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The dynamic relationship between CEO duality and firm performance: The moderating role of board independence

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ABSTRACT

For a panel of U.S. firms, we employ system GMM to estimate a dynamic model of the relationship between firm performance and governance characteristics including board leadership structure. Our results provide convincing evidence that a joint leadership structure, i.e., CEO duality has statistically significant negative impacts on firm performance. We also document that this effect is positively moderated by board independence. The results are robust across a number of sensitivity tests. The findings are consistent with arguments advanced by both agency theorists and some management scholars that though duality might reduce firm performance through managerial entrenchment, it can provide benefits to the firm in the presence of board vigilance.

1. Introduction

CEO duality and its impact on firm performance represents one of the most contentious issues in both academia and business (Dalton, Hitt, Certo, & Dalton, 2007; Finkelstein, Hambrick, & Cannella, 2009). In recent years, especially since the passage of the Sarbanes-Oxley Act of 2002, agency arguments and empirical evidence on the negative performance impact of duality (Fama & Jensen, 1983; Jensen, 1993) have led to calls for abolishing the combined leadership structure. Activist shareholders of various firms (e.g., News Corp, JP Morgan Chase, and Goldman Sachs) have campaigned against CEO duality by initiating proposals requiring its outright prohibition. Conversely, some firms (e.g., Chevron Corporation 2012) have provided arguments to support the value-enhancing attribute of the unity of leadership that duality engenders. Thus, determining whether CEO duality ultimately enhances firm performance is an increasingly important question for corporations, business practitioners and academics.

Two primary theoretical perspectives dominate the research on duality's performance effects. Agency theory argues that duality increases the power the CEO has over the board, hindering the independence between the board and management that is necessary to check managerial entrenchment (Jensen & Meckling, 1979; Fama & Jensen, 1983), resulting in negative performance effects (Jensen, 1993). In contrast, management and organizational scholars, relying on stewardship theory (Donaldson & Davis, 1991) and resource dependence theory (Pfeffer & Salancik, 1978), argue that duality promotes more focused and flexible leadership which facilitates organizational effectiveness in a potentially dynamic business environment (Finkelstein & D'Aveni, 1994; Dahya, Lonie, & Power, 1996).

The empirical literature investigating duality's impact on firm performance yields mixed results. Evidence from the 31 studies reviewed in Dalton, Daily, Ellstrand, and Johnson (1998) is inconclusive, ranging from positive to negative to statistically insignificant relationships (e.g., Daily & Dalton, 1994; Faleye, 2007). Because a board's choice of leadership structure might be endogenous (Faleye, 2007; Hermalin & Weisbach, 1998; Raheja, 2005), the ambiguous results on the relationship between duality and firm performance are often deemed a consequence of endogeneity problems (Harrison, Torres, & Kukalis, 1988; Adams, Almeida, & Ferreira, 2005) that make it difficult to identify a causal relationship between the two. Recent research (Iyengar & Zampelli, 2009) investigates this possibility and documents that studies which treat CEO duality as exogenous do not suffer from selection bias. Consistent with this, Linck, Netter, and Yang (2008) also find that performance does not appear to drive CEO duality. In contrast, Wintoki, Linck, and Netter (2012) provide evidence that CEO duality may be a function of past values of firm performance and hence not strictly exogenous.

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This paper assesses the performance effect of CEO duality within a dynamic framework, accounting for the possible linkages between current governance characteristics and other firm specific variables and past levels of firm performance. Specifically, we employ System GMM to estimate a dynamic model of firm operating performance.

We also extend the literature by examining under what other governance characteristics might the benefits of a joint leadership structure outweigh its costs (Finkelstein & D'Aveni, 1994; Harrison et al., 1988). Specifically, since board leadership structure exists within the context of other governance arrangements such as board composition, we investigate the performance effects of the interaction between duality and other elements of board structure/composition, with particular emphasis on board independence, drawing on theoretical arguments that integrate agency and resource-dependence theories (Desender, Aguilera, Crespi, & Garcia-Cestona, 2013; Hillman & Dalziel, 2003).

Our results provide evidence that duality has a statistically significant negative impact on firm performance that is positively and significantly moderated by board independence. This suggests that outside board members serve as effective monitors, limiting managerial opportunism and playing a disciplinary role while exploiting the benefits of decisive leadership associated with a joint board leadership structure. These results provide support for arguments that the performance impact of duality is contingent on board independence (Davidson, Jiraporn, Kim, & Nemec, 2004; Finkelstein & D'Aveni, 1994) and that the efficacy of corporate governance mechanisms depends on the interdependencies among them (Aguilera, Filatotchev, Gospel, & Jackson, 2008).

The remainder of the paper is organized as follows. Section 2 provides the theoretical background and hypotheses on the relationship between duality/board independence and firm performance. The econometric model of firm performance and the System GMM estimator is outlined and discussed in Section 3. Section 4 describes the sample design, data, and measurement of the dependent and explanatory variables. Estimation results are also presented and discussed in this section. Section 5 presents the results of a number of robustness tests. The implications and limitations of the study, and some concluding remarks are offered in Section 6.

2. Theory and hypotheses

Two main competing theories dominate the discussion of the relationship between CEO duality and firm performance. As the primary theoretical framework that emphasizes the monitoring role of boards, agency theory argues that boards should be independent from management to limit managerial entrenchment and opportunism (Jensen & Meckling, 1976). By breaching this independence, a dual board leadership structure is likely to have a negative impact on performance since it attenuates the board's potential to monitor management effectively (Jensen, 1993).

In contrast, a number of organizational and management theorists argue that CEO duality can enhance firm performance. Stewardship theory (Barney, 1990; Donaldson & Davis, 1991) argues that shareholder interests take priority with a joint leadership structure. In contrast to the implicit assumption of agency theory that CEOs are inherently opportunistic, stewardship theory contends that non-financial factors such as intrinsic satisfaction from achievement, recognition, respect and reputation will motivate CEOs to enhance firm value by using the unity of command to manage the firm's resources as good stewards. This view of managerial motivation is also consistent with an extension of resource dependence theory. Pfeffer and Salancik (1978) emphasize that the increased discretion afforded by dual leadership enhances the CEO's ability to more quickly react and respond in a dynamic business environment, and to secure resources critical to the firm's success. Taken together, the stewardship and resource dependence theories predict a positive relationship between CEO duality and firm performance.

Some theoretical studies that have modeled the determinants of board structure suggest that some board characteristics are dynamic. For example, Hermalin and Weisbach (1998) argue that a CEO's bargaining power derives from superior ability, suggesting that past performance, as a proxy of ability, can determine the elements of board structure implying clearly that there is a dynamic element in the determination of leadership structure. Wintoki et al. (2012) further argue and document that the dynamic element emanates from two sources: past performance and other firm characteristics that affect firm performance. Moreover, empirical papers such as Brickley et al. (1997) support the notion that CEO duality is often the reward for good corporate performance. Also, consistent with the bargaining hypothesis of Hermalin and Weisbach, various studies (e.g., Adams et al., 2005) document the positive association between duality and bargaining power. In particular, the turnover study by Harrison et al. (1988) shows that strong firm performance leads to greater CEO power resulting in duality while poor performance results in two individuals holding both titles.

Though Adams, Hermalin, and Weisbach (2010) suggest that the notion that past performance affects leadership structure does not necessarily imply that duality will improve or even affect performance, we argue that an understanding of duality's performance effects is incomplete and potentially flawed without explicitly incorporating the dynamics of leadership choice. An important implication of this view is that static models yield biased and inconsistent estimates, and raise serious concerns regarding statistical inference. While the dynamic model does not solve all endogeneity problems, it improves inference beyond pooled OLS and traditional fixed-effects estimation. Consequently, we present the following competing alternative hypotheses regarding the effect of CEO duality on firm performance:

H1a. (Agency theory): The dynamic relationship between CEO duality and firm performance is negative.

H1b. (Stewardship/resource dependence theory): The dynamic relationship between CEO duality and firm performance is positive.

These two alternative hypotheses are consistent with the "input–output" approach used in most of the research on the relationship between board characteristics and firm performance "whereby board composition or board structure (input) are linked directly to firm performance (output)" (Macus, 2008, p. 99). This approach has been criticized for neglecting "the processes that occur in the board as boards monitor management's activities, determine the strategic course of the firm, or secure important tangible or intangible external resources for the firm" (Macus, 2008, p. 101). It has also been indicted as one of the culprits in the mixed results reported in the empirical literature on the performance impacts of board characteristics (Daily & Dalton, 2003). Moreover, Macus (2008) offers a strong argument that board interactions are the building blocks of board processes, important to board effectiveness and ultimately firm performance.

We also draw on theoretical arguments that integrate agency and stewardship/resource dependence theories (Hillman & Dalziel, 2003; Desender et al., 2013). These management scholars posit that the board's impact on firm performance depends on both the incentives and the abilities (or power) of board members, and the choices a firm faces regarding the costs and benefits of different board structures. Specifically, efficiency and contingency arguments (Faleye, 2007) suggest that board independence accentuates the benefits of duality and mitigates its costs, resulting in a profitable balance between strong leadership and effective monitoring. Although information acquisition and processing costs are likely to be higher for more independent boards, extant literature (e.g., Armstrong, Core, & Guay, 2014) documents that firm transparency improves with increases in board independence, thus reducing information costs within the firm. Some studies also suggest that board independence improves the quality of accounting information. Others argue that in order to attract independent directors,

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firms commit to more transparent financial reporting and disclosure practices. We thus argue that firms alter their information environment by improving transparency (and reducing information asymmetry) to facilitate the informational requirements of independent directors. Therefore, to the extent that the separation of the CEO and board chairman positions involves costs, it seems more efficient for firms with dual structures to favor independent boards for monitoring effectiveness.

In a dynamic environment, the monitoring effectiveness associated with board independence is likely to intensify the performance effect on the leadership structure. Also, Raheja (2005) models the interaction between insider and outside board members and suggests that firms with strong leadership structure or duality need more outside board members to compensate for CEO influence. It is therefore not surprising that various scholars regard board independence and duality as important corporate governance mechanisms.

Finally, we conjecture that the effect of board independence on CEO turnover (Weisbach, 1988) also accounts for the moderating role of board independence. In a recent important paper, Schwartz-Ziv and Weisbach (2013), using private data on detailed minutes of board meetings, suggest that boards spend most of their time monitoring management. As we argue above, theory and evidence (Jensen, 1993; Fama & Jensen, 1983; Weisbach, 1988; Borokhovich, Parrino, & Trapani, 1996) show that independent directors enhance the monitoring role of the board. Even regulators consider board independence to be the key attribute of a board with high monitoring ability (Adams et al., 2010). For example, Congress, in response to the corporate governance scandals of a few years ago, passed the Sarbanes-Oxley Act (SOX) of 2002, requiring that firms should have a majority of independent directors serving on their boards (and thus justifying our focus on board independence!). Because the decision to replace a CEO is one of the most important decisions of a board, a key goal of monitoring therefore involves assessing CEO talent and using the information in the replacement decision. Consequently, prior studies (e.g., Weisbach, 1988) document a direct relationship between outside directors and the likelihood of replacing a poorly performing CEO. Because of the dynamic relationship between the board of directors and the CEO (Hermalin & Weisbach, 1998), we argue that a dynamic model is better able to capture the influence of performance on this interaction between the CEO and outside directors. Put differently, outsider directors, who are concerned about their reputation in the labor market (Fama & Jensen, 1983), are more likely to confront the powerful CEO when firm performance is poor than insider directors who may be beholden to the CEO for their career prospects (Weisbach, 1988). Moreover, since outsider directors are more likely to replace the CEO with an outsider (Borokhovich et al., 1996), further putting the careers of the inside directors at jeopardy, we expect the insiders to be less effective in the replacement decision. Therefore, to the extent that the impact of board independence on CEO turnover of a poorly performing firm is important in the moderating role of board independence, we expect the interaction of board independence and duality to be positive. Accordingly, we argue that the combination of a powerful CEO and an independent board will result in greater firm performance.

H2. (Agency/resource dependence/stewardship theories): The interaction of CEO duality and board independence is positively associated with firm performance.

3. A dynamic model of firm performance

A dynamic model describing the performance–governance relationship for firm i in period t is given by:

$$PERF_{it} = DUALITY_{it}\beta_{DUALITY} + BD_{it}\beta_{BD} + G_{it}\beta_G + Z_{it}\beta_Z + X_{it}\alpha + \rho PERF_{i(t-1)} + c_i + \varepsilon_{it} \quad (1)$$

where *PERF* is firm performance, *DUALITY* is a binary variable equal to 1 if the CEO serves as board chair and zero otherwise, *BD* is a vector of board composition variables which includes board independence, *G* is a vector of other governance variables, *Z* is a vector of pairwise interactions between *DUALITY* and other elements of the *BD* and *G* vectors, *X* is a vector of other control variables important to performance, $\beta_{DUALITY}$, β_{BD}, β_G, β_Z, and α are conformable parameter vectors, c_i represents unobservable firm heterogeneity, ε_{it} is the idiosyncratic error term, and the subscripts i and t indicate firm and year, respectively. For ease of exposition, we presume an AR(1) process in firm performance with first order correlation ρ.

Complications in estimating Eq. (1) arise since current levels of the explanatory variables may depend on past levels of firm performance (dynamic endogeneity) and may be correlated with the unobserved firm heterogeneity factor c_i. Consequently, standard pooled OLS and panel fixed effects estimators are rendered biased and inconsistent. As an alternative, Arellano and Bover (1995) and Blundell and Bond (1998) develop the System Generalized Method of Moments (System GMM) method which accounts for both dynamic endogeneity and unobserved heterogeneity in panel data models.

The System GMM estimator involves the estimation of a stacked system of level and first difference equations. In our context, the system can be written as:

$$\begin{aligned} PERF_{it} = {} & DUALITY_{it}\ \beta_{DUALITY} + BD_{it}\ \beta_{BD} + G_{it}\ \beta_G + Z_{it}\beta_Z + X_{it}\alpha \\ & + \rho PERF_{i(t-1)} + c_i + \varepsilon_{it} \Delta PERF_{it}\ \Delta DUALITY_{it}\ \beta_{DUALITY} \\ & + \Delta BD_{it}\ \beta_{BD} + \Delta G_{it}\ \beta_G + Z_{it}\ \beta_Z + \Delta X_{it}\alpha + \rho \Delta PERF_{i(t-1)} + \Delta\varepsilon_{it}. \end{aligned} \quad (2)$$

Again, for exposition purposes, model (2) presumes that including the one period lag of performance is sufficient for dynamic completeness. Lags beyond one, therefore, become suitable candidates for instruments. Specifically, the instrument sets for the level and first difference equations are given by

$$(\Delta DUALITY_{i(t-2)}, \ldots, \Delta DUALITY_{i[t-(t-2)]}, \Delta BD_{i(t-2)}, \ldots, \Delta BD_{i[t-(t-2)]}, \Delta G_{i(t-2)}, \ldots, \Delta G_{i[t-(t-2)]}, \Delta Z_{i(t-2)}, \ldots, \Delta Z_{i[t-(t-2)]}, \Delta X_{i(t-2)}, \ldots, \Delta X_{i[t-(t-2)]}).$$

and

$$(DUALITY)_{i(t-2)}, \ldots, DUALITY_{i[t-(t-2)]}, BD_{i(t-2)}, \ldots, BD_{i[t-(t-2)]}, G_{i(t-2)]}, \ldots, G_{i[t-(t-2)]}, Z_{i(t-2)}, \ldots, Z_{i[t-(t-2)]}, X_{i[t-(t-2)]}),$$

respectively.

In the case of unbalanced panels with sample gaps, the first difference formulation in (2) results in data losses which could be substantial. If $PERF_{it}$ is missing, then so too is $\Delta PERF_{it}$ and $\Delta PERF_{i(t+1)}$. The sample gaps and data loss problem prompted Arellano and Bover (1995) to develop the forward orthogonal deviations alternative to the first difference equations. For each of the variables, rather than subtracting the one period lag from the contemporaneous value, the orthogonal deviations method subtracts the average of all available future values of the variable. Regardless of the number of gaps, only the last observation is lost. Since the forward deviations contain no lags, the lags can still be used as instruments.

Before continuing, it is worth emphasizing the advantages of the System GMM estimation. Unlike traditional pooled OLS estimation, System GMM includes firm-fixed effects to account for unobservable firm heterogeneity. The method, however, goes beyond the standard fixed effects model and allows current values of *DUALITY*, *BD*, *G*, *Z*, and *X* to be influenced by past levels of firm performance. Moreover, System GMM is robust to firm-specific patterns of heteroscedasticity and serial correlation as well as to sample gaps in unbalanced panels. Lastly, if the underlying relationships between firm performance and *DUALITY*, *BD*, *G*,

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Z, and *X* are dynamic as described, then it is valid to use a set of "internal" instruments contained within the panel itself, i.e., past values of and past changes in *DUALITY*, *BD*, *G*, *Z*, *X*, and firm performance, to address endogeneity concerns. This correspondingly has the added advantage of eliminating the need for finding suitable external instruments.

4. Sample, estimations and results

4.1. Sample

The initial sample derives from the intersection of the *ExecuComp*, *ISS* (formerly *RiskMetrics*) and *Compustat* databases and consists of 17,282 firm-year observations over the 1997–2011 period. Financial data is obtained from *Compustat*, antitakeover provisions and board characteristics from *ISS*, and CEO characteristics from *ExecuComp*. We excluded 3726 firm-year observations from the regulated financial and utility industries, 5110 firm-year observations with insufficient financial data, and 1295 firm-year observations with insufficient ownership and/or governance data. Because System GMM relies on lagged values of both dependent and explanatory variables, 303 firm-year observations from firms that did not have at least three time series observations over the sample period were also eliminated. The final sample consists of 6848 firm-year observations and 950 unique firms. Table 1, panel A reports the details of the sample selection process. Finally, variables were winsorized at their 1st and 99th percentile values to reduce the potentially spurious effects of outliers (board variables, *EINDEX*, and binary variables were not winsorized).

4.2. Variables

As noted earlier, we follow Wintoki et al. (2012) and focus on a firm's operating performance as our dependent variable. Three operating performance measures are used: Return on Assets [100% × (operating income divided by average assets)], Return on Equity [100% × (net income divided by average equity)], and Return on Sales [100% × (net income divided by total sales)]. The variables are denoted by *ROA*, *ROE*, and *ROS*, respectively.

Board variables include the natural logarithm of board size [ln(*Board Size*)], the proportion of board members who are independent (*Board Independence*), the proportion of board members who are female (*Gender Diversity*), and a dummy variable equal to one if the CEO also serves as board chair (*Duality*). To capture managerial entrenchment, we include *EINDEX* [see Bebchuk, Cohen, and Ferrell (2009)]. *EINDEX* is an entrenchment measure based on six of the 24 anti-takeover provisions identified in Gompers, Ishii, and Metrick (2003). Because the components of *EINDEX* are not observed yearly, we replace them in the "off-years" using the previous year's value. To assess the potentially moderating influence of board independence on duality, we include the interaction term *Duality* × *Board Independence*.

Other control variables include the proportion of outstanding common shares owned by the CEO (*CEO Stock Ownership*), firm size measured by the natural logarithm of total assets [ln(*Assets*)], the natural logarithm of the number of business segments [ln(*Business Segments*)], the ratio of total debt to total assets (*Leverage*), the standard deviation of the previous 60 months of stock returns (*Volatility*), the ratio of research and development expenditures to lagged sales (*R&D*), a dummy variable equal to 1 if R&D expenditure is unavailable from *Compustat* (*R&D Missing*), and the four-digit industry median operating performance value (*SIC-4 Industry Median Operating Performance*).

Table 1
Sample and descriptive statistics.

Panel A: Sample selection details (1997–2011)

Details	Observations
Firm-year observations in ExecuComp	17,282
Less: Firm-year observations from financial and utility industries	(3726)
Less: Firm-year observations with insufficient financial data in CompuStat	(5110)
Less: Firm-year observations with unavailable governance/ownership data in ISS (RiskMetrics)	(1295)
Less: Firm-year observations for firms with less than three observations over the sample period	(303)
Firm-year observations in final sample	6848

Panel B: Descriptive statistics

Variable	Mean	Median	Std. dev.
ROA (%)	10.51	10.13	7.99
ROS (%)	5.16	5.61	11.70
ROE (%)	11.35	12.62	22.53
Duality	0.50	1.00	0.50
Board Independence	0.74	0.77	0.15
Board Size	9.17	9.00	2.33
Gender Diversity	0.09	0.08	0.10
EINDEX	2.82	3.00	1.33
CEO Stock Ownership (%)	1.80	0.36	4.11
Assets (millions of $)	7229	1945	15,869
Business Segments	3.19	3.00	1.91
Leverage (%)	25.88	23.19	22.89
Volatility	10.72	9.56	5.18
R&D	0.04	0.004	0.07
SIC-4 Median ROA (%)	5.22	6.67	8.12
SIC-4 Median ROS (%)	0.95	2.94	10.24
SIC-4 Median ROE (%)	6.47	8.36	11.29

4.3. Descriptive statistics

Table 1, panel B reports the summary statistics for all performance, governance, and control variables. Relative to Wintoki et al. (2012), the firms in our sample are larger in terms of assets (7229 vs. 5333), managed by marginally larger boards (9.17 members vs. 7.5–8 members), and perform far better in terms of return on assets (10.51% vs. 2.84%). The firms in our sample are managed by boards with slightly larger proportions of independent directors (0.74 vs. 0.67) and a slightly fewer proportion of CEOs acting as chairs (0.50 vs. 0.59). Our average *EINDEX* value is comparable to Chang and Zhang (2015) (2.82 vs. 2.5). Given these comparisons, our sample of firms appears comparable to previous studies.

4.4. Static models: pooled OLS and panel fixed effects

In this study, we focus on the performance effect of duality and its interaction with board independence in a dynamic environment. For comparison with the dynamic estimates presented in the following sub-section, we report the results from static, pooled OLS and panel fixed effects models of firm performance in Table 2. The results indicate statistically insignificant impacts of *Duality* and *Duality* × *Board Independence*, suggesting that a combined leadership structure has no differential impact on firm performance vis á vis a separate structure and that the proportion of independent directors on a firm's board does nothing to change that.

4.5. System GMM estimates

In the interest of transparency, the process underlying the dynamic results reported below is described here in detail. First, a test for strict exogeneity as prescribed by Wooldridge (2002) in panels where T > 2 was conducted. Briefly, the following equation was specified:

$$PERF_{it} = Duality_{it}\beta_{Duality} + BD_{it}\beta_{BD} + G_{it}\beta_G + Z_{it}\beta_Z + X_{it}\beta_X + W_{i(t+1)}\delta + c_i + \varepsilon_{it} \quad (3)$$

where $W_{i(t+1)}$ is a vector containing the one-period lead values of *Duality* and the elements of the *BD*, *G*, and *X* vectors (or of a subset thereof). Strict exogeneity of any W_i requires $\delta_i = 0$ and can be tested by estimating Eq. (3) using standard fixed effects with robust and

Table 2
OLS estimates.

Explanatory/control variables	Operating performance					
	ROA		ROS		ROE	
	Est. coef.	p-Value	Est. coef.	p-Value	Est. coef.	p-Value
Panel A: Pooled OLS estimates						
Duality	−1.031	0.370	−1.124	0.439	−3.349	0.196
Board Independence	−1.681	0.249	−0.712	0.664	2.260	0.445
ln(Board Size)	−1.018	0.210	−3.919	0.000***	0.311	0.867
Gender Diversity of Board	4.913	0.004***	2.451	0.139	9.680	0.030**
EINDEX	−0.371	0.007***	−0.297	0.076*	−0.616	0.039**
Duality × Board Independence	1.555	0.301	1.508	0.422	4.642	0.185
CEO Stock Ownership	−0.007	0.841	0.003	0.927	0.034	0.632
ln(Assets)	0.031	0.864	0.878	0.000***	0.583	0.138
ln(Business Segments)	−0.882	0.004***	−1.349	0.000***	−1.933	0.006***
Leverage	−0.059	0.000***	−0.072	0.000***	−0.056	0.014**
Volatility	−0.475	0.000***	−0.677	0.000***	−1.383	0.000***
R&D	−25.670	0.000***	−43.872	0.000***	−57.318	0.000***
R&D Missing	−1.052	0.022**	−1.337	0.006***	−3.247	0.002***
SIC-4 Industry Median Operating Performance	0.281	0.000***	0.239	0.000***	0.614	0.000***
Firm-year observations	6848		6848			
Firms	950		950			
Panel B: Panel fixed effects						
Duality	−0.272	0.702	−1.295	0.286	−1.456	0.536
Board Independence	0.956	0.344	−1.127	0.475	−2.799	0.370
ln(Board Size)	−1.060	0.080*	−3.173	0.001***	−2.222	0.263
Gender Diversity of Board	4.053	0.010**	3.233	0.056*	6.388	0.110
EINDEX	−0.176	0.116	0.036	0.844	−0.020	0.952
Duality × Board Independence	0.108	0.905	1.107	0.483	1.141	0.706
CEO Stock Ownership	−0.003	0.919	0.064	0.074*	0.091	0.264
ln(Assets)	−0.262	0.492	0.739	0.225	−1.705	0.128
ln(Business Segments)	−0.391	0.368	−1.305	0.033**	−1.839	0.123
Leverage	−0.076	0.000***	−0.109	0.000***	−0.069	0.036**
Volatility	−0.105	0.000***	−0.276	0.000***	−0.649	0.000***
R&D	−77.944	0.000***	−175.503	0.000***	−168.732	0.000***
R&D Missing	0.117	0.838	−1.222	0.109	−3.241	0.093*
SIC-4 Industry Median Operating Performance	0.431	0.000***	0.421	0.000***	0.802	0.000***
Firm-year observations	6848		6848		6848	
Firms	950		950		950	

***, **, and * indicate two-tailed significance at 1%, 5%, and 10%, respectively.

clustered standard errors. Industry and year dummies are included as well. Estimates of the δ_ts for each of the three performance equations are reported in Table 3.

Across all measures there is evidence that ln(*Assets*), *Leverage*, and *Volatility* are not strictly exogenous. Results for other variables are inconsistent. *EINDEX* and *CEO Stock Ownership* are strictly exogenous for *ROA* and *ROE* but not for *ROS*. *R&D* is found to be strictly exogenous for *ROS* and *ROE* but not for *ROA*. Similarly, for the *SIC-4 Industry Median Operating Performance*, the hypothesis of strict exogeneity can be rejected for *ROE* but not for the other two measures. For all other variables, the null hypothesis of strict exogeneity cannot be rejected.

The initial System GMM estimation of Eq. (2) was undertaken in standard fashion as described in Roodman (2009), except with the difference equation specified in orthogonal deviations form. Additionally, we use the Windmeijer (2005) correction for the standard errors to mitigate the problem of finite sample bias. Because instrument proliferation can cause the overfitting of the instrumented variables as well as weakening the Hansen over-identification test and the Difference-in-Hansen

Table 3
Strict exogeneity tests.

Explanatory variable ($t+1$)	Operating performance					
	ROA		ROS		ROE	
	Est. coef.	p-Value	Est. coef.	p-Value	Est. coef.	p-Value
Duality ($t+1$)	−0.162	0.504	0.402	0.393	0.413	0.622
Board Independence ($t+1$)	0.877	0.401	1.671	0.352	3.011	0.425
ln(Board Size) ($t+1$)	0.488	0.414	−0.430	0.727	−0.640	0.772
Gender Diversity of Board ($t+1$)	2.175	0.167	−4.326	0.130	5.952	0.307
EINDEX ($t+1$)	−0.131	0.266	−0.419	0.081*	−0.664	0.140
CEO Stock Ownership ($t+1$)	0.019	0.515	0.119	0.013**	0.073	0.434
ln(Assets) ($t+1$)	3.898	0.000***	3.630	0.000***	7.013	0.000***
ln(Business Segments) ($t+1$)	0.118	0.742	−0.622	0.569	−0.149	0.937
Leverage ($t+1$)	−0.014	0.094*	−0.030	0.066*	−0.057	0.070*
Volatility ($t+1$)	−0.101	0.000***	−0.228	0.000***	−0.511	0.000***
R&D ($t+1$)	15.044	0.031**	18.541	0.226	21.073	0.415
R&D Missing ($t+1$)	0.219	0.785	0.055	0.964	4.135	0.266
SIC-4 Median Operating Performance ($t+1$)	0.001	0.977	−0.053	0.209	−0.068	0.089*

***, **, and * indicate two-tailed significance at 1%, 5%, and 10%, respectively.

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tests of instrument validity/exogeneity, we limit the number of instruments in two ways. First, we employ the "collapse" option which combines instrument vectors into smaller sets through addition. Second, we use only the nearest lag allowable for each variable that is treated as endogenous or not strictly exogenous.

To determine the lag order, *p*, of the performance variable that ensures dynamic completeness, we began by estimating the model with a one-year lag and increased by one the number of lags until the additional lag is found to be statistically insignificant. Simultaneously, we ensured that the lag order was consistent with the absence of second order serial correlation in the first-differenced residuals (see below). For each performance equation, we treated as not strictly exogenous all those variables identified as such by the results of Table 3. All other control variables were treated as strictly exogenous.

Critical diagnostic tests for System GMM estimation include the Arellano–Bond test of the null hypothesis of no second-order serial correlation in the first differenced residuals, the Hansen over-identification test of the null hypothesis that the instruments are robust, and the Difference-in-Hansen test of the null hypothesis that the instruments are exogenous. Confidence in the specification of the model requires that all tests fail to reject their stated null hypotheses. Regarding dynamic completeness, a lag of one period was sufficient for *ROE* and *ROS* while a lag of two periods was required for *ROA*. Treating the variables identified by Table 5 as not strictly exogenous and all other controls as strictly exogenous was sufficient to conclude that the instruments were robust and exogenous according to the Hansen and Difference-in-Hansen tests noted above. In some cases where variables were treated as not strictly exogenous, the Difference-in-Hansen test diagnostic indicated that their lagged changes were invalid as instruments for the level equations, likely due to a non-zero correlation with the fixed effects component of the error term. For these variables, their lagged changes were used as instruments for the orthogonal deviations equations only.

Table 4 reports the System GMM parameter estimates along with all relevant diagnostic tests and p-values. Across all three measures of performance, we find negative and significant main effects of *Duality* and positive and significant effects of its interaction with *Board Independence*. This implies that *Duality* has a negative impact on operating performance when *Board Independence* is equal to zero, i.e., when there are no independent directors on the board, but that this effect is moderated as the proportion of independent directors rises. This is supportive of literature which argues that effective monitoring by independent boards coupled with powerful CEOs can serve as an important source of competitive advantage to a firm (e.g., Combs, Ketchen, Perryman, & Donahue, 2007) and with Finkelstein and D'Aveni (1994) and Quigley and Hambrick (2012) whose work supports the hypothesis that the potential agency and inertial effects of legacy preservation costs associated with a powerful, focused CEO may be mitigated by the vigilant oversight of an independent board in their role as stewards of shareholder value. Importantly, we conjecture that the moderating role of board independence is consistent with findings that document that firms with more independent boards are more likely to terminate poorly performing CEOs (e.g., Weisbach, 1988; Borokhovich et al., 1996).

Because some might question the validity of this implication in light of the fact that we do not mean-center *Board Independence*, Table 5 reports results from a System GMM estimation in which the variable is mean-centered (*MC.Board Independence*). As expected, all parameter estimates are identical except for the estimated main effect of *Duality* which is now positive and insignificant. The implication here is that *Duality* has no impact on performance when *Board Independence* is equal to its mean value of 0.7383.

Though one might be tempted to conclude from this that the mean-centering of *Board Independence* will make a difference in *Duality*'s reported impact on operating performance, it is critical to understand that with a significant interaction term the estimated performance impact of *Duality* cannot be separated from the value of *Board Independence*, i.e., *Duality* has no "independent" impact on firm performance. Moreover, the performance impacts will be the same whether *Board Independence* is mean centered or not. Our untabulated results show

Table 4
System GMM estimates.

Explanatory/control variables	Operating performance					
	ROA		ROS		ROE	
	Est. coef.	p-Value	Est. coef.	p-Value	Est. coef.	p-Value
Duality	−2.272	0.040**	−4.118	0.014**	−5.793	0.068*
Board Independence	0.603	0.704	0.766	0.657	1.911	0.537
ln(Board Size)	2.938	0.377	6.837	0.120	9.426	0.305
Gender Diversity of Board	1.277	0.513	7.663	0.001***	10.594	0.018**
EINDEX	−0.399	0.107	−0.341	0.391	−0.485	0.306
Duality × Board Independence	3.368	0.041**	6.885	0.009***	9.447	0.070*
CEO Stock Ownership	−0.006	0.871	0.056	0.380	−0.082	0.411
ln(Assets)	−1.293	0.363	−2.421	0.197	−2.380	0.539
ln(Business Segments)	−0.689	0.267	0.354	0.642	−0.270	0.857
Leverage	−0.009	0.791	−0.167	0.000***	−0.175	0.021**
Volatility	0.175	0.246	−0.120	0.551	−0.484	0.018**
R&D	−68.806	0.133	−46.746	0.000***	−58.929	0.000***
R&D Missing	−3.077	0.082*	−2.085	0.006***	−3.980	0.005***
SIC-4 Median Operating Performance	0.199	0.001***	0.333	0.000***	0.836	0.000***
Operating performance ($t-1$)	0.430	0.004***	0.223	0.000***	0.211	0.000***
Operating performance ($t-2$)	−0.053	0.566				
F-statistic	17.92	0.000***	15.55	0.000***	15.80	0.000***
Firm-year observations	3740		5108		5108	
Firms	910		947		947	
Number of instruments	42		45		42	
AR(1) p-value	0.031**		0.000***		0.000***	
AR(2) p-value	0.355		0.811		0.664	
Hansen tests of overidentifying restrictions (p-value)	0.292		0.579		0.686	
Difference-in-Hansen exogeneity of instruments tests (p-value range)	0.292		0.356–0.982		0.454–0.686	
Year effect	Yes		Yes		Yes	
Industry effects	Yes		Yes		Yes	

***, **, and * indicate two-tailed significance at 1%, 5%, and 10%, respectively.

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Table 5
System GMM estimates: Mean-centered board independence.

Explanatory/control variables	Operating performance					
	ROA		ROS		ROE	
	Est. coef.	p-Value	Est. coef.	p-Value	Est. coef.	p-Value
Duality	0.214	0.657	0.965	0.134	1.182	0.383
MC.Board Independence	0.603	0.704	0.766	0.657	1.911	0.537
ln(Board Size)	2.938	0.377	6.837	0.120	9.426	0.305
Gender Diversity of Board	1.277	0.513	7.663	0.001***	10.594	0.018**
EINDEX	−0.399	0.107	−0.341	0.391	−0.485	0.306
Duality × MC.Board Independence	3.368	0.041**	6.885	0.009***	9.447	0.070*
CEO Stock Ownership	−0.006	0.871	0.056	0.380	−0.082	0.411
ln(Assets)	−1.293	0.363	−2.421	0.197	−2.380	0.539
ln(Business Segments)	−0.689	0.267	0.354	0.642	−0.270	0.857
Leverage	−0.009	0.791	−0.167	0.000***	−0.175	0.021**
Volatility	0.175	0.246	−0.120	0.551	−0.484	0.018**
R&D	−68.806	0.133	−46.746	0.000***	−58.929	0.000***
R&D Missing	−3.077	0.082*	−2.085	0.006***	−3.980	0.005***
SIC-4 Median Operating Performance	0.199	0.001***	0.333	0.000***	0.836	0.000***
Operating performance ($t-1$)	0.430	0.004***	0.223	0.000***	0.211	0.000***
Operating performance ($t-2$)	−0.053	0.566				
F-statistic	17.92	0.000***	15.55	0.000***	35.34	0.000***
Firm-year observations	3740		5108		5108	
Firms	910		947		947	
Number of instruments	42		45		42	
AR(1) p-value	0.031**		0.000***		0.000***	
AR(2) p-value	0.355		0.811		0.664	
Hansen tests of overidentifying restrictions (p-value)	0.292		0.579		0.686	
Difference-in-Hansen exogeneity of instruments tests (p-value range)	0.292		0.356–0.982		0.454–0.686	
Year effects	Yes		Yes		Yes	
Industry effects	Yes		Yes		Yes	

***, **, and * indicate two-tailed significance at 1%, 5%, and 10%, respectively.

the marginal performance impacts of *Duality* and their p-values based on the results of Tables 4 and 5 for each sample value of *Board Independence*. Marginal impacts were calculated from Tables 4 and 5 as: $\beta_{DUALITY} + \beta_Z \times (Board\ Independence)$ and $\beta_{DUALITY} + \beta_Z \times (MC.\ Board\ Independence)$, respectively. For each performance measure, *Duality* has negative and significant impacts for boards with small proportions of independent directors. Because of the positive moderating effect of *Board Independence* reported above, however, these negative impacts become smaller as the proportion of independent directors increase.

5. Robustness tests

We conducted several robustness tests. First, we split the sample at the sample mean value of *Board Independence* and used System GMM to estimate the model separately for the two sub-samples. As reported in Table 6, the estimated coefficients on *Duality* have the expected signs in all cases, negative when *Board Independence* takes on a value below its mean and positive otherwise. The estimates are statistically significant in four of the six cases.

Caution, however, should be exercised in reading too much into the split sample results for three reasons. First, identifying the sample mean as the threshold for behavioral changes is somewhat arbitrary; second, the effects of sample splitting in unbalanced panels with sample gaps and serial correlation are not well known; and third, if the value of *Board Independence* is itself affected by *Duality*, such sample-splitting may be imparting unknown sample selection biases. Given such concerns, it is somewhat reassuring to see some consistency between the full- and split-sample results.

Past studies of governance/performance relationships have also employed as their dependent variables industry-adjusted measures of operating performance. As another robustness check, we re-estimate the System GMM model with industry-adjusted measures. Specifically, the dependent variables are now calculated as the raw, firm specific operating performance minus the *SIC-4 Industry Median Operating Performance* value. The estimation procedure outlined at the beginning of the previous subsection was again followed. The (unreported) results for industry adjusted performance are consistent with those reported in Tables 4, 5, and 6 for the unadjusted measures, i.e., negative performance impacts of *Duality* when the proportion of independent directors is small that are mitigated as the proportion rises. In fact, positive and significant effects of *Duality* for boards with large proportion of independent directors are observed for all three industry adjusted measures. Third, we estimate the models including the pairwise interactions of *Duality* with the industry dummy variables. The main results of the previous section are again supported.

Finally, we add the three pairwise interaction terms (*Duality* × ln(*Board Size*)), (*Duality* × *Gender Diversity*), and (*Duality* × *EINDEX*) to account for the possible moderating effects of board size, board composition, and managerial entrenchment on *Duality*. Theoretical and empirical studies have yielded conflicting

Table 6
Sub-sample estimates of duality's impact on ROA, ROS, and ROE.

	Operating performance					
	ROA		ROS		ROE	
Sub-sample	Est. coef.	p-Value	Est. coef.	p-Value	Est. coef.	p-Value
Below sample mean value of board independence	−0.749	0.098*	−1.420	0.054*	−1.279	0.253
At or above sample mean value of board independence	2.830	0.014***	0.296	0.548	7.231	0.028**

***, **, and * indicate two-tailed significance at 1%, 5%, and 10%, respectively.

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arguments and results on the relationship between these proxies of corporate governance and firm performance (e.g., Jensen, 1993; Yermack, 1996; Adams & Ferreira, 2009; Gompers et al., 2003; Upadhyay & Zeng, 2014). Therefore, the performance effect of the interactions of duality and these governance measures is an empirical question.

Our (untabulated) results based on this expanded model suggest that our conclusions regarding the moderating role of board independence generally hold. Specifically, we find that the interaction term *Duality* and *Board Independence* is positive and significant for both *ROA* and *ROS* (for ROE, it is positive but not significant), suggesting that the benefits of board independence dominate its costs in the presence of duality. In contrast, we do not find significant results for the other board variables, board size and gender diversity.

6. Summary and conclusions

Empirical research on the performance impact of duality has been predominantly oriented to static analyses. Motivated by recent studies that have examined the dynamic relation between proxies of corporate governance and firm performance (Wintoki et al., 2012; Chang & Zhang, 2015) and scholars who have called for research that examines the long run effect of duality on firm performance using a more dynamic approach and who recognize that board composition and structure are dynamic processes (e.g., Hermalin & Weisbach, 1998; Adams et al., 2010), we employ System GMM to estimate a dynamic model of the relationship between duality and operating firm performance. The dynamics of the relationship are captured by including as an explanatory variable, the lagged value of firm performance, and by explicitly accounting for evidence suggesting that a firm's choice of board leadership structure as well as other firm-specific variables is not strictly exogenous (i.e., the current period values of these variables depend on historical values of operating firm performance). We also examine the performance effect of the interaction between duality and board independence in a dynamic framework.

We find that CEO duality has negative and significant impacts on operating performance of when independent directors account for a small proportion of a board's membership. Moreover, as the proportion of independent directors rises, these negative impacts are mitigated to an extent that they eventually disappear and turn positive as the proportion of independent directors increases further. This result survives a battery of robustness tests. The clear implication is that the interdependence of a vigilant board and a powerful CEO enhances board capability such that the integration of agency theory and resource dependence arguments enhances the monitoring effectiveness of the board. Simply put, a powerful CEO enhances the board's capability to provide valuable resources to the firm, including providing advice that would enhance the firm's competitive advantage resulting in a positive impact on performance.

Our study is subject to some caveats. First, similar to static models, misspecification can certainly pose a problem with dynamic System GMM. However, since our results remain robust across numerous re-estimations of the model, serious misspecification problems are likely to be minimal. Second, a potential limitation of the study is our assumption that CEOs and the board play a critical role in influencing firm performance. However, given prior research and the strength of our results this assumption seems reasonable. Linking the power of the CEO and board vigilance to firm performance seems appropriate given that CEOs, with the oversight of the board, are charged with maximizing shareholder wealth. Accordingly, we believe that these findings contribute to the debate regarding CEO duality and offer guidance by way of caution regarding the call for the wholesale abolition of duality in certain quarters.

Future research will profit from examining the effects of international institutions and networks on the performance effect of duality on firm performance. Prior literature suggests that the degree of managerial agency conflicts vary with level of investor protection in a country. Also, a country's cultural, legal and political environment affects the quality of its corporate governance mechanisms. A study that exploits these cross-country variations will yield interesting results regarding the effect of duality on firm performance. Also, our focus in this paper has been on the moderating effect of board composition, especially board independence, on the relationship between duality and firm performance within a dynamic framework. Future research will benefit from a closer examination of such interdependencies between other corporate governance mechanisms and market settings such as institutional ownership, anti-takeover laws, financial reporting quality and firm competition on the performance effect of duality on firm performance.

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