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CEO Duality and Firm Performance Revisited

**Ali Mohammadi
Nada O. Basir
Hans Lööf**

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CEO DUALITY AND FIRM PERFORMANCE REVISITED

Ali Mohammadi¹, Nada O. Basir², & Hans Lööf³

Abstract: This paper replicates and extends the empirical work of Boyd's 1995 article: *CEO Duality and Firm Performance: A Contingency Model*. We retest Boyd's hypotheses using a database of over 11,000 Swedish firms from the year 2005 to 2009. Similar to Boyd, we find that CEO duality is positively correlated to firm performance and the effect varies across environmental dimensions of munificence, dynamism and complexity. Using quantile regression, we also show that the positive impact of CEO duality increases by firm performance. Our findings hold after we control for potential endogeneity concerns.

Keywords: CEO duality, boards of directors, agency theory, stewardship theory, replication

JEL Codes: G30, G34; L25

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¹ Centre of Excellence in Science & Innovation Studies (CESIS) Department of Industrial Economics and Management, Royal Institute of Technology (KTH) SE-100 44 Stockholm, Sweden. Phone: +46 8 7906269. E-mail: ali.mohammadi@indek.kth.se

² Faculty of Business and IT, University of Ontario Institute of Technology, 2000 Simcoe Street North, Oshawa, Ontario, Canada, L1H 7K4. Phone: (905) 721-8668 ext. 5440. E-mail: nada.basir@uoit.ca

³ Centre of Excellence in Science & Innovation Studies (CESIS) Department of Industrial Economics and Management, Royal Institute of Technology (KTH), SE-100 44 Stockholm, Sweden. Phone: +46 8 7908012. E-mail: hans.loof@indek.kth.se

INTRODUCTION

CEO duality, when the same person holds both the CEO and board chairperson positions in a corporation (Rechner and Dalton, 1991), has been the subject of academic interest for more than 20 years (Krause, Semadeni, and Cannella, 2014). Finkelstein and D'Aveni's (1994) foundational article on the topic discussed the "double-edged sword" the practice introduces due to the contradictory objectives and tradeoffs associated with duality. On the one hand, duality establishes a unity of command leading to effective decision making at the top of the firm. On the other hand, the consolidation of power can entrench a CEO and therefore prevent the board's ability to effectively monitor and discipline the CEO. Their article led to a flourish of theoretical and empirical research examining the relationship between CEO duality and firm performance. This research has provided great insight, however results have been mixed. From a theoretical perspective, proponents of CEO duality argue that when a CEO also serves as board chair, the board's ability to effectively monitor a CEO's decisions is hampered. This creates greater opportunities for CEOs to advance their personal interests to the (possible) detriment of the firm's shareholders (Finkelstein and D'Aveni, 1994). On the other hand, CEO duality is argued to provide a single focal point for leadership. This leads to an image of firm stability, and fosters better communication between management and the board of directors (Anderson and Anthony, 1986; Davis, 1991; Finkelstein *et al.*, 1994). Empirical results are similarly mixed. Research has shown that firms with independent leadership structures tend to outperform those with a duality structure (Daily and Dalton, 1994; Pi and Timme, 1993; Rechner and Dalton, 1991). However, various studies have also provided evidence that CEO duality actually has a positive relationship to firm performance (e.g. Boyd, 1995; Sridharan and Marsinko, 1997).

This lack of consensus among researchers and practitioners has motivated a call for research in the area of CEO duality. More recently, Dalton and Dalton (2011) listed CEO

duality as one of the most contentious issues in the area of corporate governance. Given the continued scholarly interest in the topic, the purpose of this study is to conduct a replication of Boyd's 1995 (hereafter: Boyd) fundamental piece of work on CEO duality and firm performance and extend his study by performing additional analysis to gain a better understanding of the CEO duality and firm performance relationship.

The importance of replication studies has been well established in the literature (Dewald, Thursby, and Anderson, 1986; Hubbard, Vetter, and Little, 1998; Tsang and Kwan, 1999; Singh, Ang, and Leong, 2003). Replications serve a fundamental role of ensuring validity and reliability of research, and are considered necessary for scientific rigor and increasing confidence in generalization, and protecting against erroneous empirical results (Eden, 2002; Hubbard and Vetter, 1996; Singh *et al.*, 2003). They are "as important as the core academic practices of peer review and publication of research, and [are] necessary for any stream of scientific inquiry to develop the requisite rigor of science (Singh *et al.*, 2003: 534). Despite the importance of replication studies, few are present in the management and social science literatures. There have been many calls for studies that replicate previous work (e.g. Hubbard *et al.*, 1998; Hamermesh, 2007; Singh *et al.*, 2003) and a call for a better balance between the publication of 'novel' results on one hand, and replication research on the other (Hubbard *et al.*, 1998). Even the mainstream press has taken an interest in the need for replication studies as they question scientific findings. Replication studies are needed to protect against the assimilation of erroneous empirical results. Replications with extensions are especially important as they help determine "the scope and limits of initial findings by seeing if they can be generalized to other populations, time periods, organizations, geographical areas, measurement instruments, contexts, and so on" (Hubbard *et al.*, 1998: 244).

Our study represents a replication with extension. It is similar to Boyd's in that we consider the moderating effects of environmental factors on CEO-duality and the performance

relationship. However, we extend Boyd's work by testing his hypotheses in a different context and use both private and public firms. Furthermore, we improve on Boyd's empirical methodology by considering several confounding factors that affect firm performance and control for various firm, board of directors, and CEO characteristics.

This paper is structured as follows: We first present a review of Boyd's original paper, including the theoretical background, methodology and findings. Next, we outline our methodology and results. Finally, we discuss the implications of these findings for our understanding of the relationship between CEO duality and performance.

BOYD'S CEO DUALITY AND FIRM PERFORMANCE MODEL

Research on the performance consequences of CEO duality and firm performance has mostly relied on two contrasting theories: agency theory and stewardship theory. Agency theory is concerned with the problem that arises when the goals of a principle (e.g., shareholders) and an agent (e.g., a CEO) conflict (see Eisenhardt, 1989 for an overview). This is especially problematic when the decision maker has little or no financial interest in the outcome of his decisions (Fama and Jensen, 1983). To reduce agency problems, firms delegate the task of decision management to the CEO, and decision control to the board. Therefore, the CEO's primary responsibility becomes the initiation and implementation of strategic decisions, while the board is responsible for ratifying and monitoring decisions by the CEO. A CEO who also serves as chairman of the board reduces board control and facilitates the potential pursuit of the CEO's agenda, which may differ from shareholder goals. Thus, agency theory would propose that combining CEO and chairman positions would weaken board control and negatively affect firm performance.

Unlike agency theory, stewardship theory assumes that managers are stewards whose behaviors are aligned with the objectives of their principals (Donaldson, 1990a, 1990b). The

theory draws from organizational theory and argues that managers are not just motivated by financial means. It views managers as loyal to the company and interested in achieving high performance. Thus they are motivated by their desire to excel and a need to deliver results and thereby gain recognition from their peers (Herzberg, Mausner, and Snyderman, 1959; McClelland, 1961). This intrinsic satisfaction is what directs them to accomplish their job and perform challenging work.

Boyd proposes that “elements of both theories are likely to be present” (Boyd, 1995: 304), and sets out to answer the critical question: “under what circumstances does the consolidation of power and decision-making afforded by duality outweigh the potential abuses described by the agency model?” To answer this question he argues that boards are a mechanism to manage external dependencies and reduce environmental uncertainties, and the characteristics of the board will vary depending on the environment. He therefore proposes that the duality-performance relationship is moderated by environmental uncertainty. His study provides evidence that indicates that duality can help firm performance under the right circumstances. More specifically, CEO duality leads to better firm performance under conditions of high environmental uncertainty because CEO duality provides increased responsiveness and consolidation of power. On the other hand, in stable environments there is a lesser need for powerful CEOs. Boyd draws on previous research by Dess and Beard (1984) that characterizes environmental uncertainty using three dimensions: munificence (the abundance of resources in the environment), dynamism (how volatile the environment is), and complexity (the inequality among competitors). He argues that duality is advantageous under conditions of resource scarcity, volatility and/or complexity.

In the final paragraph of Boyd’s paper, he calls for future research to examine the effects of CEO duality on performance among foreign firms and shift away from the focus on

U.S. based firms. This paper answers his call by retesting the following hypotheses from Boyd using data from Swedish firms⁴:

H1: CEO duality will be negatively related to firm performance.

H2: CEO duality will be positively related to firm performance in low munificence environments.

H3: CEO duality will be positively related to firm performance in high dynamism environments.

H4: CEO duality will be positively related to firm performance in high complexity environments.

DATA AND METHODOLOGY

Sample

Our data uses several sources provided by Statistics Sweden (SCB)⁵. More specifically, we build our sample based on three databases from SCB. The first database is constructed from annual reports of all registered firms in Sweden. Key variables here are balance sheet items. The second database contains information on all individuals in the Swedish labor market. This data includes age, gender, education, place of work, position and wage. In Sweden a limited company by law should have a board of directors⁶. Thus, the third source is a new and unique database containing information on the board members of all limited⁷ companies in Sweden. Although the firms and the individuals in the datasets are anonymous, an identification code associated with each entry makes it possible to link unique individuals to unique firms and boards. Firm and employee data cover the period 1986 to 2011 while data on board members is limited to the period 2004 to 2011.

⁴ Since this is a replication of Boyd, and we test the same hypotheses, we have not included the theoretical arguments building up to the hypotheses. Please see Boyd 1995 for theoretical background.

⁵ <http://www.scb.se/en/>

⁶ See <http://www.bolagsverket.se/en/bus/business/limited/2.1144>.

⁷ For a legal definition of a limited company in Sweden please see: <http://www.bolagsverket.se/en/bus/business/limited/2.1144>

To construct the final sample we merge the three data sets and restrict our final sample to those firms which: (1) have more than 10 employees; (2) have more than 1 million Swedish Kronor⁸ (SEK) in total assets; and (3) are in the following industries: manufacturing, construction, retail, transport, communication, finance, and real estate and business services. In order to control for changes in CEO, we require at least a one year lag period of data. Hence, we limit our analysis to samples between 2005 and 2011. Additionally, since we measure performance in proceeding years, we need at least two years of forward observations. Therefore, we limit our sample on CEO-Duality to 2005–2009. By considering the aforementioned restrictions, the final sample has 55,769 observations belonging to 11,474 firms in which we have observations for all variables explained in the next section.

Variable Definitions and Measures

Dependent Variable

The objective of the paper is to test whether a firm's economic performance is higher when the CEO also serves as chairman of the board of directors, everything else being equal. We use Return on Assets⁹ (ROA) of the following years (Daily and Dalton, 1992; Tuggle et al., 2010), as the observed effect of any strategic decisions made by the CEO. We examine the forward effect using four different lead variables $ROA_{t+2} - ROA_{t+5}$. Due to brevity we only report results with ROA_{t+2} . However, our findings are qualitatively similar when extending the periods. Alternatively, we employ earning before tax divided by average value of assets in $t+2$ ($ROA_{2_{t+2}}$) and industry adjusted ROA (deviation from industry mean). The results are qualitatively similar to our preferred ROA-measure as a dependent variable.

⁸ These are firms with approximately over 150,000 USD in total assets. We repeated the analysis for firms with more than 10,000,000 SEK in total assets. The results are qualitatively similar.

⁹ Boyd used Return on investment (ROI) as the performance measure. Unfortunately due to data limitation we are not able to use ROI.

Independent Variable

CEO duality. The first variable is a dummy variable with a value of ‘1’ if the CEO also served as board chair and ‘0’ if he/she only held the position of CEO.

Munificence. This variable considers uncertainty in accessing resources. Following Boyd we operationalize munificence by using a regression slope coefficient divided by mean sales over a 5 year period. The coefficients are estimated based on regression of sales on time for each industry¹⁰. Industries are defined based on their 2 digit NACE REV 1.1¹¹.

Dynamism. Dynamism is associated with uncertainty and measures environmental volatility. In line with Boyd, we measure dynamism using a standardized measure of the volatility of industry sales growth.

Complexity. Complexity measures homogeneity, concentration and competition in the market (Boyd, 1995; Dess and Beard, 1984). As recommended by Boyd we use the Herfindahl Index (based on the 2 digit NACE REV 1.1).

Control variables. This paper applies three sets of control variables in the regression analysis. The first set of controls considers individual characteristics of the CEO. We control for whether the CEO is an owner or not (*owner CEO*). CEO ownership can determine the existence and severity of agency problems, as ownership can mitigate agency problems and align the objectives of the CEO with the rest of the shareholders (Jensen and Meckling, 1976). Harris and Helfat (1998) argue that CEO duality research should look at managerial capabilities as a possible explanation for firm performance. Hence we control for several measures of CEO capabilities and knowledge. Second, we examine whether the CEO has a

¹⁰ For example, the coefficient for 2005 is calculated accordingly: $Sale = B_0 + B_1.T + \varepsilon$; hence Munificence is calculated using observations belonging to 2001-2005. For more detail on how to calculate Munificence, Dynamism and Complexity see Boyd (1995) and Keats and Hitt (1988).

¹¹ NACE REV 1.1 is Statistical Classification of Economic Activities in the European Community.

Bachelor, Master or PhD degree (education less than bachelor is an omitted category). Third, we control for CEO *age* and *gender*. Forth, we control for CEO experience by looking at the number of prior firms the CEO has worked for (*number of prior employers*). Fifth, taking advantage of wage information, we calculate unobserved skills (*unobserved skills*) of the CEO using residuals of the Mincer wage equation¹² (Acemoglu, 2002). Unobserved skills can include interpersonal skills, specific skills for their job, motivation, or IQ (Acemoglu, 2002). Sixth, we control for the CEO's working experience (*years of experience*). Finally, an individual's ethnic background can determine their access to resources and networks required in supporting a business (Taylor, 2010). Our data includes information on whether the CEO is foreign born or if one or both of his/her parents are foreign. We use this as a control for the ethnic background of the CEO (*ethnic background*).

The next set of controls concern firm characteristics. Since our data contains time-series information, we are able to examine the effect of a change of CEO (*CEO change*), which can be associated with changes in firm performance (Murphy and Zimmerman, 1993). A large number of studies provide empirical evidence on the close association between firm performance and human capital. We measure a firms' human capital as the number of employees with a master degree or higher normalized by total employees (*knowledge intensity*). In addition to this, we control for total assets (*total assets*¹³) and debt to equity ratio (*debt equity ratio*). Based on European Union classification we control for the size of the firm based on the number of employees. Firms with more than 250 employees are classified as a large firm (*large firm*). Firms with employees between 50 and 250 are classified as medium firms (*medium firm*) and firms with less than 50 employees are

¹² This is calculated based on Acemoglu (2002) in which annual wage in thousand SEK is determined by observable characteristics of an individual. Observables include age, work experience, education level, education topic, industry dummies, location dummies and time dummies.

¹³ The Assets are reported in millions of Swedish Kronor (SEK) of 2005 the exchange rate in 2005 was around 7 SEK/USD

classified as small firms (omitted category). To control for firm age, we divide firms to young entrepreneurial firms which might experience significant growth versus more mature firms. We use a dummy variable with a value of ‘1’ if the firm is younger than 10 years old (*young firm*). We are not able to use a continuous measure of age due to reporting limitations in the database as those firms established before 1986 are given a value of ‘1986’ regardless of when they were established¹⁴. We also control for whether a firm belongs to a foreign multinational (*ownership category 4*), Swedish multinational (*ownership category 3*), Swedish group (*ownership category 2*) or is an independent firm (omitted category).

The third set of explanatory variables is related to the board of directors. The literature on corporate governance has looked extensively at the relationship between board size and firm performance with findings pointing towards a negative relationship between the two (Hermalin and Weisbach, 2003; Yermack, 1996). We control for board size (*board size*) and its quadratic value (*board size square*) to consider a possible non-linear relationship. The board of directors monitoring and resource provision ability can also determine firm performance (Hillman and Dalziel, 2003). We control for board ability and knowledge by controlling for education level of board members. We do this by calculating the ratio of individuals with a Masters or PhD degree on the board of directors (*board knowledge intensity*). Homophily between CEO and board chair can alter the friction in decision making or the monitoring ability of the board of directors and consequently impact firm performance (Wellman and Wortley, 1990). In order to control for homophily¹⁵, we control for whether the CEO and chairman are of the same sex (*CEO chair gender*¹⁶). Recent research looking at decision making of board members points to differences in board decisions based on gender

¹⁴ We repeated the analysis for only firms older than 10 years old the results are qualitatively similar.

¹⁵ Alternatively we controlled if they have homophily in education, residence or industry of expertise the results regarding CEO duality are qualitatively similar.

¹⁶ The literature on psychology and behavioral economics documented several behavioral difference between men and women in case of risk tolerance, information processing, diligence, and overconfidence (e.g. Palvia, Vähämaa, and Vähämaa, 2014)

diversity (Adams and Ferreira, 2009). For example Levi, Li, and Zhang (2008) show that the proportion of women on the board of directors is negatively related to bid price in a merger and acquisition. Accordingly, we control for the share of women on the board of directors (*gender diversity*). A considerable body of research looks at board composition in relation to the proportion of outside directors (Hermalin and Weisbach, 2003). We control for this by using the proportion of insider directors (*insiders ratio*). We define an insider as a person that has worked for more than one year in the firm prior to the focal year. Finally, we control for *average age* of board of directors (Tuggle *et al.*, 2010) and *average experience* of board of directors, in terms of the number of firms they have previously worked for (Zajac and Westphal, 1996).

The final set of variables aims to control for factors associated with localization, industry classification and macroeconomic shocks. The location of a firm can determine access to resources, networks or markets which consequently can affect firm performance. Accordingly, we control for whether a firm is located in the metropolitan areas of *Stockholm*, *Gothenburg*, *Malmö* or other locations (omitted category). Finally, since firm performance can differ depending on the industry they operate in, we control for whether the firm is in manufacturing, construction, retail, transport, communication, real estate or finance (omitted category)¹⁷. Table 1 shows the definition of variables and summary statistics.

[Table 1 about here]

¹⁷ Alternatively we used the industry classification based on technology intensity (http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an2.pdf), the results are qualitatively similar

Empirical Methodology

In this study we focus on the impact of CEO duality and its interaction with environmental variables munificence, dynamism and complexity on the ROA in $t+2$. In all models (j) refers to the firm and (i) represents the CEO.

$$ROA_{jt+2} = B_0 + B_1.CEO - Duality_{jt} + B_2.Duality * Munificence + B_3.Duality * Dynamism + B_4.Duality * Complexity + B_5.CEO_{it} + B_6.Firm_{jt} + B_7.Board_{jt} + B_8.Location_j + B_7.Industry_j + B_7.T_n + \epsilon_{jt} \quad (\text{Equation 1})$$

Two important aspects of the specification of our model concerns causality and endogeneity. Here we are concerned with two questions. First, is there a possibility of reverse causality that goes from ROA to CEO-duality? Second, is there a third non observed factor that simultaneously might explain both CEO-duality and ROA? We address the causality issue by the lead structure of ROA. The performance variable is explained by the governance structure 2-5 years earlier. Concerning simultaneity, we can use a Hausman test to decide whether the CEO-duality is endogenous in the model. If this should be the case, we need to include an appropriate instrument in order to eliminate the simultaneity bias. However, the test statistics rejects the hypothesis that CEO-duality is correlated with the error term. Our rich dataset also allows us to control for several confounding factors that might affect firm performance. However in a separate robustness check we try to use instrumental variables to control for endogeneity and address the selection issue using methodology recommended by Iyengar and Zampelli (2009).

The model we apply in the main analysis is a pooled least square¹⁸, which ignores the panel nature of the data. This implies the unrealistic assumption that there is no correlation between errors corresponding to the same firm in different years. In order to estimate the

¹⁸ Since CEO duality in 98% of the sample is time invariant we are not able to use fixed effects.

heteroskedasticity-constant standard errors, we use cluster-robust standard errors, where the errors are clustered around firms¹⁹.

In equation 1, the return on assets in t+2 (ROA_{jt+2}) is dependent on dual structure ($CEO - Duality_{jt}$), interaction of dual structure with environmental variables ($Duality * Munificence$, $Duality * Dynamism$, $Duality * Complexity$), characteristics of CEO (CEO_{it}), firm characteristics ($Firm_{jt}$), board characteristics ($Board_{jt}$), location ($Location_j$), industry ($Industry_j$) and year dummies to account for macroeconomic changes (T_n). Table 2 reports pair wise correlation between main variables.

[Table 2 about here]

RESULTS

Summary Statistics and Univariate Analysis

Table 1 reports summary statistics. In our sample, only 11.71 percent of observations belong to firms with a dual structure. This is significantly smaller than the 70 percent reported for small listed firms (Daily and Dalton, 1992) and 46 percent for samples of publicly listed firms (Boyd, 1995)²⁰. The main reason here might be while prior studies only looked at publicly listed firm, we consider all type of firms. This also may be attributed to differences in Swedish corporate governance and institutional frameworks and the Anglo-Saxon model in the US (Agnblad *et al.*, 2002; Johanson and Ostergren, 2010). The frequency of CEO duality is almost constant in 2005-2009 (Appendix 1). A Chi-square test of distribution shows that there is no statistically different distribution of CEO duality across time (p= 0.959).

¹⁹ Alternatively we use dual clustering in which error terms are clustered around firm and CEO. The results are qualitatively similar.

²⁰ In more recent samples of US publicly listed firms, 66% (Tuggle *et al.*, 2010) and 79% (Iyengar and Zampelli, 2009) of firms had a dual structure. Similar patterns have been observed in other countries. For example, 78% of publicly listed firms in Egypt adopt the dual structure (Elsayed, 2007).

However, distribution varies in different industry groups ([Appendix 2](#)) with 16.42 percent in construction and 8.45 percent in finance. When we look at the technology intensity of industries we can see firms in lower technology intensity industries (Medium Tech, Low tech, and Less Knowledge intensive services) seem to have more CEO duality than firms in higher technology intensity industries (High Tech, Medium High tech, and Knowledge intensive services).

[Table 3 about here]

[Table 3](#) shows firms with CEO duality (no CEO duality) have an average ROA of 0.290 (0.257). Similar patterns are observed regarding ROA2 in which firm with CEO duality (no CEO duality) have an average ROA2 of 0.143 (0.139). The t-test shows differences regarding mean across the two groups of firms (CEO Duality vs. no CEO duality) are statistically significant at the 1 percent level. Similarly, we observe the same pattern for industry adjusted ROA. The univariate analysis suggests that firms with CEO duality perform better. However, the analysis is not able to control for other confounding factors that might affect firm performance. In order to isolate the impact of CEO duality on firm performance we use multivariate analysis and control for several confounding variables mentioned in the prior literature that might affect firm performance.

Before moving to our multivariate analysis, we observe how munificence, dynamism, and complexity alter the correlation between CEO duality and performance. CEO duality is positively correlated to performance in both low and high²¹ munificence and dynamism ([Appendix 3](#)). However the correlation is larger in low munificence and dynamism. In terms of complexity, while in low complexity environments CEO duality is positively correlated to

²¹ We divide the sample into high and low sections based on comparisons with mean of munificence, dynamism, and complexity.

performance, the direction of correlation changes in high complexity environments for ROA. However, this relationship shows weak significance.

Multivariate Analysis

Table 4 show the results obtained from the pooled regression models that regress ROA_{t+2} on a dummy variable representing whether a firm's CEO serves as chairman of the board of directors (CEO Duality). In model 1 we consider only the effect of CEO duality on performance. Model 2, similar to Boyd, considers interactions with the environmental variables²². In model 3 we control for CEO characteristics that might affect firm performance. In model 4, in addition to CEO characteristics, we include firm characteristics that may impact firm performance. In model 5 we also control for characteristics of the board that might affect firm performance. And finally in model 6 we include 5 time dummies to account for possible changes in the macroeconomic environment. In model 3-6 we also include location and industry fixed effects. Models 1-6 in Table 4 unambiguously indicate that CEO duality is associated with higher ROA, consistent with Boyd finding. In all models, the coefficient of CEO duality is significant at 1 percent confidence levels. The marginal effect varies from around 7 percent in model 2 to 2.7 percent in model 6 (corresponding to an increase equal to approximately 27 and 10.4 percent of the mean value respectively). In model 2-6 we also consider the environmental variables of munificence, dynamism and complexity. As we can see in all models, the interaction term between CEO duality and munificence is negatively related to ROA_{t+2} . This implies that in high munificence environments, CEO duality is negatively correlated to firm performance. This finding is consistent with Boyd. Similarly, we observe the interaction term between CEO duality and dynamism is negatively related to ROA_{t+2} . This implies that in high dynamism environments CEO duality is negatively correlated to firm performance. This finding is in contrast with Boyd results.

²² In a separate analysis we added interaction terms separately, the results are qualitatively similar.

Finally we observe positive correlation between the interaction term between CEO duality and complexity and ROA in t+2. However this term is only statistically significant in model 4, 5, and 6. This implies that in high complexity environments CEO duality is positively correlated to firm performance. This finding is consistent with Boyd.

[Table 4 about here]

The control variables show that firms with owner CEOs have lower performance and that firm performance decreases with a CEO's age. CEOs with more experience (numbers of firms that they worked for and working years) are associated with firms that perform better. We also find that unobserved skills are negatively correlated to firm performance and a change in CEO is associated with negative performance. Our results further indicate there is no significant difference among CEOs with different backgrounds regarding whether they or their parents are born in Sweden or abroad. Similarly consistent with prior literature (e.g. Hermalin and Weisbach, 2003), we find a negative relation between board size and firm performance. The board knowledge intensity and gender diversity are negatively correlated to firm performance. Our results regarding gender diversity are in contrast to the findings of Adams and Ferreira (2009).

Additional Analysis and Robustness Checks

Boyd's article has proven highly influential due, in part, to bringing to our attention that CEO duality is not a one size fits all relationship by focusing on environmental factors. In this section, following Ramdani and van Witteloostuijn (2010) we use quantile regression to investigate whether the relationship between CEO duality and firm performance changes for different levels of firm performance. As Table 5 shows, the CEO duality coefficient is positively related to firm performance in all conditional quantiles. The coefficient increases from 0.029 in the 10th quantile to 0.1188 in the 90th quantile. The result is consistent with

Ramdani and van Witteloostuijn (2010). The interaction term for munificence and dynamism shows a consistent effect in terms of sign (negative) and statistical significance. The interaction with complexity is positively and statistically significant related to performance in 75th and 90th quantile but is negatively related to performance in 25th quantile. In the next section we discuss the sources of endogeneity and try to address them.

[Table 5 about here]

Omitted variables that may lead to correlations between CEO-duality and error terms are of concern in our analysis. If our key-variable, CEO-duality, is correlated with the error term, the least square estimator fails. As mentioned in our model specifications, the Hausman test shows no statistically significant correlation between the error term and CEO-duality. Furthermore, since our data has both cross-sectional and longitudinal dimensions in order to account for unobserved firm-level effect, we apply an instrumental variable (IV) panel data model which accounts for endogeneity. In order to specify the IV-model we rely on specifications proposed by Iyengar and Zampelli (2009). In this model²³ board characteristics (*board size, insider share, gender diversity, number of individuals with ethnical background on the board, gender diversity*), in addition to *PPEAT*²⁴, *natural logarithm of sale* and *sales growth*, determine CEO-duality. In order to have a valid instrument we need to have at least one variable which is highly correlated with CEO-duality and not correlated with ROA. In this setting only *number of individuals with ethnical background on the board* satisfies this condition²⁵. As [Table 6](#) illustrates, similar to pooled OLS, CEO-duality will have a positive effect on ROA, however, the marginal effect from 2.7 percent in model 6 of Table 4 increases to 11.9 percent. In addition in model 2 we control for industry ROA.

²³ We repeated the full model proposed by Iyengar and Zampelli (2009: 1099) and excluded the variables that did not have any significant and positive effect on CEO-duality ([Appendix 5](#)). We used the remaining variables as instruments in the random effect IV model.

²⁴ Plants, properties and equipments divided by total assets.

²⁵ This variable was identified by trying specifications proposed by Iyengar and Zampelli (2009). We do not claim it is theoretically the most suitable instrument in the CEO-duality setting.

[Table 6 about here]

There is a possibility that a firm may choose a CEO duality structure as a mechanism to improve firm performance. This would lead to a selection bias in our analysis. In order to verify that selection bias does not exist we have replicated the Switching regression specification recommended by Iyengar and Zampelli (2009: 1099). The Switching regression results confirm that there is no selection problem ([Appendix 4](#))²⁶. It implies that firms are choosing CEO duality for other reasons other than improving performance especially when performance is measured by ROA. Therefore we are able to use pooled least square estimates.

DISCUSSION

Early research on CEO duality looked for a direct duality-performance relationship. However, with little consensus stemming from this work, scholars set out to find moderators of the relationship and alternate explanations to the conflicting findings. Boyd's study represents the first to explore a contingency model of CEO duality, and therefore proved to be very influential (Krause *et al.*, 2013). Our research represents a replication of Boyd's study on firm performance and CEO duality and the moderating effect of environmental uncertainty. Our results confirm Boyd's findings that CEO duality is beneficial under certain conditions related to environmental uncertainty. CEO duality structures are most beneficial in environments characterized by resource scarcity, and complexity. In these circumstances speedy decision making and a unity of command are critical. Our findings do not confirm

²⁶ The insignificant coefficient of ϕ in [Appendix 5](#) implies firms do not choose their governance structure for performance optimization. Due to brevity we did not report full model and structural model specifications. For detail of switching regression and its implication in governance structure see Iyengar and Zampelli (2009).

Boyd's second hypotheses regarding dynamism. Table 7 provides an overview of Boyd's results and our findings.

[Table 7 about here]

Our study heeds the call Boyd makes in his final paragraph of his 1995 study. However, we extend his work in a number of ways. First, our study leverages a database of over 55,769 observations belonging to 11,474 firms using data from 2005 to 2009 compared to the 192 firms in Boyd's study. Second, our data comes from Swedish firms and therefore represents a completely new geographical context. Furthermore, previous research on CEO duality has mostly been on publicly traded firms in the USA. By using Swedish data, we test and confirm Boyd's findings in a different legal and institutional setting. Sweden provides an interesting context as Swedish firms represent a corporate governance culture with stronger ties between the board of directors and management (Johanson and Ostergren, 2010) and they also have significantly higher ownership concentrations (Agnblad *et al.*, 2002). Furthermore, we look at both public and private firm data. Whereas the vast majority of research on CEO duality focuses on large established firms, our study responds to the call for research on boards of directors in different settings (Daily *et al.*, 2002). It is among the few studies that examine board structure and processes among privately held firms. This is especially relevant in studies of duality as while public listed firms are subject to monitoring and disciplining mechanisms of capital markets, in private firms, the board of directors is the primary monitoring mechanism (Garge, 2013). Finally, we incorporate a number of controls, including controls for human capital for both the CEO and board characteristics allowing for a more in depth and fine grained investigation.

Our findings suggest that the practice of CEO duality is most beneficial in highly complex environments and those environments characterized by resource scarcity. More importantly our study echoes research that highlights the need to account for environmental conditions when making strategic decisions. Our quantile regression analysis reveals that the CEO duality-firm performance relationship varies according to firm performance.

These findings are consistent with more recent research on CEO duality. For example, Elsayed (2007) found that the impact of CEO duality varies depending on the industry type and firm performance. In their study of young entrepreneurial firms, Atinc and Ocal (2014) investigated the moderating effects of environmental munificence, dynamism, and complexity on the relationships between changes in top management teams and board of directors and firm performance. They found that changes in the board of directors in environmentally uncertain situations had a negative impact on firm performance. Although Atinc and Ocal (2014) look at changes in the board of directors, their findings point to an important conclusion, young firms' need for their original directors "becomes even more critical given greater environmental complexity and less munificence" (p. 295). Similarly, as our findings suggest, firms need the guiding light of their CEO to make decisive strategic decision in uncertain environments.

An interesting result of our analysis is the opposite effect dynamism had on CEO duality and firm performance. Boyd hypothesized that CEO duality will be positively related to firm performance in high dynamism environments. Whereas his results showed no support for this hypothesis, our analysis showed support, however in the opposite direction. This could be for a number of reasons. Empirically, research has demonstrated negative relationships between firm performance and dynamism (Bantel, 1998) whereas other studies have shown no relationship between firm performance and dynamism (Atinc *et al.*, 2014).

Dynamism refers to the stability of the environment (Dess and Beard, 1984). High dynamism environments are characterized by turbulence and constant change and therefore, positive firm performance could be difficult regardless of whether power is centralized or split.

Like any other study, this study has limitations. We do not take into account financing sources in our study. How firms are financed can shape the structure of the board of directors and their monitoring function. For example venture capitalists usually appoint one or more directors on boards after rounds of financing (Sahlman, 1990). In this case directors have direct financial motives to monitor and support the CEO and are usually individuals with extensive industry related knowledge (Garg, 2013). Here, CEO duality may differ from a family firm in which family members appoint all directors. Future research can provide evidence on the relationship between sources of financing and CEO duality. Similarly, CEO ownership can affect board monitoring and advising functions. In a private firm, where the majority of equity is owned by the CEO, the monitoring role of directors is less relevant as they serve a more advisory role (Garg and Eisenhardt, 2013). In the entrepreneurship literature we see this being played out in studies that demonstrate the differences between a founder CEO and a professional CEO. In this study we are not able to separate founder CEOs from professional CEOs. One might argue since founder CEOs have a more psychological attachment to the firm, they are more likely to show escalation of commitment (Brockner, 1992) to their business model, idea, or product (Garg and Eisenhardt, 2013). Hence a separate chairman can help in advising and monitoring CEO decisions that might harm firm performance. Therefore the status of a CEO as founder may moderate the monitoring role of the board and consequently affect the CEO duality-performance relationship. Another limitation of this study is that we are not able to determine if firms are publicly traded or private. This being said, there are only approximately 300 publicly listed firms (around 2 percent of our sample) in Sweden. Finally, while we have tried to address the endogeneity

issue and based on Iyengar and Zampelli, (2009) we argue that CEO duality is not selected to optimize performance, we are not able to find a theoretically suitable instrument to test this out. Since endogeneity is an important issue in corporate governance research (Hermalin and Weisbach, 2003), finding an appropriate setting such as a natural experiment can be the most suitable solution for tackling endogeneity.

These limitations suggest there is still much room for strengthening the methodologies used in studying CEO duality. There is especially a need for more qualitative insight to understand what theoretical frameworks are at play. Boyd suggested that case studies could provide answers to several questions on the CEO's relationship with the board. In their review of the CEO duality literature, Krause *et al.* (2014) concur. However, there have been few qualitative studies in this area (with the exception of Parker, 1990 and Roberts, 2002). We echo this call for more qualitative studies that take the researcher in the boardroom.

The findings in this study have both theoretical and practical implications and contributions. Our database contains a large number of private firms and therefore provides for a setting that shifts the focus from agency costs to stewardship theory (Garg, 2013). This is important as the majority of research in CEO duality has looked at large established corporations with high agency costs (Krause, *et al.*, 2014). The, agency versus stewardship theory debate that plagued (and continues to plague) the CEO duality-performance debate has provided very mixed results, our study points towards a more contingency based model regarding the two theories. Our findings suggest stewardship theory is more relevant in the context of private firms. From a practical stand point, small private firms can benefit from duality structures especially in uncertain environments. Our findings from our quantile regression analysis suggest that CEO duality is not only conditional on the environment the firm is situated in but also the initial level of firm performance. Firms need to keep this in

mind when deciding on governance structure. The higher the firm performance, the more important is centralization of authority and strong leadership. This is especially of interest since high performing firms are sources of job creation and economic growth.

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Table 1- Variable definitions and Summary statistics and

Variable	Definition	N	Mean	Std.	Min	Max
Independent Variables						
CEO duality	A dummy=1 if CEO is also president of board of director	55769	0.117	0.322	0.000	1.000
Munificence	Standardized measure of industry sales growth over a five year period	55769	0.047	0.041	-1.052	0.431
Dynamism	Standardized measure of volatility of industry sales growth over a five year period	55769	0.012	0.017	0.000	0.665
Complexity	Herfindahl index of industry in focal year	55769	0.034	0.084	0.004	0.954
Dependent Variables						
Return on Assets (ROA_{t+2})	Net sales divided by average value of assets in t+2	55769	0.260	0.179	0	3.171
Control						
<i>CEO</i>						
Owner CEO	A dummy=1 if person is reported as self-employed in own company	55769	0.303	0.456	0.000	1.000
Bachelor	A dummy=1 if person has a Bachelor degree	55769	0.283	0.451	0.000	1.000
Master	A dummy=1 if person has a Master degree	55769	0.003	0.054	0.000	1.000
PhD	A dummy=1 if person has a PhD	55769	0.011	0.103	0.000	1.000
Age	Age of individual in the focal year	55769	49.038	8.475	23.000	81.000
Gender	Is equal to 1 for men and 2 for women	55769	1.065	0.247	1.000	2.000
Prior employers	Number of prior firms that a person worked in 1986	55769	3.335	2.823	0.000	22.000
Unobserved skills	Residual of mincer wage model	55769	103.530	237.075	-367.330	5902.618
Years of experience	Number of years that a person worked since 1986	55769	18.448	3.064	1.000	22.000
Ethnic background 1	A dummy=1 if person is foreign born	55769	0.044	0.205	0.000	1.000
Ethnic background 2	A dummy=1 if person is born in Sweden but both parents are foreign born	55769	0.015	0.120	0.000	1.000
Ethnic background 3	A dummy=1 if person is born in Sweden and one foreign born parent	55769	0.066	0.248	0.000	1.000
Ethnic background 4	A dummy=1 if person is born in Sweden with both parents born in Sweden	55769	0.875	0.330	0.000	1.000
<i>Firm</i>						
CEO Change	A dummy=1 if CEO was appointed in the focal year	55769	0.284	0.451	0.000	1.000
Knowledge intensity	Number of employees with master degree or higher divided by total number of employees	55769	0.134	0.190	0.000	1.000
Total assets	Book value of total assets in millions of 2005 Swedish Kronor(M SEK)	55769	294.038	3502.744	1.001	213046.300
Debt equity ratio	Book value of debt divided by book value of equity	55769	10.690	160.184	0.000	26111.670
Small firm	A dummy=1 if firm has less than 50 employees	55769	0.723	0.447	0.000	1.000
Medium firm	A dummy=1 if firm has employees between 50 and 250	55769	0.226	0.419	0.000	1.000
Large firm	A dummy=1 if firm has more than 250 employees	55769	0.050	0.219	0.000	1.000
Young firm	A dummy=1 if firm has less than 10	55769	0.412	0.492	0.000	1.000

	years since incorporation					
Ownership category 1	A dummy=1 if firm is independent private company	55769	0.230	0.421	0.000	1.000
Ownership category 2	A dummy=1 if firm is part of Swedish group	55769	0.414	0.493	0.000	1.000
Ownership category 3	A dummy=1 if firm is part of Swedish multinational	55769	0.201	0.401	0.000	1.000
Ownership category 4	A dummy=1 if firm is part of Foreign multinational	55769	0.155	0.361	0.000	1.000
Board						
Board size	Number of individual in board of director	55769	3.430	2.068	1.000	23.000
Board size square	Square of number of individuals in board of directors	55769	16.042	22.001	1.000	529.000
Board knowledge intensity	Number of board member with PhD or Master degree divided by board size	55769	0.017	0.086	0.000	1.000
CEO chair gender	A dummy=1 if CEO and chair of board have same gender	55769	0.596	0.491	0.000	1.000
Gender Diversity	Number of women divided by board size	55769	0.102	0.191	0.000	1.000
Insiders ratio	Number of insiders divided by board size	55769	0.283	0.358	0.000	1.000
Board average age	Average age of Board of directors	55769	50.34	6.56	24.000	81.000
Board average experience	Average number of prior firms that board members worked for	55769	3.37	2.24	0.000	20.000
Location						
Stockholm	A dummy=1 if firm is located in Stockholm or Uppsala	55769	0.275	0.447	0.000	1.000
Gothenburg	A dummy=1 if firm is located in Gothenburg	55769	0.180	0.384	0.000	1.000
Malmo	A dummy=1 if firm is located in Malmo	55769	0.118	0.322	0.000	1.000
Industry						
Manufacturing	A dummy=1 if the firm is in manufacturing (NACE Rev 1.1: 15-37)	55769	0.320	0.466	0.000	1.000
Construction	A dummy=1 if the firm is in construction sector (NACE Rev 1.1: 45)	55769	0.099	0.299	0.000	1.000
Retail	A dummy=1 if the firm is in retail sector (NACE Rev 1.1: 50-55)	55769	0.301	0.459	0.000	1.000
Transport	A dummy=1 if the firm is in transportation sector based on two digit NACE Rev 1.1 classification: 60-63	55769	0.064	0.245	0.000	1.000
Communication	A dummy=1 if the firm is in Communication and post sector (NACE Rev 1.1: 64)	55769	0.004	0.063	0.000	1.000
Finance	A dummy=1 if the firm is in finance sector (NACE Rev 1.1: 65-67)	55769	0.000	0.011	0.000	1.000
Real Estate	A dummy=1 if the firm is in real estate sector (NACE Rev 1.1: 70-74)	55769	0.212	0.409	0.000	1.000

Table 2- Correlation Matrix²⁷

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
ROA	1.00																													
CEO duality	0.06	1.00																												
Munificence* duality	0.03	0.81	1.00																											
Dynamism * duality	0.01	0.67	0.60	1.00																										
Complexity * duality	0.00	0.41	0.46	0.59	1.00																									
Owner CEO	0.12	0.15	0.11	0.08	0.05	1.00																								
Bachelor	-0.15	-0.06	-0.03	-0.02	0.00	-0.20	1.00																							
Master	-0.02	-0.01	-0.01	-0.01	-0.01	-0.02	-0.03	1.00																						
PhD	-0.05	-0.01	0.00	-0.01	0.01	-0.04	-0.07	-0.01	1.00																					
Age	-0.09	0.10	0.09	0.08	0.05	0.06	0.01	-0.01	0.02	1.00																				
Gender	-0.02	-0.04	-0.03	-0.03	-0.02	-0.02	0.05	0.01	0.00	-0.09	1.00																			
Prior employers	0.05	-0.06	-0.05	-0.04	-0.01	-0.10	0.08	0.00	0.02	-0.22	0.09	1.00																		
Unobserved skills	-0.11	0.00	0.01	0.01	0.02	-0.19	0.10	0.01	0.00	0.15	-0.01	0.01	1.00																	
Years of experience	0.01	0.04	0.03	0.04	0.01	0.07	-0.13	-0.06	0.00	0.43	-0.03	0.00	-0.04	1.00																
Ethnic background 1	0.01	0.02	0.01	0.01	0.02	-0.01	-0.01	0.06	0.01	0.01	0.03	0.02	0.05	-0.16	1.00															
Ethnic background 2	0.00	0.00	0.00	0.00	-0.01	-0.01	0.01	0.01	0.00	-0.03	0.00	0.03	0.00	-0.02	-0.03	1.00														
Ethnic background 3	0.01	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	-0.06	0.01	0.04	-0.01	0.00	-0.06	-0.03	1.00													
CEO Change	-0.11	-0.15	-0.12	-0.09	-0.05	-0.29	0.14	0.01	0.03	-0.13	0.06	0.17	0.04	-0.12	0.01	0.00	0.01	1.00												
Knowledge intensity	-0.14	-0.07	-0.05	-0.04	-0.02	-0.13	0.37	0.07	0.18	-0.06	0.07	0.16	0.18	-0.11	0.02	0.01	0.01	0.14	1.00											
Total assets	-0.08	-0.01	-0.01	-0.01	0.00	-0.05	0.07	0.00	0.03	0.02	-0.01	0.01	0.35	-0.03	-0.01	-0.01	0.00	0.03	0.08	1.00										
Debt equity ratio	0.01	0.00	0.00	0.00	0.00	-0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.03	-0.01	0.00	0.00	0.00	0.03	0.02	0.01	1.00									
Board size	-0.15	-0.09	-0.07	-0.06	-0.03	-0.19	0.17	0.01	0.05	0.02	0.04	0.05	0.13	-0.01	-0.05	0.00	-0.01	0.35	0.20	0.09	0.01	1.00								
Board size square	-0.13	-0.10	-0.08	-0.06	-0.04	-0.17	0.15	0.01	0.05	0.03	0.04	0.05	0.12	0.00	-0.04	0.00	-0.01	0.32	0.19	0.09	0.01	0.92	1.00							
Board knowledge intensity	-0.08	-0.04	-0.02	-0.02	0.00	-0.06	0.02	0.30	0.60	0.02	0.04	0.02	0.06	-0.04	0.03	0.00	0.00	0.06	0.27	0.06	0.00	0.10	0.10	1.00						
CEO chair gender	-0.03	0.30	0.24	0.20	0.12	-0.02	0.01	-0.01	0.01	0.03	-0.25	-0.03	0.03	0.02	-0.04	0.00	-0.01	0.00	0.03	0.01	0.00	0.40	0.26	0.01	1.00					
Gender Diversity	-0.04	0.05	0.03	0.03	0.01	0.02	0.03	0.01	0.01	0.00	0.56	0.04	0.00	0.01	0.02	0.00	0.00	0.05	0.06	0.02	0.00	0.13	0.12	0.04	-0.13	1.00				
Insiders ratio	0.09	0.05	0.04	0.03	0.02	0.28	-0.11	0.00	-0.02	-0.02	0.01	-0.06	-0.12	-0.02	0.04	-0.01	0.00	-0.10	-0.05	-0.04	-0.02	-0.25	-0.20	-0.04	-0.17	0.03	1.00			
Board average age	-0.14	-0.08	-0.06	-0.04	-0.02	-0.03	0.06	0.01	0.03	0.63	-0.04	-0.18	0.12	0.28	-0.01	-0.03	-0.05	0.00	-0.04	0.04	-0.01	0.12	0.11	0.07	0.07	-0.04	-0.10	1.00		
Board average experience	0.06	-0.07	-0.06	-0.05	-0.03	-0.09	0.08	0.00	0.01	-0.21	0.09	0.81	0.04	-0.04	0.04	0.04	0.04	0.14	0.19	0.03	0.03	0.04	0.04	0.02	-0.02	0.04	-0.09	-0.21	1.00	

²⁷ For brevity and improving visualization, we did not report the correlation for all variables. They are available upon request.

Table 3- The univariate test of differences

	Differences (t-test)	CEO Duality	No CEO Duality
ROA	-0.033 ^{***}	0.290	0.257
ROA2	-0.004 ^{***}	0.143	0.139
Industry adjusted ROA	-0.022 ^{***}	0.095	0.073

Note. *, ** or *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 4- CEO duality, Munificence, Dynamism, Complexity and Return on Assets

	(1) ROA _{t+2}	(2) ROA _{t+2}	(3) ROA _{t+2}	(4) ROA _{t+2}	(5) ROA _{t+2}	(6) ROA _{t+2}
CEO duality	0.033 ^{***} (0.005)	0.071 ^{***} (0.009)	0.057 ^{***} (0.008)	0.033 ^{***} (0.007)	0.027 ^{***} (0.007)	0.027 ^{***} (0.007)
Munificence* duality		-0.371 ^{***} (0.099)	-0.252 ^{***} (0.093)	-0.246 ^{***} (0.084)	-0.259 ^{***} (0.083)	-0.208 ^{**} (0.084)
Dynamism * duality		-1.975 ^{***} (0.289)	-1.783 ^{***} (0.269)	-0.959 ^{***} (0.232)	-1.002 ^{***} (0.230)	-1.173 ^{***} (0.233)
Complexity * duality		0.021 (0.050)	0.041 (0.045)	0.095 ^{**} (0.041)	0.104 ^{***} (0.040)	0.111 ^{***} (0.040)
Owner CEO			0.031 ^{***} (0.003)	0.004 (0.003)	0.001 (0.003)	0.000 (0.003)
Bachelor			-0.050 ^{***} (0.003)	-0.028 ^{***} (0.003)	-0.025 ^{***} (0.003)	-0.025 ^{***} (0.003)
Master			-0.061 ^{***} (0.018)	-0.043 ^{**} (0.020)	-0.022 (0.021)	-0.020 (0.021)
PhD			-0.090 ^{***} (0.008)	-0.043 ^{***} (0.008)	-0.022 ^{**} (0.010)	-0.022 ^{**} (0.010)
Age			-0.002 ^{***} (0.000)	-0.001 ^{***} (0.000)	-0.000 ^{**} (0.000)	-0.000 ^{**} (0.000)
Gender			-0.013 ^{**} (0.005)	-0.018 ^{***} (0.005)	0.008 (0.006)	0.008 (0.006)
Prior employers			0.004 ^{***} (0.001)	0.003 ^{***} (0.001)	0.000 (0.001)	0.000 (0.001)
Unobserved skills			-0.000 ^{***} (0.000)	-0.000 ^{***} (0.000)	-0.000 ^{***} (0.000)	-0.000 ^{***} (0.000)
Years of experience			0.001 [*] (0.000)	0.001 (0.000)	0.001 [*] (0.000)	0.001 ^{***} (0.000)
Ethnic background 1			0.015 ^{**} (0.006)	0.004 (0.006)	0.002 (0.006)	0.003 (0.006)
Ethnic background2			-0.002 (0.010)	-0.006 (0.010)	-0.007 (0.009)	-0.006 (0.009)
Ethnic background3			0.002 (0.006)	-0.001 (0.006)	-0.001 (0.006)	-0.001 (0.006)
CEO Change				-0.028 ^{***} (0.002)	-0.019 ^{***} (0.003)	-0.019 ^{***} (0.003)
Knowledge intensity				-0.018 ^{**} (0.008)	-0.013 (0.008)	-0.012 (0.008)
Total assets				-0.000 ^{***} (0.000)	-0.000 ^{***} (0.000)	-0.000 ^{***} (0.000)

Debt equity ratio					0.000**	0.000**	0.000**
					(0.000)	(0.000)	(0.000)
Medium firm					0.029***	0.032***	0.032***
					(0.003)	(0.003)	(0.003)
Large firm					0.049***	0.054***	0.054***
					(0.007)	(0.007)	(0.007)
Young firm					0.015***	0.010***	0.010***
					(0.003)	(0.003)	(0.003)
Ownership category 2					-0.033***	-0.028***	-0.028***
					(0.004)	(0.004)	(0.004)
Ownership category 3					-0.064***	-0.062***	-0.062***
					(0.004)	(0.005)	(0.005)
Ownership category 4					-0.055***	-0.065***	-0.065***
					(0.005)	(0.005)	(0.005)
Board size						-0.006***	-0.006***
						(0.002)	(0.002)
Board size square						0.000	0.000
						(0.000)	(0.000)
Board knowledge intensity						-0.028*	-0.029*
						(0.015)	(0.015)
CEO chair gender						0.006*	0.006*
						(0.003)	(0.003)
Gender Diversity						-0.049***	-0.049***
						(0.008)	(0.008)
Insiders ratio						0.012***	0.012***
						(0.004)	(0.004)
Board average age						-0.002***	-0.002***
						(0.000)	(0.000)
Board average experience						0.004***	0.004***
						(0.001)	(0.001)
Location fixed effects	No	No	Yes	Yes	Yes	Yes	
Industry fixed effects	No	No	Yes	Yes	Yes	Yes	
Year fixed effects	No	No	No	No	No	Yes	
N	55769	55769	55769	55769	55769	55769	55769

Note. In all models clustered Robust Std. Err. is Reported in parentheses. *, ** or *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 5- OLS and quantile regression results

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	Q 0.10	Q0.25	Q0.5	Q0.75	Q0.90
CEO duality	0.0706*** (0.086)	0.0295*** (0.066)	0.0356*** (0.038)	0.0442*** (0.039)	0.0690*** (0.055)	0.1188*** (0.114)
Munificence* duality	-0.3706*** (0.995)	0.1089 (1.122)	-0.2034*** (0.653)	-0.3412*** (0.663)	-0.6322*** (0.942)	-0.5540*** (1.952)
Dynamism * duality	-1.9746*** (2.888)	-0,1766 (3.275)	-0.5473*** (1.906)	-1.1784*** (1.937)	-1.7625*** (2.749)	-3.6393*** (5.699)
Complexity * duality	0,021 (0.502)	-0,0837 (0.644)	-0.0913** (0.375)	-0,0455 (0.381)	0.1543*** (0.541)	0.5024*** (1.121)
N	55769	55769	55769	55769	55769	55769

Note. In all models Std. Err. is Reported in parentheses. *, ** or *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 6- random effect IV regression of CEO-duality and Return on Assets

	(1) ROA _{t+2}	(2) ROA _{t+2}
CEO duality	0.119** (0.042)	0.110** (0.041)
Industry ROA	NO	0.405*** (0.020)
CEO characteristic	Yes	Yes
Firm characteristic	Yes	Yes
Location fixed effects	Yes	Yes
Industry fixed effects	Yes	No
Year fixed effects	Yes	Yes
N	55769	55769

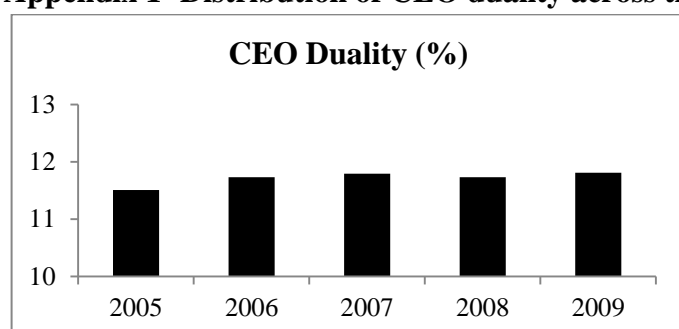
Note. In all models Std. Err. is Reported in parentheses. *,** or *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 7- Overview of Findings: Boyd versus Current Paper

Hypotheses (predicted coefficient sign)	Boyd's Results (Coefficients in results)	Current Paper (coefficients in results)
H1: CEO duality will be negatively related to firm performance (Negative)	Not Supported (Positive)	Not Supported (Positive)
H2: CEO duality will be positively related to firm performance in low munificence environments. (Negative)	Supported (Negative)	Supported (Negative)
H3: CEO duality will be positively related to firm performance in high dynamism environments. (Positive)	Not Supported (Positive)	Not Supported (Negative)
H4: CEO duality will be positively related to firm performance in high complexity environments. (Positive)	Supported (not significant)	Supported (Positive)

Appendices:

Appendix 1- Distribution of CEO duality across time



Appendix 2- Distribution of CEO duality in different industries

Industry	N	% CEO duality
Manufacturing	17832	10
Construction	5517	16.42
Retail	16776	13.47
Transport	3588	12.37
Communication	221	6.79
Real Estate	11825	8.45
Finance	11	9.09
Alternative industry Classification		
High Tech	1263	8.71
Medium High tech	4747	9.84
Medium Tech	5733	11.98
Low Tech	6284	10.46
Knowledge intensive services	12357	8.51
Less Knowledge intensive services	20064	13.29

Appendix 3- Correlation between return on investment and CEO duality in different environmental situations

	Low		High	
	ROA _{t+2}	ROA _{2 t+2}	ROA _{t+2}	ROA _{2 t+2}
Munificence	0.0565***	0.0211***	0.0456***	0.019***
Dynamism	0.0511***	0.0197***	0.0293***	0.0197***
Complexity	0.0612***	0.023***	-0.0199*	0.0084

Note. *, ** or *** indicate statistical significance at the 10%, 5%, 1% level, respectively

Appendix 4- Maximum likelihood of selection equation and testing for selection bias based on structural model specifications presented in Iyengar and Zampelli (2009:1104-1105)²⁸

	CEO duality
Sales (log)	-0.026*** (0.009)
PPEAT	0.067* (0.039)
No. employees	0 (0.000)
Sales growth	-0.008 (0.008)
Owner CEO	0.488*** (0.021)
Board size	-0.204*** (0.009)
Insider Ratio	-0.236*** (0.028)
No. employees on board	0.232*** (0.010)
No. ethnic minorities on board	0.095*** (0.025)
Gender diversity	0.160*** (0.016)
Munificence	-0.435 (0.326)
Dynamism	-0.283 (0.927)
Complexity	0.026 (0.181)
Location fixed effects	Yes
Industry fixed effects	Yes
Year fixed effects	Yes
N	46330

	ROA_{t+2}
sales (log)	0.002** (0.001)
sales growth	0.000 (0.000)
owner CEO	0.003 (0.004)
board size	-0.001 (0.001)
Insiders ratio	0.005 (0.004)
lag ROA	0.703*** (0.028)
industry ROA	0.240*** (0.028)
leverage ratio	0.045*** (0.005)
Φ*lag ROA	0.826** (0.347)
Φ*industry ROA	-0.993*** (0.333)
Φ*sales(log)	0.009 (0.020)
Φ*leverage ratio	0.025 (0.062)
Φ*Sales growth	0.239*** (0.028)
Φ*owner CEO	-0.052 (0.052)
Φ*Board size	-0.004 (0.008)
Φ*Insider ratio	0.038 (0.048)
Φ	-0.014 (0.194)
φ	0.013 (0.099)
Location fixed effects	Yes
Industry fixed effects	Yes
Year fixed effects	Yes
N	46330

Note. In all models clustered Robust Std. Err. is Reported in parentheses, *, ** or *** indicate statistical significance at the 10%, 5%, 1% level, respective

²⁸ The number of observation is less than original model since as recommended by Iyengar and Zampelli (2009) we are not able to include observation belong to firm that has any change in governance structure.

