

FIRM COMPLEXITY AND CORPORATE BOARD SIZE: TESTING THE MODERATING EFFECT OF BOARD LEADERSHIP STRUCTURE

Hayam Wahba, Khaled Elsayed***

Abstract

Most prior studies have argued that the relationship between firm complexity and board size is a monotonic one: complex firm tend to have a large board size. Contrary to previous work, it is hypothesized in this study that this relationship is more likely to be moderated by board leadership structure. Using a sample of 92 Egyptian listed firms over the period from 2000 to 2004, we found that firm complexity exerted a positive and significant coefficient on board size when the firm adopts a leadership structure that separates the roles of CEO and chairman. However, the incremental effect of firm complexity on board size was negative and significant for firms that combine the roles of CEO and chairman (i.e., CEO duality). This study provides supportive evidence for the argument that firms are more likely to manipulate their boards' characteristics to attain organizational adaptation at the minimum total cost. Thus, studying of one main characteristic of the board of directors without taking into account the expected effect of other characteristics may lead to inconclusive evidence. This study offers insights to practising managers and policy makers. If practising managers want to maximize the value of their firms, they need to broaden their insight to understand that board characteristics are multidimensional, contingent and dynamic in their nature and differ not only across firms and industry, but also across countries. Moreover, before developing and launching new and additional corporate governance reforms, policy makers need to realize that differences in corporate governance systems cannot be fully explained outside their institutional environments.

Keywords: Corporate Governance; Board Leadership Structure; Board Size; CEO Duality; Firm Complexity

**Business Administration Department, Faculty of Commerce, Ain Shams University, Main Campus (Western Division),*

Abbassia 11566, Cairo, Egypt

hayam@asunet.shams.edu.eg

Tel: (+202) 4610 3460

Fax: (+202) 4610 3569

***Business Administration Department, Faculty of Commerce, Ain Shams University, Main Campus (Western Division),*

Abbassia 11566, Cairo, Egypt

k_elsayed@mailier.eun.eg

Tel: (+202) 4610 3460

Fax: (+202) 4610 3569

Introduction

Divergence in interests between shareholders and management has been heavily investigated in the managerial and financial literature. In a corporate governance context, scholars have proposed various internal and external mechanisms to align the shareholders' objectives with those of the managers. By representing the interests of the shareholders, the board of directors is argued to be an important instrument that helps in governing the CEO's decisions (Dalton, Daily, Johnson and Ellstrand, 1999; Monks and Minow 1995; Yermack 1996). This is more likely to happen as the board of directors is

responsible for certain activities, such as hiring, firing, compensating and monitoring the CEO. Additional responsibilities include providing the CEO with needed advice, as well as helping the organization to access more external resources (Johnson, Daily and Ellstrand, 1996).

As a result, to enhance the board of directors' effectiveness, much of existing research in corporate governance has examined its main "usual suspects" (Huse, 2005). Examples of these "usual suspects" include board size (e.g., Coles, Daniel and Naveen, 2008; Lehn, Sukesh and Zhao, 2003; Raheja, 2005; Yermack, 1996), leadership structure (e.g., Boyd, 1995; Brickley, Coles and Jarrell, 1997; Elsayed,

2007 & 2009a), composition (e.g., Dalton, Daily, Ellstrand and Johnson, 1998; Kiel and Nicholson, 2003), and accountability (e.g., Aguilera, 2005; Huse, 2005), and compensation (Holthausen and Larcker, 1993). In exploring the key aspects of the board of directors, scholars have applied various substitutions theoretical perspectives, such as agency theory, stewardship theory, stakeholder theory, managerial hegemony theory and resource dependency theory (Aguilera, 2005; Huse, 2005).

In this context, an emerging question that exhibits a growing debate is whether it is better to have a small board size or it is more commendable to have a large board size. Inconsistent arguments for or against small board size are presented in the literature. Activists of small board size (e.g., Jensen, 1993; Lipton and Lorsch 1992; Yermack, 1996) asserted that when a board becomes large, the ability of the board of directors to satisfy its main functions will be limited. Specifically, as a large group (board size) has less group cohesiveness, it is more likely to experience communication and coordination difficulties, which may increase free-rider problems, information sharing cost, and the possibility of the CEO controlling the board. Furthermore, new ideas and complete opinions are less likely to be expressed in large groups, and the monitoring process becomes more diffuse (Ahmed, Hossain and Adams, 2006; Dalton et al., 1998 & 1999).

Alternatively, advocates of large board size have argued that large board size is more likely to benefit firms in different ways. Large board size, for instance, will help the firm in bringing more highly qualified counsel, securing more rare resources, and enhancing its ability to establish external links with the environment (Dalton et al., 1998 & 1999). Furthermore, large board size may improve the efficiency of the decision-making process as a result of information sharing (Lehn et al., 2003). Put in another way, "the greater the need for effective external linkage, the larger the board should be" (Pfeffer and Salancik 1978: 172).

Thus, theoretical and empirical studies are conducted to investigate the relationship between board size and different managerial and financial issues. Example of these issues include corporate performance (Dalton et al. 1999; Elsayed, 2009b; Yermack, 1996), Ownership (Donnelly and Kelly, 2005), firm efficiency (Huther, 1997), strategic change (Goodstein, Gautam and Boeker, 1994), corporate failure (Chaganti, Mahajan and Sharma, 1985), CEO compensation (Holthausen and Larcker, 1993), and informativeness of annual accounting earnings (Ahmed et al., 2006), and firm complexity (Boone, Field, Karpoff and Raheja, 2007; Coles et al., 2008; Guest, 2008; Linck, Netter and Yang, 2008). The findings of prior studies provide inconclusive and mixed evidence regarding the main variables that determine board size (Boone et al., 2007).

In this context, prior studies have argued that board size is more likely to correlate positively with

firm complexity. Firm complexity refers to what extent the firm's operations and activities are diversified and interrelated. The premise of existing literature is that the more complex the firm is, the larger the board should be. This direct relationship between firm complexity and board size has been justified on the basis that complex firms often need more information, specialized knowledge and monitoring activities (Boone et al., 2007; Coles et al., 2008; Guest, 2008; Linck, et al., 2008).

Unfortunately, in exploring the relationship between firm complexity and board size, prior works fail to recognize three main issues. First, the effect of one corporate governance mechanism can depend upon the other available mechanisms (Adams, Hardwick and Zou, 2003). Second, "various elements [of governance] may consistently complement each other to form path-dependent national systems within broader institutional and cultural context" (Aguilera, Filatochev, Gospel and Jackson, 2008: 483). Third, the effectiveness of the board of directors as a corporate governance mechanism is more likely to be contingent on some contextual variables, as well as on the power of key internal and external actors (Aguilera, 2005; Aguilera and Jackson, 2003; Huse, 2005).

Thus, this study differs from prior works as it hypothesizes that the relationship between firm complexity and board size is more likely to be moderated by board leadership structure as a corporate governance mechanism. Board leadership structure refers to whether the firm has one person to execute the duties of the CEO and the chairman (i.e., CEO duality), or whether it assigns these positions to different people (i.e., CEO non-duality). Indeed, discussion of the moderating effect of board leadership structure on the relationship between firm complexity and board size is infrequent in the existing literature. This exclusion is unexpected, given the wide range of evidence for the significance of the moderating effect of board leadership structure in exploring the relationship between corporate performance and either board composition (Combs, Ketchen, Perryman and Donahue, 2007) or CEO compensation (Dorata and Petra, 2008), the relationship between outside directors and corporate performance (Desai, Kroll and Wright, 2003), the influence of the board chairman on CEO dismissal and replacement (Bresser, Thiele, Biedermann and Lüdeke, 2006), the association between CEO tenure and outsider awareness of CEO decision style (Judge and Dobbins, 1995), the link between a firm's capability and competitive activity (He and Mahoney, 2006), the association between informativeness of earnings and levels of insider ownership (Gul and Wah, 2002), and the relationship between board size and corporate performance (Elsayed, 2009b).

The potential moderating effect of board leadership structure on the relationship between firm complexity and board size is more likely to be valid for several reasons. First, the underlying

interdependence among corporate governance mechanisms implies that rational firms often design their corporate governance systems to minimize their total cost. In other words, “the overall governance of the company could be optimised by very different board structures” (Donnelly and Kelly, 2005: 730). Unfortunately, “[r]esearch so far has focused almost exclusively on the board of directors and ignored the potential interaction effect of other control devices. However, because different corporate governance methods may substitute for or complement each other, the results of the impact of any one mechanism could potentially be biased” (Bozec and Dia, 2007:1735). Second, the optimal combination of governance mechanisms is more likely to vary with firms as the related costs and benefits differ across firm characteristics (Ahmed and Duellman, 2007), industries (Elsayed, 2007; Huse 2005), and countries (Ahmed et al., 2006; Van Veen and Marsman, 2008). Third, national institutions may not only facilitate some corporate governance mechanisms while hindering others but may also differentially allocate power within firms (Aguilera, 2005).

We believe that this study is not only the first study that explores the moderating effect of board leadership structure on the relationship between firm complexity and board size, but also the first study that provides empirical evidence regarding this issue from a developing country such as Egypt, where much of existing studies reflect evidence either from the Anglo-American context (e.g., Boone et al., 2007; Coles et al., 2008; Donnelly and Kelly, 2005; Guest, 2008; Raheja, 2005; Yermack, 1996), or from other developed countries (e.g., Dehaene, De Vuyst and Ooghe, 2001; Di Pietra, Grambovas, Raonic, and Riccaboni, 2008; Eisenberg, Sundgren and Wells, 1998; Loderer and Peyer 2002). Getting evidence from different contexts enhances comparative corporate governance debate, as it may not be valid to generalize conclusions from prior studies on other firms that operate in “different legal and cultural environments” (Eisenberg et al. 1998: 36). This notion becomes true on the basis that the boards of directors, for instance, may have different perceptions and orientations as a result of national unique governance regimes (Van Veen and Marsman, 2008) and cultural differences (Aguilera, 2005)

The rest of this paper is structured as follows. Theoretical as well as empirical evidence regarding the relationship between firm complexity and board size is presented in the second part. The third part is designated to develop the main hypothesis in this study. Sample and variable measurements are found in the fourth part. While empirical findings are introduced in the fifth part, conclusion and discussion of the main findings are positioned in the final part.

Existing Theoretical and Empirical Evidence

A growing body of literature has studied board size extensively as a key factor that may influence board efficiency. Researchers in corporate governance have tried to establish a link between board size and either the monitoring role or the advising role of the board of directors. The underlying assumption of monitoring role is that smaller boards are more effective in monitoring than larger boards as they are less likely to suffer from group conflict, free riders problems and communication and coordination difficulties (e.g., Jensen, 1993; Lipton and Lorsch, 1992; Yermack, 1996). On the other hand, other researchers argued that large board size provides more information and brings more highly qualified members to the board, which in turn may enhance the advising role of the board (Dalton et al., 1999; Kiel and Nicholson, 2003). Authors such as Harris and Raviv (2008) and Raheja (2005) have introduced theoretical models to explain that the monitoring ability of the board decreases in board size. Other scholars (e.g., Boone et al., 2007; Coles et al., 2008; Denis and Sarin, 1999; Gillan, Hartzell, and Starks, 2004; Lehn et al., 2003; Linck et al., 2008) found cross-sectional differences in board size. For instance, Boone et al., (2007) revealed that board size reflects trade-off between cost of monitoring and firm specific benefits of increased monitoring.

Inconsistency regarding the optimal board size has reflected in empirical studies that tried to investigate the relationship between board size and firm performance and resulted in mixed findings (Elsayed, 2009b). While some authors have provided empirical evidence to support the positive influence of small board size on corporate performance (e.g., Bohren and Odegarrd, 2001; Conyon and Peck, 1998; De Andres, Azofra and Lopez, 2005; Eisenberg et al., 1998; Huther, 1997; Postma, Van Ees and Sterken, 2003; Yermack, 1996), other authors have offered supportive evidence for the positive influence of large board size (Belkhir, 2009; Bozec and Dia, 2007; Dalton et al., 1999; Kiel and Nicholson, 2003). Yet other scholars have revealed no relationship between board size and corporate performance (Kaymark and Bekats, 2008). On the other hand, some studies have provided evidence that this relationship is more likely to be nonlinear (Bennedsen, Kongsted and Nielsen, 2004) and to vary with the used performance measure (Bhagat and Black, 2001; Loderer and Peyer, 2002), estimate method (Mak and Kusnadi, 2005), firm complexity (Coles et al., 2008), growth of board size (Sofia and Vafeas, 2010), and firm size and industry type (Di Pietra et al., 2008).

Furthermore, some prior studies have sought to establish a link between board size and firm complexity. In this context, complex firms are argued to have different and interrelationships with various external parties, need more information and advice to enhance their managerial decisions, and suffer from

monitoring and asymmetric information problems (e.g., Boone et al., 2007; Coles et al., 2008; Donnelly and Kelly, 2005; Guest, 2008; Raheja, 2005; Yermack, 1996). Despite various variables such as firm size, age, capital intensity, leverage and diversification are used as proxies for firm complexity, the principal theme of existing literature is that complex firms need large board size to attain organizational adaptation.

The underlying hypothesis of this work indicates that as complexity increases, the firm's probability to add more members to its board of directors also increases. By adding new members, the board of directors will have specialized knowledge that enhance the ability of the firm to access new information and implement monitoring as well as advising activities (Boone et al., 2007; Hermalin and Weisbach, 1988), which in turn help the firm to cope with its diversified activities (Coles et al., 2008; Denis and Sarin, 1999; Fama and Jensen, 1983). The positive correlation between firm complexity is also justified on the basis that complex firms often have various external contracting relationships (Booth and Deli, 1999; Guest, 2008; Pfeffer, 1972), and the key activities of the board of directors such as compensation, auditing and succession planning are often assigned to committees and rather than executed by the board as a whole (Boone et al., 2007).

In general, empirical findings tend to support the positive and direct relationship between firm complexity and board size. For instance, Boone et al., (2007) found that board size increases as firms grow and diversify over time. Coles et al., (2008) pointed out that complex firms have large boards comparing with simple firms, a comparable conclusion that is also reported by Linck et al., (2008). In a similar vein, the results of Guest (2008) supported the positive correlation between board size and the need for advice. However, by using firm size as a proxy for firm complexity, Donnelly and Kelly (2005) reported a negative association between firm size and board size. They explained this finding as "large companies tend not to have boards that are of the optimal size for monitoring" (Donnelly and Kelly, 2005: 736).

Hypothesis Development

Firm complexity is expressed, as in previous work, using various variables such as firm size, age, capital intensity and debt (e.g., Boone et al., 2007; Coles et al., 2008; Guest, 2008; Linck et al., 2008). The main argument in this paper is that board leadership structure is more likely to moderate the relationship between firm complexity and board size. In other words, as a firm gets complex, it is more likely to manipulate between its board size and board leadership structure to attain organizational adaptation. Thus, to assume that the firm will consider its board size only to adapt with complexity is a short-sighted view that overlooks the interrelationship between agency cost of both board size and board leadership structure.

Simple firms may lean toward a CEO duality structure as a means of increasing their survival. They are likely to do this as the CEO in this case has complete information about day-to-day work and industry context, which in turn will help them to achieve quick response to external environment, clear direction and unity of command, fast and effective decisions, and easy strategy formulation and implementation (Elsayed, 2009a). However, CEO duality structure in simple firms increases agency cost and the power of the CEO. Thus, to minimize its total cost, simple firms are less likely to increase their board size. Small board size helps simple firms in reducing not only the agency cost of large board size, but also the possibility of CEO domination. Under CEO duality structure, small board size satisfies the need of simple firms not only for less advising activities but also for more monitoring responsibilities from the side of the board of directors. The monitoring role of the board of directors in simple firms is increasingly important as monitoring from external parties such as debtors and institutional investors is likely to be limited. Moreover, small board size increases board cohesiveness and reduces communication problems as well as cost of information sharing.

However, as firms become more complex, their activities and operations become more complicated and interrelated. In turn, complexity in firms' operations and activities has various consequences. First, more skills and capabilities are now needed to copy, internally and externally, with diversity in operations and relationships. Second, more external parties are more likely to be involved in the firm's task environment. This is because complex firms are likely to have more resources, which in turn give the firm more competitive advantages. Third, firm complexity may reflect the legitimacy principle, or to what extent the firm is visible to the public and this is because a complex firm either is seen as industry leader (Henriques and Sadorsky, 1996, Wahba, 2009), or is likely to have more environmental risk (Cohen et al., 1995, Wahba, 2008a). Fourth, more resources that is available to complex firms increase the chance of managerial entrenchment (Elsayed, 2009a, Elsayed and Paton, 2009; Wahba, 2008b).

These developments indicate that the firm's strategic orientation and priorities may need to be modified. In response, since complex firm now concerns more with advising and monitoring activities than before, it is more likely to make a simultaneous change in its board size and board leadership structure to be able to achieve organizational adaptation. The need for more capabilities and skills induces complex firms to increase their board size to enhance the efficiency of decision-making process. Complex firms may also increase their board size either to deal with their different and interrelated external links, or to secure more physical and informational resources.

However, the ability of complex firms to increase their board size is more likely to be

contingent on their board leadership structure. This is because, first, rational firms often design their corporate governance systems to minimize their total cost, as one weak governance mechanism in one area will be offset by a strong one in another area (Donnelly and Kelly, 2005). Second, the optimal combination of governance mechanisms is more likely to vary with firms characteristics (Ahmed and Duellman, 2007). Third, CEO influence affects board size negatively (Elsayed, 2009b; Guest, 2008).

Thus, complex firms that adopt CEO duality structure are expected to be less likely to increase their board size comparing with complex firms that apply CEO non-duality structure. This is because, first, information asymmetry between the executive manager and the board of directors is expected to increase with CEO duality (Eisenhardt, 1989). Asymmetric information collaborates with group diffusion in large group to intensify communication and coordination problems, which in turn weakens the monitoring power of the board of directors. Second, these conditions enable the CEO to dominate the board of directors with a high chance of managerial entrenchment. Third, CEO duality structure may discourage (encourage) some inner or outer actors to join (or withdraw from) the board (Elsayed 2009a; Lorsch and MacIver 1989). Fourth, since sharing information cost in CEO duality firms is expected to be more than monitoring cost, complex firms that adopt CEO duality structure is less likely to increase its board size. This is because adding more members to the board in such this case increases also sharing information between the CEO and the board of directors. Thus, the main hypothesis of this study can be stated as follows:

H1: Board Leadership structure will moderate the relationship between firm complexity and board size, with the relationship being weaker in firms with CEO duality structure

Sample Description and Variable Measurement

Sample Selection

The topic of corporate governance has received a great amount of attention from the Egyptian government during the past few years. The Egyptian government recognized corporate governance as an inevitable matter to complete its economic reform program (Abdel Shahid, 2001; Elsayed, 2007; Fawzy, 2003). Thus, the government has applied and implemented different compulsory and voluntary initiatives to stimulate corporate governance practices in Egypt. Examples of these initiatives include, for example, reforming regulations that govern the Egyptian capital market, tightening disclosure and transparency requirements for quoted firms, benchmarking corporate governance practices in Egypt against corporate governance principles of the Organization of Economic Co-operation and

Development (OECD), and establishing the Egyptian Institute of Directors (EIOD) to render proper corporate governance awareness among Egyptian corporations. The Egyptian approach to corporate governance reform can be best described as a "mixture" structure of the USA mandatory reform and UK voluntary reform. For instance, whilst the USA and the UK share an Anglo-American common law system, the Egyptian corporate law system is fundamentally influenced by French civil law. However, concepts of the Anglo-American common law system are well established in the capital market and central depository laws.

The number of listed firms in the Egyptian stock market dropped from 1076 firms with a total market capitalization of LE 121 billion in 2000 to 795 firms with a total market capitalization of LE 234 billion in 2004 (Cairo & Alexandria Stock Exchange, 2007). As tax laws encourage listing, "few active companies constitute the bulk of trading over the Egyptian Exchange" (Abdel Shahid 2001: 10). The sample searching began by examining lists of the most active firms published by Cairo & Alexandria Stock Exchange (CASE) (it is called now the Egyptian Exchange) during 2000-2004. This period was mainly chosen because covers ex- and post-effects of the initiation of new listing rules in the Egyptian stock market in 2002. In addition, much of the existing evidence regarding corporate governance mechanisms in Egypt covers most of this period (see, for example, Abdel Shahid, 2001, Elsayed, 2009b; Fawzy, 2003, MENA, 2003, MENA-OECD, 2006; ROSC, 2004), aiding comparisons of the results of this study.

This study excluded from these lists firms that belonged to financial industries, as these companies are subject to unique governmental regulations and their operations are quite different. The needed data on board structure and explanatory variables were found to be available for 92 firms covering 19 different industrial sectors. Abdel Shahid (2001), for example, utilized a list of the 90 most active firms in the Egyptian stock market and observed that they accounted for 87 percent of the total deals and 44 percent of the total market capitalization in 2000. Following that and to test for whether the sample of the current study represents all listed firms in the CASE, the average of the total market capitalization during 2000-2004 for all companies listed in the CASE, as well as for those firms constituting the sample, is computed. The average for all listed firms was LE 537.4 billion and reached LE 246.91 billion for the sample. Given that the sample accounted for 46 percent of the total market capitalization of the entire market during 2000-2004, it can be argued that sample does represent the population (i.e., all firms listed in the CASE).

Dependent Variable

Board size (BOS) is the main dependent variable in this study. The Egyptian legal system specifies that

the board of directors for any company should be not only constituted according to capital distribution but also nominated to represent shareholders. Board size is exemplified by the total number of directors on the board (e.g., Bonne et al., 2007; Coles et al., 2008; Guest, 2008; Linck et al., 2008; Kim, 2005; Wen, Rwegasira and Bilderbeek, 2002). The natural logarithm is used to transform the number of directors because it does not follow the normal distribution (the Shapiro-Wilk *W* test for normality is significant at 0.968, $p < 0.05$).

Independent Variable

Firm complexity (COM) is the main independent variable in this study. Firm complexity is expressed, as in previous work, using various variables such as firm size, age, capital intensity and debt (e.g., Bonne et al., 2007; Coles et al., 2008; Guest, 2008; Linck et al., 2008). The firm's total assets provide a proxy for the firm size (Eisenberg et al., 1998). The natural logarithm is employed to transform firm size, as the Shapiro-Wilk *W* test for normality is significant (0.332, $p < 0.001$). Firm age is represented by the time period from the incorporation date to the year of analysis (Eisenberg et al., 1998; Mumford, 2003). Capital intensity is utilized to express firm growth and is measured by the ratio of net fixed assets to total assets (Elsayed and Paton, 2009). Firm leverage is measured by the ratio of total debt to total assets (Baliga, Moyer and Rao, 1996).

Factor analysis was explored to construct a factor that represents firm complexity using all the four measures. Principal component analysis with Varimax as a common orthogonal rotation method was used on the standardized forms of the four variables (Tabachnick and Fidell, 2001). The Kaiser criterion that retains factors with eigenvalues greater than or equal to unity was employed to determine the number of factors. Next, the values of the Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity statistics were checked to test for the factorability of the data (i.e., testing the null hypothesis that states that the correlation matrix is an identity matrix) (Hair, Anderson, Tatham and Black, 1998).

Based on the Kaiser criterion, one factor has been extracted (which has an eigenvalue of 1.35263) to express firm complexity. The factorability of the data is assured, as the Kaiser-Meyer-Olkin (KMO) statistic is not less than 0.6 and the Bartlett's test of Sphericity is significant (Chi-Square 83.67, $p < 0.001$). Thus, the hypothesis that the correlation matrix is an identity matrix can be rejected (Tabachnick and Fidell, 2001; Pallant, 2001), and the output factor is valid.

Moderating Variable

Board leadership structure (DUL) is the main variable that is argued, in this study, to moderate the relationship between firm complexity and board size.

A binary variable is used as a proxy for board leadership structure. This binary variable takes a value of one if it is found that the CEO also serves as the chairman (i.e., CEO duality), and a value of zero otherwise (Elsayed, 2009a; Rechner and Dalton, 1989).

Control Variables

A number of associated control variables, according to previous work, were included in the analysis models. Firm financial performance is proxied in the literature using various measures, such as return on assets, return on equity, return on sales, and return on investments. However, return on assets has been chosen in this study as it reflects operating results rather than decisions of capital structure (Schmalensee, 1989). Return on assets (ROA) is measured by the ratio of net profit to total assets (Elsayed, 2007). Ownership structure is another important variable in investigating the moderating role of board leadership structure. This is not only because ownership dispersion and type may, to some extent, affect the chosen structure, but also because existing ownership structure may be a result of some earlier board characteristics (Huse, 2005). Firm ownership structure is controlled for by including the ratios of managerial shareholding (MEQ), institutional ownership (IEQ), employee ownership (EEQ), private shareholding (PEQ), and foreign shareholding (FEQ). Each variable is represented based on the proportion of its stake to the total equity, respectively. Furthermore, on the basis that board characteristics and effect may vary with industry type (Elsayed, 2007), industry effect is also controlled for. Industry heterogeneity is captured by inclusion of dummy variables using the two-digit standard industrial classification codes.

Econometric Analysis and Model Selection

Cluster Analysis

The factor that represents firm complexity was used as input to classify firms, using cluster analysis, into two groups (simple firms and complex firms) according to their characteristics. Cluster analysis as a grouping technique seeks to enhance homogeneity between members of the same group and heterogeneity among groups themselves. Validation tests demonstrated that firms in the sample have been classified appropriately. First, a Multivariate Analysis of Variance (MANOVA) test of the two clusters and four variables (firm size, age, capital intensity and leverage) was performed and obtained the Wilks lambda statistic (0.36) and the multivariate *F*-statistic of 157.7 ($p < 0.001$). This indicates that the two groups of firms (simple firms and complex firms) differ across the main four variables. Furthermore, a *T*-test was performed to test for the cluster mean for each of the four variables. The *T*-statistic ($p < 0.001$)

indicates that significant differences exist in mean values for each of the variables. Second, the internal validation of cluster solution was tested by conducting a Multiple Discriminant Analysis (MAD) of the four variables and two groups of firms. The results of this showed that one canonical discriminant function was significant ($p < 0.001$) in differentiating among groups with canonical correlation 0.80. Also, the discriminant analysis shows that about 92% of original grouped cases are correctly classified.

To test for the validity of firm complexity variable, an unrestricted model in which both firm complexity variable and the four component criteria (firm size, age, capital intensity and leverage) are included as explanatory variables (in addition to the control variables). Two restricted models nested within this are considered (results are reported in Table 1). The first ('components only' model) excludes the firm complexity variable. The second restricted model ('firm complexity variable only' model) excludes the four component variables. Then, a likelihood ratio (LR) test is conducted for each of the restricted models against the unrestricted model (Gujarati, 2003). The LR chi-square statistics are 36.03 ($p < 0.001$) for the 'components only' model and 0.24 ($p > 0.10$) for the 'firm complexity variable only' model. The implication of this is that the component variables can be safely dropped, but not the firm complexity variable.

Insert Table 1 about here

More analysis on this point was performed by computing the standard information criteria (namely the Akaike information criterion or AIC and the Bayesian information criterion or BIC) for the unrestricted and restricted models (results are reported in Table 1). The AICs for the unrestricted model, 'components only' model and 'firm complexity variable' model are 134.35, 162.38 and 132.59, respectively, while the values of the BIC, correspondingly, are 254.47, 267.06 and 248.84. Remembering that for both AIC and BIC a lower figure means a better specified model (Greene, 2003), both criteria confirm that the 'firm complexity variable' model is superior to both the 'components only' model and the unrestricted model.

Descriptive Statistics

Descriptive statistics of the main variables, as reported in Table 2, indicate that the average (median) board size is 8 (7). Thus, board size is, to some extent, close to the figures reported in both US and UK studies. For instance, Linck et al. (2008) reported an average (median) of 7.5 (7) in the US context. Guest (2008) reported an average (median) of 7.18 (7) using the UK dataset. Furthermore, classification of firms according to their board leadership structure (i.e., CEO duality or CEO non-duality) showed that the same person holds the posts of CEO and chairman

(i.e., CEO duality) in about 79% of the sample. Comparable figures are reported in prior works. For instance, it is 76% in Booth, Cornett and Tehranian, 2002; 62% in Boone, et al., 2007, and 58.3% in Linck et al., (2008). On the other hand, the CEO duality ratio is not consistent with findings in the UK, where about 22% of firms do not split the roles of CEO and chairman (as reported in Lasfer, 2006).

Insert Table 2 about here

Bivariate Analysis

Figures in Table 2 suggest that board size is 28% higher for complex firms compared with simple firms (8.9 versus 6.9). Furthermore, CEO duality is 22% lower for complex firms compared with simple firms (0.71 versus 0.86). A T-test as a parametric test as well as a Mann-Whitney U test as a nonparametric test was conducted and the results demonstrated that there is a significant difference in board size between simple firms and complex firms ($T = -6.06$, $p < 0.001$ and $z = -5.59$, $p < 0.001$). The results also showed that board leadership structure vary with firm complexity ($T = 3.56$, $p < 0.001$ and $z = 3.51$, $p < 0.001$). When the sample was subdivided into CEO duality and CEO non-duality sub-groups, it is found that board size, in the CEO duality sub-group, is 22% higher for complex firms compared with simple firms (7.05 versus 8.6). However, in the CEO non-duality sub-group, it is found that board size is 43% higher for complex firms compared with simple firms (9.4 versus 6.6). This finding is consistent with the predication of the main hypothesis in this study and is graphically presented in Figure 1.

Insert Figure 1 about here

Further analysis showed that correlation coefficients between firm complexity and both of board size and CEO duality are 0.3278 and -0.1834 ($p < 0.001$), respectively. However, when the sample subdivided into two groups (CEO duality and CEO non-duality sub-samples), correlation coefficient between firm complexity and board size was found to be 0.4473 ($p < 0.001$) for CEO non-duality sub-sample and 0.2246 ($p < 0.001$) for CEO duality sub-sample. Although these two correlation coefficients seem different and give initial supporting evidence for the prediction of the main hypothesis in this study, it is important to test for the significance of this difference.

The method of testing the statistical significance of the difference between correlation coefficients was followed as it is explained in details in Pallant (2001: 126-128). The observed Z value for the difference between the two correlation coefficients is -2.03 . Thus, since Z observed value $-2.03 <$ the standard value -1.96 , it can be concluded that there is a statistically significant difference in the strength of

the correlation between firm complexity and board size for CEO duality firms and CEO non-duality firms. Specifically, firm complexity explains significantly more of the variance in board size for CEO non-duality firms than for CEO duality firms. The same result can be obtained from comparing the coefficient of determination in every case. By squaring the coefficients of correlation between firm complexity and board size under CEO duality structure and CEO non-duality structure, we find that firm complexity is able to explain only 5 percent $(0.2246)^2$ in board size with the presence of CEO duality scenario. However, firm complexity is able to explain 20 percent $(0.4473)^2$ in board size under the CEO non duality structure. Thus, it is clear that all the results of the bivariate analysis demonstrate the validity of the main hypothesis in this study.

With regard to control variables, it seems that there are significant differences between simple firms and complex firms in their profitability, managerial equity, private equity and foreign equity. However, they vary significantly in employee equity and institutional equity. Employee ownership is 149% lower for complex firms compared with simple firms (2.57 versus 6.4, $p < 0.001$). On the other hands, institutional ownership is 32% higher for complex firms compared with simple firms (40.5 versus 30.8, $p < 0.001$).

Multivariate Analysis

Although the results of the bivariate analysis give strong evidence for the argument of this study, multivariate regression analysis was performed to check for the validity of this argument after taken into account the joint effect of other control variables. The investigated model is proposed as follows:

$$BOS_{it} = \alpha + \beta_1 COM_{it} + \beta_2 DUL_{it} + \beta_3 COM_{it} * DUL_{it} + \beta_4 ROA_{it} + \beta_5 MEQ_{it} + \beta_6 IEQ_{it} + \beta_7 EEQ_{it} + \beta_8 PEQ_{it} + \beta_9 FEQ_{it} + \beta_{10} IND_{it} + \varepsilon_{it}$$

Where (α) denotes the constant, (i) refers to the firm number, (t) represents the time period, and ε_{it} stands for the error term. β_1 to β_{10} are the coefficients of explanatory and control variables.

Thus, in accordance with prior work, OLS regression model was established to estimate the effect of firm complexity on board size (without including interaction term between firm complexity and board leadership structure). In this model, board size is treated as the main dependent variable, while firm complexity, board leadership structure and control variables are the main explanatory variables. Since corporate performance can not only be a result of earlier board decisions and characteristics, but can also be a determinant of one or more of these characteristics, possible endogeneity was tested using the Hausman specification test (1978) as it is explained in details in Gujarati (2003). The Hausman test showed no signs for possible endogeneity

between board size and ROA as the F-statistics is not significant ($F=0.82, p = 0.3660$).

In agreement with existing evidence in the literature, the results of OLS regression showed that firm complexity exerts a positive and significant coefficient on board size (0.108, $p < 0.001$). Although, the link test (Pregibon, 1980), as a special form of the regression specification error test (RESET) (Ramsey, 1969), does not show a specification error that results from an incorrect functional form (as it was not significant), specification tests of the OLS assumptions (as they are also reported in Table 3) demonstrate that the assumption of normality of residuals is violated (Shapiro-Wilk W test for normality of residuals is significant, 0.9812, $p < 0.001$). Running the interquartile range test (Hamilton, 2003) suggests that this can be traced back to the presence of severe outliers.

Insert Table 3 about here

An alternative method to correct for non-normality of residuals is the median regression model. It “has recently gained acceptance as an alternative to ordinary least squares (OLS) estimation when outliers may be present” (Dielman and Rose 1995:199). Therefore, STATA version 8 was used to perform median regression and results are reported in Table 3 under median regression without interaction term. The results of median regression model not only confirmed the positive and significant influence of firm complexity on board size (0.024, $p < 0.001$), but also showed that CEO duality has exerted a negative and significant coefficient on board size ($-0.116, p < 0.001$).

When interaction term between firm complexity and board leadership structure (i.e., CEO duality) is included in regression model, firm complexity is shown to exert a positive and significant coefficient on board size only when the firm follows a leadership structure that separates the roles of CEO and chairman ($\beta_1 = 0.241, p < 0.001$). On the other hand, firm complexity was found to exert a negative and significant coefficient on board size when the CEO also has the position of the chairman. In other words, the incremental effect of firm complexity on board size for CEO duality firms is negative and significant ($\beta_3 = -0.234, p < 0.001$). The total effect of complexity of board size for CEO duality firms ($\beta_1 + \beta_3 = 0.007$) is positive and significant ($F = 14.80, p < 0.001$). These results are also consistent with the findings of the bivariate analysis and give quite reassurance regarding the applicability of the main hypothesis in this paper (β_3 should be negative and $(\beta_1 + \beta_3)$ should be positive).

Conclusion and Discussion

Researchers in corporate governance have argued that board size is more likely to play a central role as an internal mechanism in lessening conflict of interest between managers and owners. Unfortunately, theoretical as well as empirical evidence regarding either the influence or the determinants of board size is mixed and inconclusive. In this context, most prior studies have argued that the relationship between firm complexity and board size is a monotonic one. Contrary to previous work, it is hypothesized in this study that board leadership structure will moderate the relationship between firm complexity and board size, with the relationship being weaker in firms with CEO duality structure. By using as sample of Egyptian listed firms, econometric analysis provided strong evidence for the applicability of this hypothesis. Therefore, the results of this study add to the recently increasing literature that theoretically models (Harris and Raviv, 2008; Raheja 2005) and empirically investigates (Boone, et al., 2007; Coles, et al., 2008; Guest, 2008; Linck et al., 2008) the determinants of board size.

The moderating effect of board leadership structure on the relationship between firm complexity and board size may indicate that findings of prior studies need to be read with some caution. This is important especially when we notice that the main characteristics of complex firms and simple firms that are reported in this study from the Egyptian context are consistent with prior works. For instance, Coles et al., (2008) reported that board size is 25% higher for complex firms compared with simple firms (28% in this study). Furthermore, they also found that while board size for complex firms is 8.6% higher than the mean board size (11.2% in this study), board size for simple firms is 12.5% lower than the mean board size (13.7% in this study). Furthermore, the inverse relationship between board size and CEO duality, as two main governance mechanisms, in this study is also consistent with some prior studies. For example, Bonne et al., (2007) tracked board size and CEO duality for 1,019 firms over ten years and revealed that while the mean of board size was increased by 11% (from 6.74 to 7.52), CEO duality at the same time was decreased by 5% (from 0.63 to 0.60).

The results of this study provide some theoretical, practical and governmental implications. As for theoretical implications, this study provides supportive evidence for the argument that firms are more likely to manipulate their boards' characteristics to attain organizational adaptation at the minimum total cost. This is because the effect of one mechanism depends upon others (Adams et al., 2003), as one weak governance mechanism in one area will be offset by a strong one in another area (Donnelly and Kelly 2005). Thus, studying board size (or board leadership structure) without taking the effect of the other variable into account may lead to diverse results

and conclusions. For instance, while prior studies, as explained above, revealed that board size increases in firm complexity, studies that investigated the relationship between firm complexity and board leadership structure (e.g., Dey et al., 2009; Faleye, 2007) also argued that CEO duality is more likely to increase in firm complexity. This also, in fact, may explain why prior studies that sought to link board size (e.g., Bozec and Dia, 2007; Kiel and Nicholson, 2003; Yermack, 1996) or board leadership structure (e.g., Brickley et al., 1997; Donaldson and Davis, 1991; Rechner and Dalton, 1989) to firm performance presented mixed findings. It is important to clarify that the results of this study do not discard the argument of "optimal board size" (e.g., Jensen, 1993; Lipton and Lorsch 1992), instead, the results emphasize that this "optimal board size" varies with different contextual and institutional variables.

As for practical implications, to assume that "one size fits all" and argue that "large/small board size" or "CEO duality/CEO non-duality" is always the right choice is an idealistic argument because this assumption ignores the fact that the effectiveness of board of directors, as a corporate governance mechanism, is more likely to be contingent on some contextual variables, as well as the power of key internal and external actors (Aguilera 2005, Aguilera and Jackson 2003, Huse 2005). Thus, if practising managers want to maximize the value of their firms, they need to broaden their insight to understand that board characteristics are multidimensional, contingent and dynamic in their nature and differ not only across firms and industry, but also across countries.

This study also has some implications for regulators and policy makers. First, before developing and launching new and additional corporate governance reforms, policy makers need to realize that differences in corporate governance systems cannot be fully explained outside their institutional environments. This is important because if we agree that different motivations can exist for the same action or behaviour, then it would be wrong to interpret results "out of their context". Second, although the government in Egypt, as it is the case in many developing countries, has altered regulations in recent years and launched many new instruments that have improved the quality of corporate governance conditions in Egypt, it appears that more work is needed to increase awareness among Egyptian organizations of corporate governance best practices. For instance, although corporate governance practices in Egypt now align various international codes, existing reports (see, for example, ROSC, 2004) indicate that legal and regulatory changes move faster than changes in business organizations.

The results of this study open new directions for research in the future. First, as this is the first study that offers empirical evidence regarding the moderating effect of board leadership structure on the relationship between firm complexity and board size, researchers are invited to replicate and retest the

argument that is presented here in other institutional contexts. Doing so helps to better understand the comparative corporate governance debate. Second, it is also important to replicate this study in future research by using panel data techniques. This is important as such techniques allow researchers to control for unobservable firm-specific effects and, as a consequence, have the potential to provide a much more powerful evidence base. Third, future research may also investigate the role of other board characteristics such as board composition and behavior in explaining the relationship between firm complexity and board size. Finally, firm complexity may reflect the legitimacy principle (i.e., to what extent the firm is visible to the public (Wahba, 2009), or is likely to have more environmental risk (Cohen, Fenn and Konar, 1995; Whaba, 2008a)). Thus, one promising area for investigation in the future studies, which is currently far from the research spotlight, is the relationship between firm complexity, corporate governance and corporate social and environmental responsibility. For instance, future studies may examine the moderating effect of corporate social/environmental performance on the relationship between board characteristics and firm complexity.

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