402***	3.762***	1.678***	3.308***
	(5.31)	(6.10)	(6.60)	(3.45)	(5.50)
INTERCEPT	-2.480	-3.771	-4.545*	1.262	10.58***
	(-1.10)	(-1.60)	(-1.89)	(0.61)	(4.17)

R^2	67.9%	67.9%	67.1%	35.4%	70.1%
CHI^2	489.9	491.4	474.0	127.1	543.1
OVERALL P-VALUE	0.00000	0.00000	0.00000	0.00000	0.00000

NOTE: *t*-statistics are reported in parentheses; ***, **, and * denote significance at 1%, 5% and 10% levels, respectively

LSHAREPX = log of share price at year end, LSHAREPX3 = log of share price three months after year end, LSHAREPX6 = log of share price six months after year end, LMTB = log of market to book value of equity, LMV = log of market capitalisation, BOARDCOM = board composition, CEODUAL = CEO duality, BOARDSZ = board size, BOARDOWN = board ownership, $BOARDCOM^2$ = board composition squared, $BOARDSZ^2$ = board size squared $BOARDOWN^2$ = board ownership squared, FINSECTOR = financial sector dummy, TOPSHARES = top shareholder, GOVSHARES = government ownership, FSIZE = firm size, LISTINGAGE = listing age, LEV = leverage, ROE = return on equity.

Table 3: Results of Financial Sector Interaction of Board Size and Firm Value using Seemingly Unrelated Regression.

	1 LSHAREPX	**2 LSHAREPX3**	**3 LSHAREPX6**	**4 LMTB**	**5 LMV**
BOARDCOM	0.190	0.168	0.330	-0.562	-1.323*
	(0.30)	(0.26)	(0.50)	(-0.99)	(-1.81)
CEODUAL	-0.784***	-1.252***	-1.214***	0.0775	-1.019***
	(-3.10)	(-4.79)	(-4.54)	(0.34)	(-3.44)
BOARDSZ	0.160***	0.157***	0.176***	0.192***	0.305***
	(3.40)	(3.23)	(3.53)	(4.49)	(5.53)
BOARDOWN	-2.995***	-2.685***	-2.565***	1.113**	-0.861
	(-5.51)	(-4.78)	(-4.47)	(2.25)	(-1.35)
FINSECTOR	5.572***	5.691***	5.978***	1.184	5.564***
	(4.53)	(4.48)	(4.60)	(1.06)	(3.87)
FINSECTOR*BOARDCOM	-5.459***	-5.604***	-5.738***	-0.309	-2.563**
	(-5.02)	(-4.98)	(-4.99)	(-0.31)	(-2.01)

FINSECTOR*BOARDSZ	-0.0451	-0.0401	-0.0614	-0.175**	-0.232**
	(-0.53)	(-0.46)	(-0.69)	(-2.28)	(-2.35)
FINSECTOR*BOARDOWN	1.353**	1.083	0.979	-0.909	0.839
	(2.07)	(1.60)	(1.41)	(-1.52)	(1.09)
TOPSHARES	0.602*	0.755**	0.642*	1.356***	2.215***
	(1.72)	(2.09)	(1.74)	(4.26)	(5.41)
GOVSHARES	-2.212***	-2.123***	-2.057***	-0.733**	0.618
	(-6.36)	(-5.90)	(-5.60)	(-2.32)	(1.52)
LISTINGAGE	0.0626***	0.0664***	0.0667***	-0.0212*	0.0523***
	(5.08)	(5.22)	(5.12)	(-1.89)	(3.63)
FSIZE	-0.00307	0.00100	0.0000502	0.0123	0.133***
	(-0.08)	(0.02)	(0.00)	(0.35)	(2.92)
LEV	-0.218	-0.252	-0.240	1.658***	-0.459
	(-0.69)	(-0.77)	(-0.71)	(5.73)	(-1.23)
ROE	3.027***	3.579***	3.945***	1.673***	3.631***
	(5.73)	(6.55)	(7.07)	(3.48)	(5.87)
INTERCEPT	-2.634***	-2.811***	-3.071***	-1.864**	11.61***
	(-2.79)	(-2.88)	(-3.08)	(-2.17)	(10.51)
R^2	68.5%	69.0%	68.2%	36.2%	68.0%
CHI^2	503.6	515.5	497.1	131.8	493.6
OVERALL SIGNIFICANCE	0.00000	0.00000	0.00000	0.00000	0.00000

NOTE: *t*-statistics are reported in parentheses; ***, **, and * denote significance at 1%, 5% and 10% levels, respectively

LSHAREPX = log of share price at year end, LSHAREPX3 = log of share price three months after year end, LSHAREPX6 = log of share price six months after year end, LMTB = log of market to book value of equity, LMV = log of market capitalisation, BOARDCOM = board composition, CEODUAL = CEO duality, BOARDSZ = board size, BOARDOWN = board ownership, FINSECTOR = financial sector dummy, FINSECTOR*BOARDCOM = interaction of board

composition, FINSECTOR*BOARDSZ = interaction of board size, FINSECTOR* BOARDOWN = interaction of board ownership, TOPSHARES = top shareholder, GOVSHARES = government ownership, LISTINGAGE = listing age, FSIZE = firm size, LEV = leverage, ROE = return on equity.

Table 4: Results of Board Size Dummies for 7, 8, 9 and 10 Members and Firm Value Using Seemingly Unrelated Regression

	LSHAREPX	**LSHAREPX3**	**LSHAREPX6**	**LMTB**	**LMV**
BOARDCOM	-0.421	-0.529	-0.321	-0.372	-1.203*
	(-0.76)	(-0.93)	(-0.55)	(-0.73)	(-1.83)
CEODUAL	-0.752***	-1.191***	-1.183***	-0.0175	-1.108***
	(-3.02)	(-4.64)	(-4.51)	(-0.08)	(-3.72)
BOARD≤7	-0.401*	-0.278	-0.341	-0.163	-0.416*
	(-1.95)	(-1.31)	(-1.58)	(-0.86)	(-1.69)
BOARD≤8	-1.100***	-1.226***	-1.222***	-.586***	-0.961***
	(-4.82)	(-5.22)	(-5.10)	(-2.78)	(-3.53)
BOARD≤9	0.429*	0.494**	0.437*	0.423**	0.344
	(1.89)	(2.12)	(1.84)	(2.02)	(1.27)
BOARD≤10	0.254	0.201	0.277	-0.363*	-0.297
	(1.10)	(0.85)	(1.14)	(-1.70)	(-1.08)
BOARDOWN	-1.856***	-1.739***	-1.677***	0.688**	-0.0798
	(-5.23)	(-4.76)	(-4.50)	(2.10)	(-0.19)
FINSECTOR	1.245***	1.269***	1.253***	-.690***	1.710***
	(7.82)	(7.74)	(7.49)	(-4.69)	(8.99)
TOPSHARES	1.152***	1.255***	1.175***	1.375***	2.534***
	(3.37)	(3.56)	(3.27)	(4.35)	(6.21)
GOVSHARES	-2.228***	-2.153***	-2.101***	-0.918***	0.406
	(-6.57)	(-6.17)	(-5.90)	(-2.93)	(1.00)
LISTINGAGE	0.0966***	0.0984***	0.0998***	-0.0198*	0.0692***
	(7.86)	(7.77)	(7.72)	(-1.74)	(4.71)
FSIZE	-0.0844**	-0.0824**	-0.0873**	0.0210	0.112***

	(-2.38)	(-2.25)	(-2.34)	(0.64)	(2.65)
LEV	0.0107	-0.0208	0.00377	1.741***	-0.303
	(0.03)	(-0.06)	(0.01)	(6.03)	(-0.81)
ROE	3.148***	3.667***	4.028***	1.649***	3.753***
	(6.08)	(6.88)	(7.40)	(3.45)	(6.07)
INTERCEPT	-0.117	-0.131	-0.231	-0.186	14.61***
	(-0.15)	(-0.16)	(-0.28)	(-0.25)	(15.43)
R^2	69.5%	70.2%	69.6%	36.6%	67.9%
CHI^2	528.4	547.4	531.0	134.1	490.1
OVERALL SIGNIFICANCE	0.00000	0.00000	0.00000	0.00000	0.00000

NOTE: *t*-statistics are reported in parentheses; ***, **, and * denote significance at 1%, 5% and 10% levels, respectively

LSHAREPX = log of share price at year end, LSHAREPX3 = log of share price three months after year end, LSHAREPX6 = log of share price six months after year end, LMTB = log of market to book value of equity, LMV = log of market capitalisation, BOARDCOM = board composition, CEODUAL = CEO duality, BOARD≤7 = board size less or equal to 7, BOARD≤8 = board size less or equal to 8, BOARD≤9 = board size less or equal to 9, BOARD≤10 = board size less or equal to 10, BOARDOWN = board ownership, FINSECTOR = financial sector dummy, TOPSHARES = top shareholder, GOVSHARES = government ownership, LISTINGAGE = listing age, FSIZE = firm size, LEV = leverage, ROE = return on equity.