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SELF-SELECTION, ENDOGENEITY, AND THE RELATIONSHIP BETWEEN CEO DUALITY AND FIRM PERFORMANCE

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This study focuses explicitly on the methodological implications of the endogenous theory of governance as applied to firm performance. In particular, if firms choose their governance structures as part of a constrained performance maximization process, then application of an appropriate empirical methodology should reveal statistical evidence of such behavior. In this study we take advantage of the endogenous switching regression model framework to determine whether such predicted optimizing behavior can be corroborated by the data. The model allows us to test explicitly for selection behavior in accordance with comparative advantage and, concomitantly, the presence of selectivity bias, in estimating the impact of CEO duality on firm performance. The selection and performance equations are modeled in accordance with the extant accounting, economics, and management literature on the impact of the dual governance structure on firm performance. Overall, we tested four performance measures for the entire sample of firm-year observations as well as for the largest three industries in terms of sample sizes. The major finding, robust in all cases, is that there is no evidence to support a contention that CEO duality is a structure purposefully chosen for optimizing performance. If firms are indeed choosing the dual leadership structure, they are doing so for reasons other than improving performance from what it would be otherwise. In fact, for performance measured as market return and earnings per share, there is evidence of a significant selectivity bias that acts to lower performance below what it would have been under random assignment. For performance measured by Tobin's q and return on assets, we found neither evidence of selectivity bias, nor any significant marginal performance impacts of CEO duality. Such findings are inconsistent with an endogenous governance theory, at least when applied to firm performance.

INTRODUCTION

Should a firm's CEO also serve as the chair of its board of directors? The corporate scandals of the very recent past have placed this question squarely at the forefront of the public discourse on the nature and structure of corporate governance in the United States. The academic research on this issue, both theoretical and empirical, has provided mixed results. Fama and Jensen (1983) and Jensen (1993) argue that CEO duality, that is, a firm's CEO also serving as board chair, violates the rubric of the separation of decision-management from decision-control. This in turn impedes a board's ability to monitor effectively a CEO's decisions, leaving greater opportunities for CEOs to advance their own personal interests to the (possible) detriment of the firm's shareholders. However, Stoeberl and

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Sherony (1985) and Anderson and Anthony (1986) contend that CEO duality provides a single focal point for company leadership, thereby creating an image of firm stability, instilling confidence in the firm's management, and fostering better communication between management and the board of directors. This argument is echoed in Donaldson and Davis (1991), Finkelstein and D'Aveni (1994), Dahya, Lonie, and Power (1996), Brickley, Coles, and Jarrell (1997), and Bhagat and Black (2001). In addition, Brickley *et al*. (1997) point out that employing a leadership structure that separates the roles of CEO and board chair is not costless. The authors identify information, agency, and incentive costs of such a structure that are, in fact, ameliorated by a structure where the CEO serves in the dual capacities. The reduction in these costs as a consequence of CEO duality may outweigh the benefits from a structure that separates the roles of CEO and board chair.

The empirical evidence on the impact of CEO duality on firm performance is similarly mixed. In an analysis of Fortune 500 companies, Rechner and Dalton (1991) find that firms with 'independent' leadership structures consistently outperform those with a duality structure with respect to return on investment (ROI), return on equity (ROE), and profit margins. In their study of the banking industry, Pi and Timme (1993) provide evidence of higher accounting returns for banks that separate the roles of CEO and board chair. Consistent with these results, Daily and Dalton (1994), in an examination of the relationship between corporate governance/board composition variables and bankruptcy filings, report a strong and robust positive association between CEO duality and firm bankruptcies. In contrast, Boyd (1995) estimates that after controlling for the interactions between duality and different organizational environments, duality has an independent and positive impact on subsequent firm performance. Sridharan and Marsinko (1997) investigate the impact of CEO duality and firm value in the paper and forest products industry and find that firms with dual CEOs exhibit higher market values than their non-dual counterparts. And Peng (2004), in a study of 405 firms listed on the Shanghai and Shenzhen Stock Exchanges, reports a statistically robust positive impact of CEO duality on firm performance as measured by either ROE or sales growth. Baliga, Moyer, and Rao (1996) only add to the ambiguity in their analysis of the announcement effects of changes in duality status. Specifically, their results indicate that the market does not respond to changes in duality status, that changes in duality status do not affect the operating performance of firms, and that there is, at best, only weak evidence of a link between CEO duality and long-term firm performance. Finally, Faleye (2007) examines the impact of the dual structure for a large sample of *COMPUSTAT* firms in 1995 on performance, accounting for the interactions of CEO duality with the mediating factors of firm complexity, CEO reputation, and governance structure. His findings, similar to but more compelling than Boyd's (1995), provide evidence that the impact of duality depends on firm and CEO characteristics.

The overall lack of consensus among researchers certainly provides some of the motivation for undertaking this project. In addition, however, is our concern that the prior empirical literature may suffer from a serious methodological problem. Specifically, the typical empirical analysis incorporates CEO duality into a firm performance equation through the use of a dummy (binary) variable indicating whether a firm's CEO is board chair or not. The estimation technique, in turn, treats the variable as exogenous, implying that a firm's decision to institute (or not) a dual governance structure is either a function of forces external to and out of the control of the firm or is simply the result of random choice.[1] This implicit 'exogenous' view of the nature of the governance structure choice is challenged, however, by the work of Hermalin and Weisbach (1998) who formulate a model in which a firm's decisions regarding the structure and composition of its board of directors are looked upon as the solution to an organizational design problem subject to, of course, legal and political constraints. In our particular context, then, this suggests that a firm's selection of a dual governance structure results from rational choice consistent with constrained optimization behavior. More intuitively, the literature identifies both costs and benefits to firms of a dual leadership structure and, as noted by Faleye, 'the appropriateness of a particular leadership structure for a given firm depends on how the firm's characteristics influence the balance between these costs and benefits

[1] The exogeneity assumption is true even in Faleye (2007), where prior to his analysis of duality on firm performance, he conducts probit regressions to examine the relationship between firm characteristics and the choice of the dual governance structure.

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at the margin' (Faleye, 2007: 242). Within such an 'endogenous' framework, the results from prior empirical studies of the impact of CEO duality on firm performance may be tainted by self-selection bias. It is the intention of this study to examine the causal relationship between CEO duality and firm performance with an empirical methodology that explicitly tests for the presence of a selection bias problem. The framework will allow us to first test explicitly for whether or not firms purposefully choose a governance structure, and, secondly, if that choice is consistent with improved performance.

The remainder of the article is organized as follows. We provide the theoretical background and develop the hypotheses to be tested, then describe the characteristics of a general self-selection model that may be usefully applied to the 'endogenous' view of the duality decision. The model's econometric specification and variable definitions are then presented and the sample design and descriptive statistics follow. Next, we detail the multivariate analysis, report the empirical results and discuss their implications. Results from a number of robustness tests are also discussed. Finally, we offer a brief summary and concluding remarks.

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

As noted in the introduction, there are two primary theoretical perspectives on the relationship between firm performance and the dual corporate governance structure. From an agency theory perspective, CEOs (the agents) are cast as utility-maximizing or risk-minimizing individuals who make decisions that enhance their own personal welfare at the expense of shareholders (the principals). An effective counterbalance to such behavior rests in an independent board of directors that monitors the decisions of CEOs to ensure that they are in the best interests of shareholders, that is, in a governance structure that separates *decision management* from *decision control*. When the CEO serves as the chair of the board of directors, this separation is breached and the board becomes less effective in its monitoring function. Consequently, a dual governance structure makes it more probable that CEOs will be able to implement decisions that enhance their personal welfare at the expense of shareholders' wealth. This then naturally leads to the hypothesis that CEO duality will negatively impact a firm's performance.

In contrast, other research by organizational economists and management theorists contends that agency theory is excessively restrictive in its view of the CEO as an opportunistic personal welfare maximizer. Specifically, it argues that agency theory ignores a vast array of alternative motivations, for example, achievement, recognition, respect, reputation, altruism, and so on, that provide a CEO with the incentive to do the best he/she can in the responsible stewardship of the assets of the firm. Additionally, organizational and management theorists have argued that the dual governance structure provides focused leadership, greater decision accountability, the flexibility to make strategic decisions more quickly in response to market/environmental changes, and an effective counterweight to the power of special interests. From this theoretical perspective, the logical hypothesis is that CEO duality will have a positive effect on firm performance.

The major empirical literature on the duality-performance relationship over the last 25 years or so has been motivated by one or both of these theoretical perspectives and has yielded equivocal and conflicting results. For example, Berg and Smith (1978) analyzed the relationship from the agency perspective for a sample of Fortune 200 firms and reported both positive and negative significant effects of duality on firm performance. Chaganti, Mahajan, and Sharma (1985) examined a sample of 21 matched pairs of bankrupt and non-bankrupt retail firms in the United States using the agency perspective and reported no significant relationship between CEO duality and performance. Rechner and Dalton (1991) and Pi and Timme (1993) employ both perspectives and find significant negative relationships between duality and firm performance. In contrast, relying on both perspectives, a study by Sridharan and Marsinko (1997) of 18 firms in the U.S. paper and forest products industry yielded a significant positive impact of CEO duality on firm performance.

A number of other studies might also be cited as evidence that the empirical work thus far has failed to provide compelling evidence regarding the duality-performance relationship from either the agency or stewardship perspectives. References for 30 such papers can be found in Kang and

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Zardkoohi (2005).[2] But more importantly, Kang and Zardkoohi (2005) identify a critical conceptual issue that has been generally ignored by the aforementioned empirical research and that is consistent with the 'endogenous' framework of Hermalin and Weisbach (1998). Specifically, 'duality is not a random phenomenon, but an organizational practice that is adopted under appropriate or inappropriate conditions' (Kang and Zardkoohi, 2005: 786). In this regard, any examination of the duality-performance relationship must at least attempt to integrate the literature on the antecedents of duality, that is, those factors that help to explain the firm's choice of a dual governance structure and, in turn, may moderate the impact of duality on firm performance.[3] As noted by Kang and Zardkoohi (2005), this literature identifies five antecedents of duality: institutional, power, social reciprocity, reward, and organizational. The institutional explanation suggests that a firm's board may choose the dual structure as a response to industry institutional pressures, specifically because the practice is commonplace in the industry. The power antecedent explains the choice as the result of a powerful CEO exercising his/her will over a relatively weak and less vigilant board of directors. Social reciprocity implies that top executives from firms with a dual governance structure will likely favor such a structure in their capacities as directors on the boards of other firms. The reward explanation simply suggests a CEO may be appointed as board chair as a reward for good performance and to demonstrate the board's confidence in the competence and stewardship of its top executive. And finally, the dual structure may be chosen as an organizational solution for firms that are internally complex and/or for firms that operate in environments characterized by high levels of uncertainty where speedy decision making and flexibility are critical to competitiveness, growth, and survival.

The general hypothesis emanating from the conceptual framework underlying the works of Hermalin and Weisbach (1998), Kang and Zardkoohi (2005), Faleye (2007), and others is clear: a firm's choice of a dual governance structure is not random but strategic and is determined as part of a broader constrained optimization process. To test the hypothesis, of course, requires the specification of an objective function, that is, the metric to be optimized. For our purposes, that metric is firm performance. Correspondingly, a major hypothesis to be tested in this study is:

Hypothesis 1: Ceteris paribus, a firm chooses its governance structure according to comparative advantage in performance.

If the hypothesis is rejected, the study will subsequently test the following:

Hypothesis 2: There is no selection bias affecting the relationship between a firm's choice of governance structure and its performance.

Tests of Hypothesis 1 and Hypothesis 2 will be based on an econometric specification that explicitly recognizes the (potential) nonrandomness of the governance structure decision.

Before proceeding to a description of our model, we note that there is one recent study that examines the relationship between CEO duality and firm performance within the selection bias framework. Chen, Lin, and Yi (2008) examines the relationship between CEO duality and Tobin's q for a sample of firms over the 1999–2003 period using a standard two-step treatment effects model. For the full sample, their results indicate no independent effect of CEO duality on firm performance, but do show the presence of a positive selection bias, supporting the hypothesis that firms choose their leadership structure to improve their performance. For a fairly small subsample of firms that changed leadership structure from dual to non-dual or vice versa, they continue to find no independent effect of duality on Tobin's q. Surprisingly, however, for this subsample of firms they find a negative selection bias. Differences between their and our results are likely due to methodological and/or sample differences that will become clear from the discussions and descriptions that follow.

[2] A useful review of the empirical literature on the more general topic of board composition and firm performance is offered by Hermalin and Weisbach (2003).

[3] This literature includes Harrison, Torres, and Kukalis (1988), Finkelstein and D'Aveni (1994), Westphal and Zajac (1997), Vancil (1987), and Boyd (1995).

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A SELF-SELECTION MODEL OF FIRM PERFORMANCE AND DUALITY[4]

Consider a situation in which one wishes to model the 'benefits' to firms of choosing a dual governance structure. The general model that is often used is:

$$Y_j = X_j\beta + \delta I_j + \varepsilon_j \tag{1}$$

where Y is firm performance, X is a vector of firm, industry, and/or environmental characteristics, I is a dummy variable equal to one for firms with a dual governance structure and zero otherwise, and ε is a random error term. The *ceteris paribus* effect of CEO duality on firm performance is given by δ. Effectively, the dual governance structure is assumed to shift exogenously the firm's performance function. Other forms of Equation (1), as found in Faleye (2007), permit the slope coefficients to be affected by the dual governance structure as well by including the interaction of I with the X vector. This latter form of the Equation (1) model is more general, of course, and in accordance with the theoretical literature that suggests certain firm, industry, and/or environmental factors may 'modify' the impact of duality on firm performance. It is instructive at this point to think of the more general alternative form of Equation (1) as tantamount to the two equation system given by:

$$Y_{1j} = X_j\beta_1 + \varepsilon_{1j} \text{ (performance of firms with dual governance structure)} \tag{2a}$$

$$Y_{2j} = X_j\beta_2 + \varepsilon_{2j} \text{ (performance of firms with non - dual governance structure)} \tag{2b}$$

OLS estimation of Equations (2a) and (2b), or equivalently of Equation (1) expanded to include interactions of I_j with X_j, will yield unbiased and consistent estimates if I_j is exogenous. If, however, the choice of governance structure is not random but is motivated by firm-specific and other factors important to the constrained maximization of firm performance, then I_j will not be exogenous and the ordinary least squares (OLS) estimates will be subject to selectivity bias. In such a case, a more appropriate specification is offered by the following endogenous switching regression model:

$$\begin{aligned}
&Y_{1j} = X_j\beta_1 + \varepsilon_{1j} \text{ (firm performance with dual governance structure)}\\
&Y_{2j} = X_j\beta_2 + \varepsilon_{2j} \text{ (firm performance with non - dual governance structure)}\\
&I_j^* = Z_j\gamma - u_j \text{ (governance structure selection function)}\\
&I_j = 1 \text{ iff } I_j^* > 0\\
&I_j = 0 \text{ iff } I_j^* \le 0.
\end{aligned} \tag{3}$$

I_j^* is an unobserved latent variable measuring the benefits of a dual governance structure and Z_j is a vector of observable firm, industry, and/or environmental variables that affect the firm's choice of governance structure. The observed Y_j are defined as:

$$Y_j = Y_{1j} \text{ iff } I_j = 1 \tag{4}$$

$$Y_j = Y_{2j} \text{ iff } I_j = 0. \tag{5}$$

The random errors are assumed to be trivariate normally distributed with zero means and covariance matrix:

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1u} \\ \sigma_{12} & \sigma_{22} & \sigma_{2u} \\ \sigma_{1u} & \sigma_{2u} & 1 \end{bmatrix} \tag{6}$$

The model permits the interaction of both observable and unobservable firm characteristics with the choice of governance structure and, unlike the conventional formulation represented by Equations (1) [or (2a) and (2b)], is suitable for determining whether or not there is statistical evidence that a firm's choice of governance structure is part of a rational constrained optimization process whose objective is maximum performance.

The expectations of firm performance conditional on the chosen governance structures can be written as:

$$\begin{aligned}
E(Y_{1j}|I_j = 1) &= X_j\beta_1 + E(\varepsilon_{1j}|I_j = 1)\\
&= X_{1j}\beta_1 - \sigma_{1u}\left(\frac{\varphi(Z_j\gamma)}{\Phi(Z_j\gamma)}\right)
\end{aligned} \tag{7}$$

$$E(Y_{2j}|I_j = 0) = X_j\beta_2 + E(\varepsilon_{2j}|I_j = 0)$$

[4] The discussion in this section borrows liberally from chapters 5, 8, and 9 of Maddala (1983).

DOI: 10.1002/smj

$$= X_{2j}\beta_2 + \sigma_{2u}\left(\frac{\varphi(Z_j\gamma)}{1-\Phi(Z_j\gamma)}\right) \qquad (8)$$

where $\varphi(Z_j\gamma)$ and $\Phi(Z_j\gamma)$ are the standard normal density and cumulative distribution functions, respectively. Define $H_{1j} = \varphi(Z_j\gamma)/\Phi(Z_j\gamma)$ and $H_{2j} = \varphi(Z_j\gamma)/[1-\Phi(Z_j\gamma)]$, and rewrite (7) and (8) as:

$$E(Y_{1j}|I_j = 1) = X_j\beta_1 - \sigma_{1u}H_{1j} \qquad (9)$$

$$E(Y_{2j}|I_j = 0) = X_j\beta_2 + \sigma_{2u}H_{2j} \qquad (10)$$

Equations (9) and (10) make it clear that the selection bias that results from the OLS estimation of Equations (2a) and (2b) is, in effect, an omitted variables problem where the omitted variables are H_{1j} and H_{2j}. In other words, the endogeneity arises from a stochastic sorting process, the nature of which is embedded in the covariances between the unobservables in the performance and governance structure selection equations. To examine the nature of self-selection and its implications for the parameters of Equations (9) and (10), one must consider as well the expected value of firm performance conditioned on the governance structure *not chosen* by the firm. In other words, one needs to know the expected performance of firms with a dual (non-dual) structure had they chosen a non-dual (dual) structure. These conditional expectations are given by:

$$E(Y_{2j}|I_j = 1) = X_j\beta_2 - \sigma_{2u}H_{1j} \qquad (11)$$

$$E(Y_{1j}|I_j = 0) = X_j\beta_1 + \sigma_{1u}H_{2j} \qquad (12)$$

where (11) represents the mean performance of dual governance structure firms had they chosen a non-dual governance structure and (12) represents the mean performance of non-dual governance structure firms had they chosen a dual governance structure. The $X_j\beta_i$ terms on the right-hand sides of Equations (9)–(12) can be interpreted as the mean firm performance under a random assignment of governance structures among the population of firms. Subtracting Equation (11) from (9) and Equation (12) from (10) yields:

$$E(Y_{1j}|I_j = 1) - E(Y_{2j}|I_j = 1) = X_j(\beta_1 - \beta_2) + (\sigma_{2u} - \sigma_{1u})H_{1j} \qquad (13)$$

$$E(Y_{2j}|I_j = 0) - E(Y_{1j}|I_j = 0) = X_j(\beta_2 - \beta_1) + (\sigma_{2u} - \sigma_{1u})H_{2j} \qquad (14)$$

Equations (13) and (14) demonstrate that if the self-selection process is based on comparative advantage in performance, then $(\sigma_{2u} - \sigma_{1u})$ must be greater than zero, that is, performance will be higher with self-selection than with random assignment.

Keeping in mind that $(\sigma_{2u} - \sigma_{1u})$ is a crucial parameter to be estimated, we consider the unconditional expected performance of a randomly selected firm given by:

$$E(Y_j) = E(Y_j|I_j = 1) \times P(I_j = 1) + E(Y_j|I_j = 0) \times P(I_j = 0) \qquad (15)$$

where $P(I_j = 1) = \Phi(Z_j\gamma)$ and $P(I_j = 0) = 1 - \Phi(Z_j\gamma)$. Multiplying and recognizing that the X_j vector is common to all firms, Equation (15) can be rewritten as:

$$E(Y_j) = X_j\beta_2 + X_j\Phi(Z_j\gamma)(\beta_1 - \beta_2) + \varphi(Z_j\gamma)(\sigma_{2u} - \sigma_{1u}) \qquad (16)$$

Using all observations, Equation (16) can be estimated in two stages. In the first stage, probit maximum likelihood (ML) is used to obtain an estimate of γ, $\hat{\gamma}$, which in turn can be used to obtain estimates of Φ and φ. These are inserted into Equation (16), which can then be estimated by OLS. If $(\beta_1 - \beta_2) \neq 0$ and $(\sigma_{2u} - \sigma_{1u}) \neq 0$, then the correct model is given by Equation (3), that is, a two-regime performance model with endogenous switching. In this case, the parameters β_1, β_2, σ_{2u}, and σ_{1u} can be obtained from the two-stage estimations of Equations (9) and (10). In the first stage, probit ML is used to obtain $\hat{\gamma}$, which in turn allows us to calculate $\hat{H}_{1j}$ and $\hat{H}_{2j}$. In the second stage, Equations (9) and (10) can be estimated separately by OLS, substituting $\hat{H}_{1j}$ and $\hat{H}_{2j}$ for H_{1j} and H_{2j}. Or equivalently, they can be estimated as a single equation by including I_j as an endogenous shift dummy, the X_j variables, interactions of I_j with X_j, the variable $\hat{H}_j$ defined as $I_j \times \hat{H}_{1j} + (1 - I_j) \times \hat{H}_{2j}$, and the interaction of I_j with $\hat{H}_j$. If, however, $(\beta_1 - \beta_2) = 0$ and $(\sigma_{2u} - \sigma_{1u}) = 0$, then the correct specification is a single regime performance model similar to Equation (1) with I_j as an endogenous shift dummy and including the variable $\hat{H}_j$ to account for the selectivity problem.

Two remaining possibilities from the estimation of Equation (16) are worth mentioning: $[(\beta_1 - \beta_2) = 0$ and $(\sigma_{2u} - \sigma_{1u}) \neq 0]$ and $[(\beta_1 - \beta_2) \neq 0$

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and $(\sigma_{2u} - \sigma_{1u}) = 0$]. In both instances, the two-regime performance model with endogenous switching still applies. In the former case, Equations (9) and (10) can be estimated as a single equation with I_j as an endogenous shift dummy, the X_j variables, the variable $\hat{H}_j$, and the interaction of I_j with $\hat{H}_j$. In the latter case, the estimating equation includes I_j as an endogenous shift dummy, the X_j vector, interactions of I_j with X_j, and the variable $\hat{H}_j$.

For our purposes, a finding that $(\sigma_{2u} - \sigma_{1u}) \neq 0$ from the two-stage estimation of Equation (16) would provide evidence in support of our hypothesis that firms self-select into the governance structure in accordance with comparative advantage. In principle, subsequent estimates of σ_{2u} and σ_{1u} obtained from the estimation of Equations (9) and (10) would be unnecessary, though they would provide additional insight into the self-selection process. For example, if both σ_{2u} and σ_{1u} were found to be less than zero, this would suggest that dual (non-dual) structured firms would perform better (worse) than average under either governance structure, but do relatively better under the dual (non-dual) governance structure. In contrast, if the estimation of Equation (16) leads to a conclusion that $(\sigma_{2u} - \sigma_{1u}) = 0$, our hypothesis would not be supported but subsequent estimations of Equations (9) and (10) would be imperative. The reason is straightforward—if subsequent estimations cannot reject the hypothesis that $\sigma_{1u} = \sigma_{2u} = 0$, then there is no evidence of selection bias and the conventionally used methodologies to determine the performance impact of the dual governance structure are appropriate.

ECONOMETRIC SPECIFICATION AND VARIABLE DEFINITIONS

The operational version of the endogenous switching regression model described previously by Equation (3) relies mainly on the extant literature on the antecedents of duality and the relationship between CEO duality and firm performance.

Selection equation specification

The dependent variable, *DUAL*, is dichotomous and equal to one for firms with a dual governance structure and equal to zero for firms with a non-dual governance structure. Variables influencing the dual/non-dual decision were chosen in accordance with the antecedents to duality literature. In particular, explanatory variables associated with duality as a solution to internal organizational complexity include the size of the firm as proxied by the natural log of sales (*LNSALES*), the total number of employees (*EMP*), the number of business segments (*SEGNUM*), the ratio of net property, plant, and equipment to total assets (*PPEAT*), and the growth opportunities of the firm as proxied by the realized growth of sales revenue (*REVGWTH*).[5]

Similar to Boyd (1995), we include measures of growth in industry sales (*INDSLG5*) and the volatility in industry sales (*INDSLV5*) over the most recent previous five-year period to account for the possibility that duality is chosen as an organizational solution to environmental uncertainties. More specifically, the two variables, respectively, are proxies for *munificence,* which refers to the abundance of resources in the environment, and *dynamism,* which measures environmental volatility. Low munificence/high dynamism environments lead to greater uncertainties that, in turn, may require the faster response, greater flexibility, and greater accountability afforded by the dual governance structure.

To account for the 'power' explanation of CEO duality, we include the percentage of the firm's common stock outstanding that is owned by the CEO (*OWN*), board size (*BDSIZE*), and board independence as proxied by the percent of board directors who are unaffiliated with the firm (*INDBD*).[6] The predicted impact of *OWN* on duality is *a priori* ambiguous in that it can measure both the degree of entrenchment and the degree of alignment of the CEO's interests with shareholders' interests. In line with Jensen (1993), the expected sign on board size is negative as larger boards are probably less effective in communicating and reaching consensus and, hence, more susceptible to manipulation by the CEO.

[5] *PPEAT* is assumed to be inversely related to the ratio of intangible assets to total assets. Hence, firms with smaller *PPEAT* would be considered more complex. Though a common measure of growth opportunities is the market-to-book ratio, we choose to exclude it since it could be also be interpreted as measure of firm performance.

[6] CEO tenure is not included here as it is likely endogenous with respect to duality as noted by Faleye (2007)—CEOs who serve as board chairs are more difficult to remove and hence are likely to have longer tenures.

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Board independence is expected to increase the probability of CEO duality. Since independent boards are more effective at monitoring CEOs, the adverse consequences that could result from the separation of decision-management from decision-control become less probable. We also include three other board 'demographic' composition variables to account for the potential influences on the selection process of unique perspectives on organization and management brought to the board by different subgroups. These include the number of employee directors (*EMPDIRS*), the number of directors who are members of a racial/ethnic minority group (*MINONBRD*), and the number of female board directors (*FEMONBRD*). We make no *a priori* claims regarding the direction of their impacts on the choice of a dual governance structure. Finally, industry- and time-specific effects are controlled for with industry and year dummy variables.[7]

Performance equation specification

Because there exists no single, unique measure of firm performance, we employ four alternatives. These include the one-year total market return to shareholders, including the reinvestment of dividends (*MKTRET*), Tobin's q calculated as the ratio of the sum of the market value of common equity and the book values of preferred equity and long-term debt to the book value of assets (*TOBINSQ*), return on assets (*ROA*), and earnings per share deflated by beginning-of-year stock price (*EPS*). We assume that an individual firm's performance can be explained in part by the overall performance of the industry of which it is a part. These are labeled *INDMKTRET, INDTOBINSQ, INDROA*, and *INDEPS*, respectively, and their marginal performance impacts are expected to be positive. We also assume that past performance may be related to current performance and include the one-year lagged values of the performance measures labeled *MKTRETLAG, TOBINSQLAG, ROALAG*, and *EPSLAG*. Other explanatory variables are taken from the past literature and include firm size as measured by the natural log of sales (*LNSALES*), future growth opportunities as measured by realized revenue growth (*REVGWTH*), leverage as measured by the ratio of long-term debt to total assets (*DAT*), managerial ownership (*OWN*), board size and board independence (*BDSIZE* and *INDBD*), and dividends paid out as a percent of net operating income (*DVPOR*). *DAT* and *DVPOR* are included since both can be used to limit managerial discretion by reducing the size of free cash flow. To account for the potential impact of past performance on current performance, the right-hand sides also include the one-year lags of the performance variables, labeled as *MKTRETLAG, TOBINSQLAG, ROALAG*, and *EPSLAG*. Industry and year dummies are included in all performance equations.

Structural model specification

Given the discussion of subsections *Selection equation specification* and *Performance equation specification* and in accordance with the model specified in Equation (3), the probit selection and performance equations can be written as:

$$\begin{aligned} P(DUAL_j = 1|Z_j) = \Phi(&\gamma_0 \\ &+ \gamma_1 LNSALES_j + \gamma_2 PPEAT_j \\ &+ \gamma_3 EMP_j + \gamma_4 SEGNUM_j \\ &+ \gamma_5 REVGWTH_j + \gamma_6 OWN_j \\ &+ \gamma_7 BDSIZE_j + \gamma_8 INDBD_j \\ &+ \gamma_9 EMPDIRS + \gamma_{10} MINONBRD_j \\ &+ \gamma_{11} FEMONBRD_j + \gamma_{12} INDSLG5_j \\ &+ \gamma_{13} INDSLV5_j - u_j) \end{aligned} \tag{17}$$

$$\begin{aligned} PERF_{ij} = {} & \beta_{i0} + \beta_{i1} PERFLAG_j \\ &+ \beta_{i2} INDPERF_j + \beta_{i3} LNSALES_j \end{aligned}$$

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[7] Firm-specific dummy variables are not included for two reasons. First, severe to near-fatal colinearity problems are likely to cause serious convergence/computational problems, since for most firms in the sample the binary variable *DUAL* is time invariant and other variables, such as board size (*BDSIZE*), board independence (*INDBD*), the number of employees (*EMP*), and the number of distinct business segments (*SEGNUM*) are quasi-time invariant. Second, even in the absence of (quasi-) time invariant variables, fixed effects estimation of the current model would be susceptible to the incidental parameters problem that plagues many nonlinear panel data models, especially those including probit selection equations. In particular, when the number of time periods (T) is small and the number of firms (N) is large, as in the present case ($T \leq 5$ and $N = 531$), the estimation of firm-specific effects will render estimates of the model's structural parameters inconsistent. Additionally, there would probably be a small T sample bias in the estimates as well. Since predictions from the probit selection equation are used to construct estimates of the hazard variables for inclusion in the performance equations, we think it best that such problems be avoided. See Greene (2003) and Wooldridge (2002).

Table 1. Selection of sample of firm years 1995–2003

	Number of firm years
Number of nonfinancial, nonutility, firm-year observations from *ExecuComp* database for the sample period	3,153
Less: firm years	
1) with insufficient financial data in *Compustat* database	(1,039)
2) with insufficient governance data in IRRC database or in proxy statements	(127)
3) with insufficient data on CEO stock ownership in *ExecuComp* database	(107)
Number of firm-year observations in the final sample	1,880

$$+ \beta_{i4} DAT_j + \beta_{i5} REVGWTH_j + \beta_{i6} DVPOR_j + \beta_{i7} OWN_j + \beta_{i8} BDSIZE_j + \beta_{i9} INDBD_j + \varepsilon_{ij} \quad (18)$$

where $PERF = \{MKTRET$ or $TOBINSQ$ or ROA or $EPS\}$, subscript $i =$ one for dual firms and two for non-dual firms, and where γ_0 and β_{i0} are assumed to be linear functions of industry- and year-specific dummy variables.

RESEARCH DESIGN AND DESCRIPTIVE STATISTICS

Sample

To compile the sample of firms, we began with the population of nonfinancial, nonutility firms in the *ExecuComp* database for the period 1995–2003. The sample was restricted to those firms in which there was no change in the duality structure over the sample period.[8] This initial sample consisted of 3,153 firm-year observations. From this population, we deleted 1,039 observations with insufficient financial data in the *Compustat* database. We then discarded 127 observations due to lack of governance data in the Investor Responsibility Research Center (*IRRC*) database. An additional 107 firm-year observations were excluded because of insufficient data about CEO stock ownership in the *ExecuComp* database. Table 1 details how the selection criteria resulted in a final sample of 1,880 firm-year observations.

[8] The model as structured is inappropriate for dealing with firms that change their leadership structures during the sample period. For a study that examines the relationship between performance changes and changes in leadership structure within a selection bias framework, the reader is referred to Chen *et al*. (2008).

Descriptive statistics

Table 2 presents the distribution of our sample by industry and median values of main variables in our study. Table 2, Panel A, reports the median values of the dependent variables, while Table 2, Panel B, presents the median values of the independent variables. The industry distribution of our sample is similar to prior studies using comparable sample evidence (Frankel, Johnson, and Nelson, 2002; Whisenant, Sankaraguruswamy, and Raghunandan, 2003).

On average, companies in the pharmaceutical and extractive industries have performed best with a median Tobin's q of 3.15 and a median market return of over 18 percent, respectively, while firms in the mining and computer industries have done the worst with a Tobin's q of 0.97 and market return of −3.54 percent, respectively. In terms of accounting performance, retail industry firms have performed exceedingly well with an average (i.e., median) ROA of 7.12 percent while the computer industry has been the laggard with an average ROA of 4.40 percent and EPS of 0.02. Companies comprising the chemical industry have the largest board (10.00), headed by executives who have the lowest median stock ownership (0.00), but the highest median dividend payout ratio (33.01%). On the other hand, companies in the computer industry have the smallest board (7.00), the lowest leverage (0.03), and the lowest median dividend payout ratio (0%). Also, pharmaceutical firms have the lowest sales on average ($507 million), but the highest growth in revenue of 16.12 percent.

We employ a Wilcoxon rank-sum test[9] to test for significant differences in corporate governance,

[9] Wilcoxon rank-sum test is a nonparametric two-sample test that is solely based on the order (rank) in which the observations from the two samples fall.

Table 2. Descriptive statistics
Panel A—Medians of dependent variables

Industry	Number of firm years	MKTRET	TOBINSQ	ROA	EPS
Mining/construction	50	10.09	0.97	6.27	0.10
Textiles print/publish	154	4.84	1.14	5.74	0.06
Chemicals	97	10.07	1.15	4.93	0.05
Pharmaceuticals	75	7.55	3.15	6.44	0.03
Extractive	94	18.07	1.23	5.19	0.05
Durable	607	11.69	1.26	5.02	0.05
Computers	343	−3.54	1.95	4.40	0.02
Retail	270	8.09	1.44	7.12	0.06
Services	190	4.34	1.28	5.06	0.04
Overall	**1880**	**8.88**	**1.38**	**5.38**	**0.05**

Panel B—Medians of independent variables

Industry	INDMKTRET	INDTOBINSQ	INDROA	INDEPS	SALES	REVGWTH	OWN	BDSIZE	DAT	DVPOR
Mining/construction	27.75	1.01	6.85	0.11	2683	14.64	0.00	9.50	0.32	3.61
Textiles print/publish	9.07	1.32	6.06	0.05	1571	2.67	1.20	9.00	0.29	22.31
Chemicals	9.89	1.31	4.20	0.04	1806	2.86	0.00	10.00	0.28	33.01
Pharmaceuticals	30.54	3.89	1.67	−0.00	507	16.12	1.90	8.00	0.19	0.00
Extractive	34.98	1.36	4.73	0.04	986	14.50	1.15	8.00	0.26	7.33
Durable	9.75	1.39	4.54	0.04	1073	5.31	1.70	9.00	0.22	8.19
Computers	−5.94	2.36	1.48	−0.00	641	8.57	2.10	7.00	0.03	0.00
Retail	10.07	1.74	7.95	0.06	2737	10.17	1.50	9.00	0.19	0.00
Services	8.30	1.54	4.54	0.04	858	6.31	2.75	8.00	0.15	0.00
Overall	**9.46**	**1.55**	**4.61**	**0.04**	**1193**	**7.08**	**1.70**	**8.00**	**0.20**	**0.00**

Industry membership is determined by SIC code as follows: mining and construction (1000–1999, excluding 1300–1399), textiles and printing/publishing (2200–2799), chemicals (2800–2824, 2840–2899), pharmaceuticals (2830–2836), extractive (2900–2999, 1300–1399), durable manufacturers (3000–3999, excluding 3570–3579 and 3670–3679), computers (7370–7379, 3570–3579, 3670–3679), retail (5000–5999), and services (7000–8999), excluding 7370–7379). Financial services (6000–6999) firms, transportation (4000–4799), utilities (4900–4999), food (2000–2199) and others (000–0999, 9000–9999) are excluded from the sample. This classification is followed in the prior literature [see, Whisenant *et al.* (2003)].

TOBIN's q is defined as follows = (market value of equity + book value of preferred stock + book value of debt)/book value of total assets; *MKTRET* is one year total return to shareholders, including reinvestment of dividends; *ROA(%)*: return on assets defined as income before extraordinary items divided by total assets; *EPS:* earnings per share (scaled by beginning-of-period share price); *INDMKT, INDTOBINSQ, INDROA, INDEPS* are, respectively, the average (i.e., mean) market return, *TOBIN'S q*, *ROA*, and *EPS* of all firms within the same four-digit SIC code as the experimental firm; *REVGWTH* is the average growth in sales over the preceding five-year period; *OWN* is the percentage of common stocks held by CEO; *BDSIZE* is the number of board members of the firm; DAT is total debt over total assets; and *DVPOR* is the dividend payout ratio defined as the percentage of income before extraordinary items distributed as cash dividends.

Table 3. Descriptive statistics and two-sample tests on DUAL and NON-DUAL firms for the period 1995–2003

Independent variable	NON-DUAL firms (n = 390) Mean (Median)	DUAL firms (n = 1490) Mean (Median)	Wilcoxon Z (Prob > |Z|)
MKTRET (%)	22.361	17.447	1.083
	(12.218)	(8.436)	(0.279)
TOBIN'S q	2.215	1.914	2.275**
	(1.454)	(1.375)	(0.023)**
ROA (%)	4.240	4.019	0.910
	(5.775)	(5.275)	(0.363)
EPS	0.036	0.027	−0.485
	(0.043)	(0.047)	(0.628)
INDMKTRET (%)	24.982	23.874	−0.516
	(7.735)	(9.545)	(0.606)
INDTOBINSQ	2.087	1.881	2.841*
	(1.701)	(1.521)	(0.005)*
INDROA (%)	3.974	3.650	0.771
	(4.780)	(4.538)	(0.441)
INDEPS	0.031	0.024	0.320
	(0.036)	(0.039)	(0.749)
SALES	5534	4422	−5.324*
	(762)	(1303)	(0.000)*
REVGWTH (%)	12.474	9.330	2.276**
	(9.513)	(6.313)	(0.023)**
OWN (%)	2.061	5.675	−7.620*
	(1.10)	(1.800)	(0.000)*
BDSIZE	8.803	8.683	0.794
	(9.00)	(8.00)	(0.427)
DAT	0.183	0.217	−3.368*
	(0.164)	(0.216)	(0.001)*
DVPOR (%)	12.878	54.23	−2.840*
	(0.000)	(0.000)	(0.005)*

Notes:
** , * indicate two-tailed significance at the 0.05 and 0.01 levels respectively.
TOBIN's q is defined as follows = (market value of equity + book value of preferred stock + book value of debt)/book value of total assets; *MKTRET* is one year total return to shareholders, including reinvestment of dividends; *ROA(%)*: return on assets defined as income before extraordinary items divided by total assets; *EPS:* earnings per share (scaled by beginning-of-period share price); *INDMKT, INDTOBINSQ, INDROA, INDEPS* are, respectively, the average (i.e., mean) market return, *TOBIN'S q*, *ROA*, and *EPS* of all firms within the same four-digit SIC code as the experimental firm; *REVGWTH* is the average growth in sales over the preceding five-year period; *OWN* is the percentage of common stocks held by CEO; BDSIZE is the number of board members of the firm; DAT is total debt over total assets; and *DVPOR* is the dividend payout ratio defined as the percentage of income before extraordinary items distributed as cash dividends

financial, and all other explanatory variables between firms whose CEOs are *not* the chair of the board ($DUAL = 0$) and whose CEOs are ($DUAL = 1$). Table 3 offers a glimpse of the differences in these variables between non-dual (n = 390) and dual firm-year observations (n = 1, 490). Results from the two-sample difference test suggest that dual and non-dual firms are significantly different along several dimensions. For instance, dual firms, on average, have, lower Tobin's q, higher leverage, lower revenue growth and lower dividend payout ratio, and are managed by CEOs with substantially larger stock ownership. Despite these differences, we need to be cautious before drawing conclusions based on these univariate statistics.

MULTIVARIATE ANALYSIS

As noted above, the estimation of the model's structural parameters will proceed in a number of stages. In the first stage, Equation (17) is estimated by ML with standard errors robust to heteroskedasticity and autocorrelation. The results are reported in Table 4. The positive and significant coefficients on *LNSALES* and *PPEAT* are consistent with the hypothesis that larger, more complex firms benefit

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from focus, stability, and better communication offered by the dual governance structure. Inconsistent with this hypothesis are the negative and significant coefficients for the number of employees, *EMP*, and future growth opportunities as proxied by *REVGWTH*. The results also indicate a positive and significant impact of CEO stock ownership, *OWN*, on the likelihood of a dual structure. This finding provides some support for the contention that a CEO's stock ownership aligns managerial interest with shareholder interest and helps to lessen the agency costs that might arise from appointing the CEO as board chair. Conversely, it is also consistent with the power hypothesis—greater ownership provides the CEO with the leverage necessary to win appointment as the board's chair. Also, as expected, larger boards (*BDSIZE*) reduce the probability of selecting a dual governance structure since larger boards may be more easily manipulated by a CEO who also serves as board chair. Consistent with this is the finding that more independent boards (*INDBD*) increase the likelihood of a dual structure since they more effectively monitor the actions of the CEO. More minority directors (*MINONBRD*) are found to raise the probability of the dual structure, while interestingly, a greater number of employee directors (*EMPDIRS*) are shown to reduce it. The latter result may signal a reluctance on the part of a firm's employees to confer 'too much' power and authority upon the firm's executives. Finally, environmental munificence (*INDSLG5*) and uncertainty (*INDSLV5*) seem to play no significant role in the governance structure selection decision.

With the estimated parameters from Table 4, the cumulative standard normal distribution, Φ, and standard normal density, φ, are evaluated at $Z_j\hat{\gamma}$ for all observations. Using least squares with standard errors robust to heteroskedasticity and autocorrelation, we then estimate the operational versions of Equation (16) given by:

$$PERF_{ij} = \beta_{20} + \beta_{21} PERFLAG_j + \beta_{22} INDPERF_j + \beta_{23} LNSALES_j + \beta_{24} DAT_j + \beta_{25} REVGWTH_j + \beta_{26} DVPOR_j + \beta_{27} OWN_j + \beta_{28} BDSIZE_j + \beta_{29} INDBD_j + (\beta_{10} - \beta_{20})\hat{\Phi}_j + (\beta_{11} - \beta_{21})\hat{\Phi}_j PERFLAG_j + (\beta_{12} - \beta_{22})\hat{\Phi}_j INDPERF_j + (\beta_{13} - \beta_{23}) \hat{\Phi}_j LNSALES_j + (\beta_{14} - \beta_{24})\hat{\Phi}_j DAT_j + (\beta_{15} - \beta_{25})\hat{\Phi}_j REVGWTH_j + (\beta_{16} - \beta_{26})\hat{\Phi}_j DVPOR_j + (\beta_{17} - \beta_{27})\hat{\Phi}_j OWN_j + (\beta_{18} - \beta_{28}) \hat{\Phi}_j BDSIZE_j + (\beta_{19} - \beta_{29})\hat{\Phi}_j INDBD_j + (\sigma_{2u} - \sigma_{1u})\hat{\varphi}_j + \varepsilon_{ij} \quad (19)$$

for the four performance measures.[10] Recall that the purpose of this estimation is to determine specifically whether there is evidence that firms choose a dual or non-dual structure according to comparative advantage, and whether there are differences in the marginal performance impacts of the independent variables between the two governance structures. Results are reported in Table 5.

Table 4. Maximum likelihood estimates of selection equation

Variable	Est. coef.	Std. err.	Z	P-value
LNSALES	0.248	0.065	3.80	0.000***
PPEAT	0.640	0.389	1.64	0.100*
EMP	−0.002	0.001	−2.88	0.004***
SEGNUM	−0.005	0.046	−0.11	0.908
REVGWTH	−0.003	0.001	−2.33	0.020**
OWN	0.090	0.025	3.61	0.000***
BDSIZE	−0.084	0.040	−2.09	0.036**
INDBD	0.013	0.005	2.85	0.004***
EMPDIRS	−0.225	0.081	−2.77	0.006***
MINONBRD	0.293	0.113	2.60	0.009***
FEMONBRD	0.045	0.096	0.47	0.636
INDSLG5	0.008	0.006	1.35	0.176
INDSLV5	0.216	0.854	0.25	0.800
constant	−0.725	0.754	−0.96	0.336
Number of obs		1880		
Wald $\chi^2(25)$		104.83		
P-value		0.000***		
Pseudo r^2		0.174		

*, **, *** indicate significance at the 0.10, 0.05, and 0.01 levels for a two-tailed test. Estimated coefficients for year and industry dummy variables not reported. Standard errors are robust to heteroskedasticity and autocorrelation.

[10] Year and industry dummies along with the associated interaction terms are included in the estimation but are not shown in the text of Equation (19) in the interest of space. The reader will also note that all independent variables have been mean-centered in accordance with the work of Irwin and McClelland (2001) on moderated multivariate regression models. This is true for all estimations in this study that include interaction terms. We thank an anonymous referee for this suggestion.

Table 5. Parameter estimates—Equation (19)—testing for two regimes and comparative advantage

	Dependent variable							
	MKTRET		*TOBINSQ*		*ROA*		*EPS*	
Variable	**Est. coef.**	**P-value**	**Est. coef.**	**P-value**	**Est. coef.**	**P-value**	**Est. coef.**	**P-value**
MKTRETLAG	−0.046	0.670						
INDMKTRET	0.438	0.054*						
TOBINSQLAG			−0.298	0.058*				
INDTOBINSQ			1.973	0.000***				
ROALAG					0.464	0.059*		
INDROA					1.005	0.021**		
EPSLAG							1.171	0.001***
INDEPS							−2.386	0.004***
LNSALES	7.991	0.041**	0.094	0.590	1.812	0.171	0.024	0.008***
DAT	−0.099	0.781	0.029	0.123	−0.068	0.603	0.000	0.697
REVGWTH	0.309	0.359	0.008	0.202	0.044	0.469	0.000	0.453
DVPOR	−0.039	0.035**	0.000	0.612	0.004	0.179	0.000	0.485
OWN	0.166	0.932	0.091	0.135	−0.714	0.080*	0.001	0.817
BDSIZE	−4.079	0.117	−0.259	0.009***	−1.381	0.056*	−0.015	0.001***
INDBD	−0.145	0.748	0.007	0.678	−0.117	0.381	−0.001	0.199
Φ_*MKTRETLAG*	−0.134	0.332						
Φ_*INDMKTRET*	0.216	0.490						
Φ_*TOBINSQLAG*			0.785	0.001***				
Φ_*INDTOBINSQ*			−1.627	0.003***				
Φ_*ROALAG*					−0.211	0.503		
Φ_*INDROA*					−0.403	0.432		
Φ_*EPSLAG*							−1.108	0.009***
Φ_*INDEPS*							3.975	0.000***
Φ_*LNSALES*	−9.555	0.049**	−0.083	0.670	−0.968	0.541	−0.025	0.024**
Φ_*DAT*	−0.141	0.758	−0.047	0.033**	−0.028	0.854	−0.001	0.258
Φ_*REVGWTH*	0.049	0.909	−0.002	0.819	0.042	0.565	0.000	0.824
Φ_*DVPOR*	0.039	0.040**	0.000	0.633	−0.004	0.172	0.000	0.399
Φ_*OWN*	−0.020	0.992	−0.091	0.142	0.727	0.075*	−0.001	0.784
Φ_*BDSIZE*	4.081	0.206	0.277	0.015**	1.677	0.043**	0.020	0.001***
Φ_*INDBD*	0.262	0.632	−0.003	0.845	0.124	0.423	0.001	0.197
Φ	43.686	0.458	0.795	0.598	2.689	0.799	−0.431	0.006***
φ	5.090	0.874	0.172	0.875	1.176	0.877	0.028	0.647
Constant	−39.651	0.457	−0.516	0.712	−7.892	0.416	0.366	0.007***
Number of obs.	1880		1880		1880		1880	
F (44, 530)	17.64		38.95		22.75		14.03	
P-value	0.000***		0.000***		0.000***		0.000***	
r^2	0.321		0.551		0.480		0.707	

*, **, *** indicate significance at the 0.10, 0.05, and 0.01 levels for a two-tailed test. Coefficients for year and industry dummy variables not reported. Standard errors are robust to heteroskedasticity and autocorrelation.

Selection under comparative advantage requires the estimate of $(\sigma_{2u} - \sigma_{1u})$ to be positive or $\sigma_{2u} > \sigma_{1u}$. Examining the results in the row labeled φ, all parameter estimates are positive, but all are highly insignificant with p-values well in excess of the standard significance levels. Hence, we cannot reject the null hypothesis that $(\sigma_{2u} - \sigma_{1u}) = 0$, or equivalently, there is no evidence that firms choose their governance structure based on comparative advantage. Hypothesis 1 is rejected. The result is consistent with the sample means reported in Table 3, which show that the mean performance levels over the sample period were lower for firms with a dual governance structure. Table 5 also shows a number of significant interaction terms suggesting that the marginal performance impacts of at least some variables may differ for dual versus non-dual firms.

For each of the performance measures, a single equation is now estimated by least squares

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with robust standard errors. The dummy variable *DUAL* is included as a shift parameter and is interacted with those explanatory variables identified in Table 5 as possibly having differential marginal performance impacts for dual versus non-dual firms. To account for selection bias, the equations include the hazard variable, $\hat{H}_j$, henceforth labeled as *HAZARD*.

The results, reported in Table 6, indicate that selection bias is present in the *MKTRET* and *EPS* equations as the estimated coefficients on *HAZARD* are positive and significant at a five percent level, that is, Hypothesis 2 is rejected.[11] Selection bias does not seem to be problematic when performance is measured by *TOBINSQ* or *ROA*. In addition, the dual governance structure shifts the performance relationship significantly only when performance is measured as *MKTRET*. *Ceteris paribus*, dual governance increases a firm's market return by about 17.9 percent relative to the non-dual structure, excluding the quantitative impact of the selection bias.

Before returning to the selection bias issue below, we first offer a brief discussion of some other results in Table 6. Results that are robust across the equations are that the previous level of the firm's performance (*PERFLAG*), the overall industry level of performance (*INDPERF*), and a firm's revenue growth (*REVGWTH*), are highly significant in explaining current performance levels. Moreover, there is a positive and significant moderating influence of the dual structure on the performance impact of industry performance for the *EPS* equation with a fairly large point estimate of 0.877 on *DUAL_INDEPS*. The positive coefficients for *LNSALES* imply that larger firms perform better than smaller firms, though the estimates are significant only for *ROA* and *EPS*. The negative coefficients on *DUAL_LNSALES* suggest that larger firms do poorer under a dual structure, though none are statistically significant. More leverage (*DAT*) has a significant adverse impact on a firm's *MKTRET*, its *ROA*, and its *EPS*. Dividends as a proportion of operating income (*DVPOR*) have a significant negative impact on performance when measured by market return, which is contrary to expectations according to the free cash flow/managerial alignment argument. However, for dual firms this is almost entirely offset by a positive and significant moderating influence of the dual governance structure as evidenced by the point estimate on *DUAL_DVPOR*. In contrast, the free cash flow/managerial argument for a positive performance impact of *DVPOR* seems to be supported for performance measured as *TOBINSQ* and *EPS*, though the point estimates are quite small. CEO stock ownership (*OWN*) is significant only for *EPS* with more ownership leading to poorer performance. Larger boards are estimated to have a negative impact on *MKTRET*, *ROA*, and *EPS*, though the point estimate is significant only for *ROA*. Dual structured firms with larger boards seem to have higher *EPS* ratios than their non-dual counterparts according to the positive and significant coefficient on *DUAL_BDSIZE*. Board independence is insignificant in three out of the four equations, but is positively and significantly associated with a firm's *EPS*.

More on selection bias

In extending our discussion of selection bias, it is useful to recall Equations (9) and (10), which show the expected values of firm performance conditional on governance structure. The difference in expected performance between dual and non-dual firms can be derived by subtracting Equation (10) from Equation (9). Since the hypothesis that $(\sigma_{2u} - \sigma_{1u}) = 0$ could not be rejected, we set $\sigma_{1u} = \sigma_{2u} = \sigma$ and write this difference as:

$$E(Y_{1j}|I_j = 1) - E(Y_{2j}|I_j = 0) = X_j(\beta_1 - \beta_2) - \sigma\left(\frac{\varphi(Z_j\gamma)}{\Phi(Z_j\gamma)[1 - \Phi(Z_j\gamma)]}\right) \quad (20)$$

where the ratio in parentheses on the right-hand side is equal to $(H_{1j} + H_{2j})$, henceforth labeled as *SELECT*. With $\sigma > 0$, Equation (20) implies that firms that select the dual (non-dual) structure perform poorer (better), on average, than under random assignment due to the correlation between the nonobservables of the selection equation and the nonobservables of the performance equation,

[11] The variables *PPEAT, EMP, SEGNUM, EMPDIRS, MINONBRD, FEMONBRD, INDSLG5*, and *INDSLV5* are treated as instrumental variables, included in the selection equation but excluded from the performance equations. A test of weak instruments strongly rejected the null hypothesis that all instrumental variables coefficients are jointly zero in the selection equation (p-value = 0.0019). Subsequent, Sargan tests for instrument validity do not reject the null hypotheses that all of the overidentifying restrictions (surplus moment conditions) are valid with p-values well above standard levels. Details are available upon request.

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Table 6. Performance equation estimates—testing for selection bias

Dependent variable											
MKTRET			*TOBINSQ*			*ROA*			*EPS*		
Variable	**Est.coef.**	**P-value**	**Variable**	**Est.coef.**	**P-value**	**Variable**	**Est.coef.**	**P-value**	**Variable**	**Est.coef.**	**P-value**
MKTRETLAG	−0.150	0.000***	*TOBINSQLAG*	0.272	0.059*	*ROALAG*	0.312	0.000***	*EPSLAG*	0.293	0.008***
INDMKTRET	0.604	0.000***	*DUAL_TOBINSQLAG*	−0.074	0.650	*INDROA*	0.684	0.000***	*DUAL_EPSLAG*	−0.089	0.536
LNSALES	1.173	0.433	*INDTOBINSQ*	1.125	0.008***	*LNSALES*	1.281	0.000***	*INDEPS*	0.427	0.020**
DUAL_LNSALES	−1.014	0.560	*DUAL_INDTOBINSQ*	−0.445	0.291	*DAT*	−0.087	0.001***	*DUAL_INDEPS*	0.877	0.013**
DAT	−0.186	0.008***	*LNSALES*	0.003	0.948	*REVGWTH*	0.066	0.001***	*LNSALES*	0.007	0.053*
REVGWTH	0.352	0.000***	*DAT*	−0.004	0.388	*DVPOR*	2E-05	0.605	*DUAL_LNSALES*	−0.005	0.295
DVPOR	−0.210	0.000***	*DUAL_DAT*	−0.007	0.283	*OWN*	−0.195	0.172	*DAT*	6E-04	0.000***
DUAL_DVPOR	0.209	0.000***	*REVGWTH*	0.008	0.000***	*DUAL_OWN*	0.194	0.164	*REVGWTH*	3E-04	0.006***
OWN	0.096	0.483	*DVPOR*	−1.3E-05	0.041**	*BDSIZE*	−0.475	0.045**	*DVPOR*	3E-06	0.030**
BDSIZE	−0.887	0.167	*OWN*	−0.005	0.221	*DUAL_BDSIZE*	0.393	0.138	*OWN*	−0.001	0.084*
INDBD	0.028	0.700	*BDSIZE*	0.001	0.990	*INDBD*	−0.015	0.401	*BDSIZE*	−0.003	0.126
DUAL	17.899	0.053*	*DUAL_BDSIZE*	−0.036	0.477	*DUAL*	3.965	0.151	*DUAL_BDSIZE*	0.005	0.048**
HAZARD	10.765	0.049**	*INDBD*	0.001	0.786	*HAZARD*	1.434	0.363	*INDBD*	3E-04	0.083*
Constant	−5.520	0.572	*DUAL*	0.243	0.468	*constant*	0.931	0.763	*DUAL*	−0.055	0.191
			HAZARD	0.149	0.454				*HAZARD*	0.029	0.044**
			constant	1.898	0.000***				*constant*	0.035	0.340
Number of obs	1880		Number of obs	1880		Number of obs	1880		Number of obs	1880	
F (25, 530)	24.99		F (28, 530)	48.46		F (32, 530)	23.01		F (37, 530)	11.80	
P-Value	0.000***		P-Value	0.000***		P-Value	0.000***		P-Value*	0.000***	
R^2	0.320		R^2	0.523		R^2	0.466		R^2	0.658	

*, **, *** indicate significance at the 0.10, 0.05, and 0.01 levels for a two-tailed test. Coefficients for year and industry dummy variables not reported. Standard errors are robust to heteroskedasticity and autocorrelation.

that is, the correlation of the disturbances. This can be seen more clearly from a simple rewriting of Equations (7) and (8) with σ in place of both σ_{1u} and σ_{2u}

$$E(Y_{1j}|I_j = 1) = X_j\beta_1 + E(\varepsilon_{1j}|I_j = 1)$$
$$= X_{1j}\beta_1 - \sigma\left(\frac{\varphi(Z_j\gamma)}{\Phi(Z_j\gamma)}\right)$$
$$E(Y_{2j}|I_j = 0) = X_j\beta_2 + E(\varepsilon_{2j}|I_j = 0)$$
$$= X_{2j}\beta_2 + \sigma\left(\frac{\varphi(Z_j\gamma)}{1 - \Phi(Z_j\gamma)}\right)$$

A quantitative assessment of Equation (20) at the sample means is straightforward. Since the mean-centered interaction terms, by construction, will equal zero at their sample means, the predicted difference in the mean performance levels can be written simply as:

$$DIFF = \hat{\delta}_0 - \hat{\sigma} \times SELECT \qquad (21)$$

where $\hat{\delta}_0$ is the estimated coefficient on *DUAL* and $\hat{\sigma}$ is the estimated coefficient on *HAZARD*. The sample mean of *SELECT* is calculated as the sample mean of:

$$\left(\frac{\varphi(Z_j\hat{\gamma})}{\Phi(Z_j\hat{\gamma})[1 - \Phi(Z_j\hat{\gamma})]}\right)$$

where the values of the vector $\hat{\gamma}$ are taken from the maximum likelihood estimates presented in Table 4.

For the market return equation, $\hat{\delta}_0 = 17.9$, $\hat{\sigma} = 10.8$, and the sample mean of $SELECT = 1.96$. Using Equation (21), this yields a selection bias of −21.1 and a predicted difference in mean returns of −3.2 percent. The actual difference in the sample mean market returns is about −4.9 percent. A similar calculation for the difference in mean *EPS* ratios yields a selection bias of −0.057 and a predicted difference in means of −0.110. The actual sample mean *EPS* difference is approximately −0.009.

Does accounting for selection bias matter?

An obvious yet important question is whether or not our approach in accounting for selection bias yields fundamentally different conclusions from those that would be reached under (1) a conventional dummy variable approach and (2) the standard treatment effects approach. To offer some insight, we report the results from these two approaches in Tables 7 and 8, respectively.[12]

A comparison of the results from Table 6 with those from Table 7 reveals a dramatic difference when measuring performance by market return. Specifically, the conventional dummy variable model shows a negative and statistically significant impact of CEO duality on market return with the point estimate suggesting that dual governance firms, on average, yield a market return that is almost six percentage points lower than non-dual firms. Clearly, in this instance, neglecting selection bias leads to very different conclusions regarding the relationship between CEO duality and firm performance. This does not seem to extend to the case where *EPS* is taken as the measure of performance. Though the sign on *DUAL* from Table 7 is opposite to that from Table 6, neither of the coefficients is significant at standard levels.

Additionally, we estimated the conventional dummy variable model including all of the interaction terms appearing in Table 6. Here, we discuss selected results only.[13] Using market return as the measure of performance, the estimated coefficient on *DUAL* was 0.489 with a p-value of 0.818, indicating in this case that the dual governance structure has no impact on firm performance except through a significant moderating effect on the performance impact of *DVPOR* similar to that reported in Table 6. Including the interaction terms in the conventional version of the *EPS* equation resulted in an estimated coefficient on *DUAL* equal to −0.099 with a p-value of 0.009, implying a negative independent impact of CEO duality on firm performance. The estimated coefficients on the interaction terms were virtually identical in magnitude and significance to those reported in Table 6, suggesting that CEO duality may have positive moderating influences on the performance impacts of other explanatory variables. Again, it seems clear that a failure to account for selection bias can have serious impacts on the conclusions to be drawn from such analyses.

[12] Though we report the results for *TOBINSQ* and *ROA*, they are not discussed as they are qualitatively the same as Table 6, and at this juncture, not very interesting.

[13] The entire set of results is available from the authors upon request.

Table 7. Performance equation estimates—conventional dummy variable approach

Dependent variable											
MKTRET			*TOBINSQ*			*ROA*			*EPS*		
Variable	**Est. coef.**	**P-value**	**Variable**	**Est. coef.**	**P-value**	**Variable**	**Est. coef.**	**P-value**	**Variable**	**Est. coef.**	**P-value**
MKTRETLAG	−0.149	0.000***	*TOBINSQLAG*	0.216	0.005***	*ROALAG*	0.315	0.000***	*EPSLAG*	0.222	0.015**
INDMKTRET	0.604	0.000***	*INDTOBINSQ*	0.809	0.000***	*INDROA*	0.676	0.000***	*INDEPS*	1.230	0.000***
LNSALES	1.206	0.201	*LNSALES*	0.017	0.639	*LNSALES*	1.407	0.000***	*LNSALES*	0.005	0.042**
DAT	−0.189	0.007***	*DAT*	−0.009	0.013**	*DAT*	−0.087	0.001***	*DAT*	−0.001	0.001***
REVGWTH	0.340	0.000***	*REVGWTH*	0.008	0.000***	*REVGWTH*	0.063	0.001***	*REVGWTH*	3E-04	0.034**
DVPOR	−0.002	0.002***	*DVPOR*	6E-06	0.404	*DVPOR*	−2E-05	0.622	*DVPOR*	3E-06	0.060*
OWN	0.238	0.050**	*OWN*	−0.002	0.575	*OWN*	0.009	0.702	*OWN*	−0.001	0.196
BDSIZE	−1.395	0.021**	*BDSIZE*	−0.029	0.195	*BDSIZE*	−0.216	0.163	*BDSIZE*	−2E-04	0.868
INDBD	0.113	0.076*	*INDBD*	0.002	0.447	*INDBD*	−0.004	0.774	*INDBD*	−10E-05	0.493
DUAL	−5.857	0.023**	*DUAL*	−0.074	0.497	*DUAL*	−0.292	0.689	*DUAL*	0.003	0.711
constant	−1.180	0.898	*constant*	0.371	0.274	*constant*	−5.785	0.007***	*constant*	−0.077	0.012**
Number of obs	1880		Number of obs	1880		Number of obs	1880		Number of obs	1880	
F (22, 530)	27.78		F (22,530)	27.15		F(22,530)	35.31		F(22,530)	15.92	
P-value	0.000***		P-value	0.000***		P-value	0.000***		P-value	0.000***	
R^2	0.318		R^2	0.503		R^2	0.463		R^2	0.635	

*, **, *** indicate significance at the 0.10, 0.05, and 0.01 levels for a two-tailed test. Coefficients for year and industry dummy variables not reported. Standard errors are robust to heteroskedasticity and autocorrelation.

Table 8. Performance equation estimates—standard treatment effects approach

Dependent variable											
MKTRET			*TOBINSQ*			*ROA*			*EPS*		
Variable	**Est. coef.**	**P-value**	**Variable**	**Est. coef.**	**P-value**	**Variable**	**Est. coef.**	**P-value**	**Variable**	**Est. coef.**	**P-value**
MKTRETLAG	−0.150	0.000***	*TOBINSQLAG*	0.216	0.005***	*ROALAG*	0.315	0.000***	*EPSLAG*	0.222	0.015**
INDMKTRET	0.606	0.000***	*INDTOBINSQ*	0.809	0.000***	*INDROA*	0.675	0.000***	*INDEPS*	1.228	0.000***
LNSALES	0.461	0.630	*LNSALES*	0.015	0.681	*LNSALES*	1.338	0.000***	*LNSALES*	0.003	0.207
DAT	−0.191	0.006***	*DAT*	−0.009	0.013**	*DAT*	−0.087	0.001***	*DAT*	−0.001	0.000***
REVGWTH	0.353	0.000***	*REVGWTH*	0.008	0.000***	*REVGWTH*	0.064	0.001***	*REVGWTH*	3E-04	0.017**
DVPOR	−0.002	0.001***	*DVPOR*	−6E-06	0.402	*DVPOR*	2E-05	0.612	*DVPOR*	3E-06	0.058*
OWN	0.103	0.455	*OWN*	−0.003	0.542	*OWN*	−0.004	0.872	*OWN*	−0.001	0.088*
BDSIZE	−1.020	0.110	*BDSIZE*	−0.028	0.224	*BDSIZE*	−0.180	0.234	*BDSIZE*	0.001	0.656
INDBD	0.034	0.641	*INDBD*	0.002	0.536	*INDBD*	−0.012	0.516	*INDBD*	−3E-04	0.128
DUAL	10.283	0.263	*DUAL*	−0.027	0.928	*DUAL*	1.224	0.620	*DUAL*	0.040	0.084*
HAZARD	10.066	0.061*	*HAZARD*	0.029	0.861	*HAZARD*	0.946	0.551	*HAZARD*	0.023	0.089*
constant	−7.979	0.452	*constant*	0.351	0.361	*constant*	−6.411	0.011**	*constant*	−0.092	0.005***
Number of obs	1880		Number of obs	1880		Number of obs	1880		Number of obs	1880	
F (23, 530)	26.7		F (23, 530)	26.38		F (23, 530)	32.53		F (23, 530)	15.21	
P-value	0.000***		P-value	0.000***		P-value	0.000***		P-value	0.000***	
R^2	0.319		R^2	0.503		R^2	0.463		R^2	0.636	

*, **, *** indicate significance at the 0.10, 0.05, and 0.01 levels for a two-tailed test. Coefficients for year and industry dummy variables not reported. Standard errors are robust to heteroskedasticity and autocorrelation.

Turning now to Table 8, which presents the results from the estimation of a standard treatment effects model, we see that for both the *MKTRET* and the *EPS* equations, selection bias is supported with estimated coefficients on *HAZARD* statistically significant at less than 10 percent. Note also that the point estimates are almost identical to the values shown in Table 6. A difference, however, lies in the estimated coefficient on *DUAL*. In the market return equation, it is statistically insignificant, implying no independent impact of the dual structure on firm performance. Conversely, in the earnings per share equation the coefficient is positive and significant, indicating a beneficial independent impact of CEO duality on firm performance. These results suggest that at least with this sample dataset, the standard treatment effects model is equally capable of accounting for selection bias. However, a *formal* testing of the endogenous switching regression model allows for the identification of potentially significant interaction terms which, if not included, can bias the estimate of the *independent* performance effect of CEO duality. A lesson to be drawn from this is that accounting for possible moderating influences of CEO duality on the performance impact of other relevant variables is important for identifying the independent performance impact of the dual governance structure.

Robustness tests

The durable goods industry comprises almost one-third of the entire sample of firm-year observations. The model was estimated for this industry only. Qualitatively, the results for *MKTRET, TOBINSQ*, and *ROA* remained unchanged from what is reported in Table 6. For *EPS*, however, selectivity bias was no longer significant. We also estimated the model for the computer and retail industries individually. No selectivity bias was found for any of the performance measures, nor did we find any significant marginal performance impacts of CEO duality. The model was estimated with no interaction terms and with a complete set of possible interaction terms in the four performance equations. The results for *MKTRET* and *EPS* again were consistent with those reported in Table 6, both qualitatively and quantitatively. The same was true for *TOBINSQ*. For the *ROA* equation including the complete set of interaction terms, we found a marginal selectivity bias (p-value $= 0.105$) with a positive and significant main effect of duality on *ROA*. Finally, each of the performance equations was estimated including all of the variables appearing in the selection equation. In other words, there was no set of instrumental variables so that identification of the performance equations relies solely on the nonlinearities of the hazard variable. For all performance equations, no significant selectivity bias was detected, nor was any significant independent performance impact of CEO duality. Results for all robustness tests are available upon request.

SUMMARY AND CONCLUDING REMARKS

This study has focused explicitly on the methodological implications of the endogenous theory of governance as applied to firm performance. In particular, if firms choose their governance structures as part of a constrained performance maximization process, then application of an appropriate empirical methodology should reveal some statistical evidence of such behavior. Heretofore, no study has employed such a methodology. In this study, we have taken advantage of the endogenous switching regression model framework to do just that. The model allowed us to test explicitly for selection behavior in accordance with comparative advantage and, concomitantly, the presence of selectivity bias in estimating the impact of CEO duality on firm performance. The selection and performance equations were modeled in accordance with the extant accounting, economics, and management literature on the impact of the dual governance structure on firm performance. We tested four performance measures for the entire sample of firm-year observations as well as for the largest three industries in terms of sample sizes. Comparisons were made with a conventional dummy variable model with no accounting for selection bias, as well as with the standard treatment effects model.

Overall, our results suggest that a firm's selection of the dual governance structure is not consistent with either comparative advantage or the objective of maximizing firm performance. Indeed, with respect to performance as measured by market returns or by earnings per share, the selection of the dual structure, on average, is clearly suboptimal. In the terminology of Kang and Zardkoohi (2005), CEO duality seems to be an organizational practice that is adopted under (*nonobservable*) conditions that are *inappropriate* with regard to firm performance. Comparison with a standard treatment effects model corroborated the presence of a significant selectivity bias in the market return and earnings per share performance equations. For particular firms, however, we have provided some evidence that the adverse performance consequences of such selection bias may be mitigated by the moderating influences of CEO duality on the impacts of other performance-related variables. We also find a significant independent positive performance impact of the dual leadership structure for only market return, consistent with arguments that a dual structure provides a single focal point, firm stability, and better communication between management and the board.

The findings of no selectivity bias when performance is measured by Tobin's q and ROA are inconsistent with the theory that governance is endogenous with respect to performance. Specifically, the results of this study suggest that firms do not sort themselves between the two governance structures strategically with the objective of improving performance, but rather do so in a way that neither improves nor worsens performance relative to what it would be under simple random assignment.

Of course, no study is without its limitations and ours is no exception. The selection of CEO duality is the sole governance choice that we consider. That, of course, is a simplification and it might be that a model endogenizing a number of other governance choices would reveal some sort of constrained performance maximizing behavior. Additionally, we measure performance using four often used metrics that certainly do not constitute an exhaustive list of possible performance measures. Using other measures could possibly lead to different conclusions. It also could be that performance is not an objective itself, but acts as a constraint on the optimization of some other objective or criterion, possibly only known to the management of the firm. Finally, unlike Chen *et al.* (2008), we exclude firms that changed leadership structure one or more times over the sample period. Closer examination of these firms could certainly yield different results.

Even with these limitations, however, we believe the study makes an important contribution that should not be overlooked. In particular, if one subscribes to an endogenous theory of governance, then the empirical methodology of any associated study of the impacts of corporate governance on firm 'objectives' must address explicitly the issue of self-selection. Otherwise, within such a theoretical context, the empirical results would have to be considered unreliable because of their susceptibility to selectivity bias. In this regard, ironically, our study provides some retroactive support to previous research using conventional econometric techniques to examine the relationship between CEO duality and firm performance measured by Tobin's q or ROA. Finally, even with the selectivity bias framework, researchers would be well advised not to ignore potential moderating influences that governance structures may have on the impact of other performance-related factors, as this may yield biased estimates of the governance structure's independent performance effect.

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