The Effects of Board Independence and CEO Duality on Firm Performance: Evidence from the NASDAQ-100 Index with Controls for Endogeneity

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This study examines the effects of board independence and CEO duality on firm performance. We analyze data for the NASDAQ-100 firms over the period 2010-2014. Three measurements of board independence are used: (1) proportion of independent directors, (2) committee overlap, and (3) board interlock. We use an alternative and more appropriate definition of committee overlap and board interlock that only considers independent-director committee overlaps and interlocks. Our method includes the use of a treatment effect approach to control for endogenous issues that have likely caused mixed results in prior research. Several significant results are found from this study. First, independent-director committee overlaps are shown to have a significantly positive relationship with firm performance. Secondly, board interlocks of independent directors are also found to be positively associated with firm performance. Lastly, we find a negative relationship between CEO duality and firm performance. The relevance of these results is discussed from corporate governance policy and academic research perspectives.

INTRODUCTION

Investor confidence was shaken with betrayals by company management in the early 2000s (e.g., Enron, WorldCom, and Tyco). These management-perpetrated frauds brought attention to corporate governance issues, and caused the Sarbanes-Oxley Act of 2002 to be enacted. Corporate governance issues were reignited by the global financial crisis of 2008. Much of the responsibility for such frauds and crises rests with the board of directors as they are expected to protect investors' interests through their advisory and oversight responsibilities.

Because of these frauds and crises, boards have received the attention of considerable academic research. Much of this corporate governance research has focused on board independence and leadership structure (Bhagat & Bolton, 2008). Board independence measures can include: (1) the proportion of independent directors in the board, (2) committee overlap of independent directors (i.e., independent directors serving on multiple committees of the same board), and (3) board interlocks of independent

directors (i.e., independent directors sitting on multiple boards across firms). Leadership structure includes the issue of CEO duality (i.e., where the CEO also holds the position of chair of the board of directors).

The corporate governance literature on this topic adopts diverse theoretical perspectives including agency, stewardship and resource dependence theories. These three schools of thought represent conflicting perspectives on the effects of board independence and CEO duality on firm performance. From an agency perspective, individual actors are motivated by self-interests and utility-maximizing behavior (Clarke, 2007). The theory emphasizes agency costs and managerial opportunism (Zona et al., 2015). This theory assumes that independent directors will effectively monitor managers (Ramdani & Witteloostuijn, 2010). Further, it predicts that a non-CEO duality leadership structure will provide more effective supervision of the CEO (Peng et al, 2007).

Stewardship theory assumes that managers act in the interests of the owners (i.e., they are "stewards") (Ramdani & Witteloostuijn, 2010). This theory predicts that CEO duality is an essential contributor to the unity of the firm (Donaldson & Davis, 1991). From resource dependence perspective, it is assumed that firms depend upon one another for gaining valuable resources (L'Huillier, 2014). Having interlocking independent directors will allow greater resources to be brought into the firm.

Empirical results from prior studies are as varied as the supporting theories. The relationship between independent board members and firm performance has supported a positive relationship (e.g., Daily & Dalton, 1993; Cornett et al., 2008; Vo & Nguyen, 2014; and Issarawornrawanrch, 2015), negative relationship (e.g., Agrawal & Knoeber, 1996; Bhagat & Black, 2002; and Vintila et al., 2015), and no significant relationship (Bhagat & Bolton, 2013; and Elbarrad, 2014). Similarly, the empirical results for the relationship between CEO duality and firm performance are also mixed; some indicate a positive relationship (e.g., Krause & Semadeni, 2013; and Guillet et al.. 2013), some indicate a negative relationship (e.g., Daily & Dalton, 1994, and Cornett et al., 2008), and some studies find no relationship (e.g., Daily & Dalton, 1992; Abdullah, 2004; and Chen et al., 2008). These results are mixed because it is likely that there are endogenous variables affecting the relationships that have not been considered in the prior studies. We resolve this and other issues in the current study.

The current study contributes to the corporate governance literature on the effects of board independence, and CEO duality on firm performance. First, the prior literature concerning committee overlap is only investigates overlaps between audit committees and compensation committees, and only focuses on the effects of committee overlap on the audit, management incentives, or financial reporting (Laux & Laux, 2009; Chang et al., 2011; Karim et al., 2015).

Second, prior literature often emphasises the supervisory role of independent directors but rarely consider other functions (Crespi-Cladera & Gispert, 2003). Such research on committee overlaps seldom expands to include its effects on firm performance, and specifically the interlocking "independent" directors are not studied. We focus on overlapping and interlocking "independent" directors and their linkage to firm performance (e.g., the monitoring and advisory effectiveness of "independent" directors). By using a wider set of variables as proxies for board independence, this study extends our understanding of the effects of board independence on firm performance.

Third, the current governance literature on committee overlaps and board interlocks demonstrates a lack of research concerning our sample firms (e.g., firms listed on the NASDAQ-100 Index), particularly for recent years. We study such firms for the period 2010 to 2014. This allows our findings to be informative and instrumental for governance and research issues related to high-tech and high-growth firms. Lastly, as our review of the literature reveals, some relationships we examine have shown inconclusive result in previous studies. We look deeper into these relationships by using a more appropriate methodology including a step-wise model, proper control variables, and controls for endogeneity, and conclude with tests for robustness.

Using the treatment effect approach to control endogenous issues, the findings indicate that committee overlap of independent directors has a significantly positive effect on firm performance, consistent with agency perspectives. Consistent with the resource dependence perspective, board interlock of independent directors is also shown to improve firm performance. Lastly, a negative relationship is

found to exist between CEO duality and firm performance. These results are robust even after the replacement and exclusion of control variables.

The remainder of this study is organized as follows: Section 2 discusses background the prior relevant literature, and develops testable hypotheses. Section 3 describes the sample selection, measurements and model specifications. The fourth section reports descriptive statistics and the results from correlations, multiple regressions (including endogeneity tests), and robustness tests. Lastly, Section 6 concludes the study with a discussion of the relevance and contributions of the study.

RELATED LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

In this study, we examine the relationship between board independence and firm performance using three measures of board independence (proportion of independent directors, committee overlap of independent directors, and board interlocks of independent directors). We also examine the relationship between CEO duality and firm performance.

Board Independence and Firm Performance
There are two broad theories that can be used to explain how board independence might influence firm performance. These include agency theory and stewardship theory. Agency theory assumes the existence of 'goal conflict' between the principal (e.g., the board) and the agent (e.g., CEO), because the agent/CEO is motivated to act in his own self-interest rather than that of the principal/board. Having independent board members is a necessary condition for effective monitoring of CEOs (Huse, 1994). Accordingly, agency theory suggests that a higher proportion of independent directors on the board should contribute to improved firm performance.

As an alternative, stewardship theory assumes that directors and manages are stewards on behalf of shareholders of the corporation. Their motivation is driven by a need to perform well and achieve success. They are motivated by the satisfaction of successful performance for themselves and the corporation, and by recognition. The directors and the CEO will cooperate with each other because their goals are similarly aligned (Davis et al., 1997). Therefore, stewardship theory suggests that boards with a lower proportion of independent directors on the board should contribute to enhance corporate performance.

Board Independence (The Proportion of Independent Directors) and Firm Performance (H1)
When board independence is measured as the proportion of directors that are independent, the evidence is mixed as to the relationship between board independence and firm performance. Daily and Dalton (1993) study 186 small-size US firms (firms with fewer than 500 employees and $20 million sales). The results find that more outside directors is associated with higher firm performance as measured by ROA. Cornett et al. (2008) study the effect of earnings management on the relationship between corporate governance structure and firm performance. They study S&P 100 firms over the period 1994 to 2003. The authors find a positive relationship between the number of independent directors and firm performance, and this relationship becomes stronger after adjusting for the impact of earnings management. Several more recent studies also find a positive relationship between the proportion of independent directors and firm performance (Vo and Nguyen (2014) for Vietnamese firms; Palmberg (2015) for Swedish firms, and Issarawornrawanrch (2015) for Thai firms).

Alternatively, some studies find the relationship between the proportion of independent directors and firm performance is negative. Agrawal and Knoeber (1996) investigate 400 large US firms, and find firms with a majority-outside board had reduced performance as compared to those that did not have majority-outside boards. Bhagat and Black (2002) study 934 large US corporations. They found a significant negative correlation between firm performance and board independence. Vintila et al. (2015) examine 51 high-tech US companies over the period 2000-2013 and find the relationship between the proportion of non-executive board members and firm performance is negative. Other studies find mixed or non-significant results. For example, Bhagat and Bolton (2013) found the relationship to be negative for sample firms in the pre-SOX period, but the relationship was positive during the post-SOX period.

Elbarrad (2014) finds the relationship is negative for 33 banking firms, but not significant for two other sectors (cement, and multi-investment). Because he previous empirical studies produced mixed results, we present the following non-directional hypothesis in the null form:

> $H1_0$: There is not a significant relationship between board independence (as measured by the proportion of independent board members) and firm performance.

Board Independence (Committee Overlaps of Independent Directors) and Firm Performance (H2)

Prior studies examining committee overlap are quite limited. Most studies suggest net benefits to firm performance from committee overlaps. Zajac and Westphal (1996) suggest that decision quality should be enhanced through the knowledge transfers from committee overlaps. Hartzell and Starks (2003) note that such overlapping members will be more knowledgeable about managerial performance, thus improve monitoring effectiveness by restraining managerial opportunism. From an agency perspective, Brandes et al. (2015) suggests that committee overlap can reduce information asymmetry, thereby making committee members more effective monitors and advisors. When independent directors engage in committee overlaps then information flows more seamless (e.g., information about finance, risk and performance) (Brandes et al., 2015). Larcker et al. (2014) argue that a high degree of committee overlap maximizes the sharing of specialized knowledge on the board, thus, information asymmetry is reduced. The implication from these studies is that there is a positive relation between committee overlap of independent directors and firm performance, thus the following hypothesis is suggested.

> $H2_a$: There is a positive relationship between board independence (as measured by the overlap of committee positions held by independent board members) and firm performance.

Board Independence (Board Interlocks of Independent Directors) and Firm Performance (H3)

A board interlock is present when a director serves on two or more boards across firms, and thereby creates an interlock between organizations (Iturriaga & Rodríguez, 2014). A board interlock can be more specifically identified as an interlock of independent directors.

Agency theory suggests that a board interlock is likely to aggravate opportunistic behaviors and agency costs (Jensen, 1986; Fich & White, 2005; Perry & Peyer, 2005), and will reduce firm performance (Dalton et al., 2007). Overcommitted directors may also be unable to adequately comply with their monitoring roles, and the monitoring intensity will decline causing greater agency costs, and result in reduced firm performance (Ferris et al., 2003). Therefore, from an agency perspective, it is expected that board interlocks reduce firm performance (Perry & Peyer, 2005; Fich & Shivdasani, 2006; Zona et al., 2015).

Alternatively, resource dependence suggests that a corporation acts as an open mechanism where the firm performance relies on capabilities to use valuable resources from other firms through reciprocal exchanges (Wry et al., 2013). This theory predicts that board interlocks will provide greater resources, and reduce environmental dependence and uncertainty, thereby contributing to the firm performance (Zona et al., 2015).

Empirical findings on the relationship between board interlocks and firm performance are also mixed. Brown and Maloney (1999) find that firms with interlocking directorships gain superior returns from acquisitions. Zona et al. (2015) finds that the board interlocks with resource-rich corporations create key benefits that enable them to overcome resource constraints and achieve higher performance. Conversely, Fich and Shivdasani (2006) report that firms whose directors hold at least three boards seats have lower performance. Jackling and Johl (2009) also document a negative relationship between board interlock and corporate performance. Still other studies do not provide support for either theory (e.g., Fligstein & Brantley, 1992; Devos et al., 2009). Theoretical and empirical research has not supported a clear direction for the relationship between board interlocks of independent directors and firm performance; accordingly, the following non-directional hypothesis is proposed in the null form:

H3$_0$: There is not a significant relationship between board independence (as measured by the proportion of independent directors with board interlocks) and firm performance.

CEO Duality and Firm Performance (H4)

Agency theory predicts that CEO duality strengthens the CEO's power to further their self-interests rather than the interests of shareholders, and will usurp the power of other directors, thus giving rise to a weak board. This may be due to CEO duality combining the decision management with the decision control (Fama & Jensen, 1983), and making other directors unable or unwilling to focus on the performance and practices of the CEO (Chi, 2009; Conger & Lawler, 2009). As a consequence, combining the titles of CEO and chairman will negatively affect firm performance. Alternatively, stewardship theory suggests that CEO duality will positively affect firm performance. Managers are self-actualizing rather than opportunistic, thus, CEO duality should facilitate a powerful and clear leadership structure, and is an effective device for promoting the productiveness and performance of the firm (Stoeberl & Sherony, 1985, Lam and Lee (2008). Further, in order to promote their job satisfaction and reputation, managers will not risk their career to act against the interests of shareholders (Lam and Lee, 2008). So, according to stewardship theory, CEO duality is expected to benefit firm performance.

Similar to the empirical studies on board independence, CEO duality research is equivocal. Consistent with agency theory, Cornett et al. (2008) found a significant negative relationship between the lagged CEO duality and firm performance for 100 firms from the S&P Index. Daily and Dalton (1994) investigate 114 publicly traded U.S. firms in manufacturing, retail and transportation fields and find a negative effect of CEO duality on performance.

Consistent with stewardship, Krause and Semadeni (2013) study S&P 1500 firms and concluded that CEO *non*-duality has negative effects following strong performance. Guillet et al. (2013) find that CEO duality in U.S. restaurants promotes restaurants' performance. Still other empirical studies find no significant relationship between CEO duality and firm performance. Daily and Dalton (1992) examine the data from 100 firms listed in Inc. magazine's annual ranking of the fastest-growing small companies listed in US stock market, and found no significant relation between CEO duality and firm performance. Abdullah (2004) has similar findings for Malaysian firms. Since the theoretical and empirical research do not supported a clear direction for the relationship between CEO duality and firm performance, the following non-directional hypothesis is proposed in the null form:

H4$_0$: There is not a significant relationship between CEO duality and firm performance.

Conflicting predictions and evidence are provided in the literature above. Several efforts have been made to reconcile some of the inconsistencies. Chen et al. (2008) note that board leadership structure is an endogenous outcome that may achieve the firm's value maximization. Hermalin and Weisbach (2003) suggest the governance mechanism is endogenously influenced by the context of board process, board characteristics, and corporate performance. Further, the definition of independence has been too loose (Hwang & Kim, 2009), and does not cover many aspects of independence. The current study incorporates three different measures of independence, and later in this study, we incorporate issues associated with endogeneity.

METHOD

Sample Selection

Firms in the NASDAQ-100 Index are considered the best representation of nonfinancial securities listed on The NASDAQ Stock Market. The index comprised of mostly U.S, and somewhat "tech heavy" firms that have opportunities for growth (NASDAQ Global Indexes, 2015). After many corporate failures, the SEC mandated that the NYSE and NASDAQ forbid the listing of the securities if no independent director serves on the audit committee. In 2009, the NASDAQ required that a majority of the board must consist of independent directors. However, there is no requirement to separate the CEO and chairman.

The sample firms for this study initially include all 100 firms in NASDAQ-100 Index during the 5-year period from 2010 to 2014. Financial data used in the study comes from the Compustat database, and the data is obtained from annual reports to supplement any missing information. Two observations in 2010, three observations in 2011 and three observations in 2014 are omitted due to a lack of data.

Next, information about the firms' board of directors (independent directors, committee overlap, board interlock, and CEO duality) is obtained from the BoardEx database which contains information on firms' boards and senior management. Two observations from 2010, one from 2012, and four from 2014 are excluded in this step due to missing data. Lastly, three observations in each year are deleted due to company mergers, splits, or a substantial change in the business. The final sample size ranges from a high of 97 observations in 2013 to a low of 90 observations in 2014. The total number of firm-year observations is 470.

Measurement of Firm Performance, Board Independence, and CEO Duality

Consistent with a majority of prior studies, the dependent variable that proxies for firm performance is return on assets (ROA). Following Finkelstein and D'Aveni (1994) and Ramdani and Witteloostuijn (2010), we calculate ROA as earnings before interest and tax (EBIT) divided by total assets. Three measures of board independence are used including: (1) PID - the proportion of independent directors on the board (the most common measure found in the literature), (2) OVERLAP – the committee overlap of independent directors, and (3) INTERLOCK – the board interlock of independent directors. An independent chairman is also classified as independent director in order to avoid potential misclassification and biases that could lead to misinterpretations.

We estimate OVERLAP as the total committee positions of the same board held by independent directors divided by the number of independent directors of committees. Similar to Ferris et al. (2003) and Fich and Shivdasani (2006), INTERLOCK is calculated as the proportion of independent directors with three of more directorships across firms. CEODUAL is proxied by a dummy variable. It is coded "1" if the CEO and the Board Chair for a firm are the same person; otherwise "0" (see Lam and Lee 2008; Ramdani and Witteloostuijn, 2010).

Model Specification

We use a stepwise model design to determine the model that uses the most predictive variables (MacNally, 2000). Model 1, as expressed in Equation 1, is used to determine the effects of the three independence measures and CEO duality on firm performance. The model also includes five control variables that have been considered in previous studies including firm size, fixed assets to sales, current ratio, board size, and firm age (c.f., Yermack, 1996; Bhagat & Black, 1999; Joh, 2003; Peng, 2004, Gul & Leung, 2004; Lam & Lee, 2008; Abidin et al., 2009; Vo & Nguyen, 2014; Issarawornrawanich, 2015). Model 1 is as follows:

$$ROA = \beta_0+\beta_1 PID_i+\beta_2 OVERLAP_i+\beta_3 INTERLOCK_i+\beta_4 CEODUAL_i+\beta_5 FSIZE_i$$
$$+\beta_6 FAPS_i+\beta_7 CR_i+\beta_8 BSIZE_i+\beta_9 FA_i+\varepsilon_i \quad\quad (1)$$

where:
- The dependent variable ROA = earnings before interest and tax (EBIT) divided by total assets.
- The independent variables include PID = the proportion of independent directors on the board; OVERLAP = the average number of committee positions of the same board held by independent directors; INTERLOCK = the proportion of independent directors with three or more directorships across firms; and CEODUAL = CEO duality (1 for duality, 0 otherwise).
- The control variables include FSIZE = Firm size expressed as the Log of sales; FAPS = Fixed assets per sales dollar; CR = Current ratio calculated as current assets scaled by current liabilities; BSIZE = Board size calculated as the log of total number of directors on board; and FA=Firm age (in years).

The results from the linear regression estimated using Model 1 are presented in Table 1. All independent and control variables are found to be significantly related to ROA at $p = 0.01$ or better, except PID. The coefficient for PID is not significantly associated with firm performance (ROA) ($t = 0.76$, $p = 0.447$). In addition, a high condition index in the diagnostics (not presented) indicates a possibility of multicollinearity. This result is consistent with many previous studies that produce no evidence of a significant relationship between the proportion of independent directors and firm performance (e.g., Bhagat and Black, 2002; Abdullah, 2004; Elbarrad, 2014).

TABLE 1
LINEAR REGRESSION COEFFICIENTS AND P-VALUES FOR MODEL 1 (*t*-statistics)

Variables	ROA (*t* stat)	P-Values
PID	**0.0253**	**0.447**
	(0.76)	
OVERLAP	**0.0280****	**0.006**
	(2.75)	
INTERLOCK	**-0.0783*****	**0.000**
	-(3.74)	
CEODUAL	**-0.0281****	**0.002**
	-(3.17)	
FSIZE	0.0137***	0.000
	(3.55)	
FAPS	-0.0673***	0.000
	-(8.56)	
CR	0.0109***	0.000
	(4.20)	
BSIZE	-0.0826***	0.000
	-(3.86)	
FA	0.0009***	0.000
	(4.48)	
constant	0.175*	0.014
	(2.46)	

N = 470
$R^2 = 0.2917$
t-statistics in parentheses
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Next, we use a stepwise method to find the best fitting model. All the independent and control variables from Model 1 enter into the Model 2 except the PID, and none of the variables that enter are subsequently removed. PID is not significant in the linear regression, and PID did not enter our stepwise model. $H1_0$ (the null) is not rejected because no significant relationship is found between the proportion of independent board members and firm performance.

Therefore, two measures of board independence (OVERLAP and INTERLOCK) remain and are used in Model 2 (see equation 2), which is similar to the measures used by Kaplan and Reishus (1990). In addition, Model 2 retains CEODUAL and each of the control variables.

$$ROA = \beta_0 + \beta_1 OVERLAP_i + \beta_2 INTERLOCK_i + \beta_3 CEODUAL_i + \beta_4 FSIZE_i + \beta_5 FAPS_i$$
$$+ \beta_6 CR_i + \beta_7 BSIZE_i + \beta_8 FA_i + \varepsilon_i \qquad (2)$$

Regression results from Model 2 are presented in Table 2. The three independent variables (OVERLAP, INTERLOCK, and CEODUAL) have highly significant p-values of 0.009, 0.000, and 0.002, respectively. R^2 for the regression is at 29.1%. Model 2's condition index from the collinearity diagnostics (not shown) is reduced from Model 1. More importantly, these results explain some of the differences and potential difficulties with measures of board independence, and this difference also may explain the mixed findings regarding the association between board independence and firm performance (Hwang & Kim, 2009).

TABLE 2
LINEAR REGRESSION COEFFICIENTS AND P-VALUES FOR MODEL 2 (*t*-statistics)

Variables	**ROA** **(*t* stat)**	**P-Values**
OVERLAP	**0.0256****	**0.009**
	(2.64)	
INTERLOCK	**-0.0772*****	**0.000**
	-(3.70)	
CEODUAL	**-0.0269****	**0.002**
	-(3.08)	
FSIZE	0.0136***	0.000
	(3.52)	
FAPS	-0.0672***	0.000
	-(8.56)	
CR	0.0111***	0.000
	(4.31)	
BSIZE	-0.0822***	0.000
	-(3.56)	
FA	0.0010***	0.000
	(4.74)	
constant	0.196**	0.003
	(3.00)	

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N = 470
$R^2 = 0.2908$
t-statistics in parentheses
* p < 0.05; ** p < 0.01; *** p < 0.001

The estimation of Model 2 proceeds in a series of stages. First, we use multivariate regressions with standard errors robust to heteroscedasticity and autocorrelation to examine the relationship between board independence, CEO duality and firm performance. Next, the model is assessed with an additional control variable, EPR (earnings-to-price ratio), as a proxy for growth opportunity. In the third stage, the endogenous treatment effects approach (maximum likelihood estimates) is applied to control for the endogeneity of board independence, and board leadership structure, and to estimate its impact on corporate performance. Last, robustness tests are applied by the replacement and exclusion of the control variables. The selection models are written as:

$$\text{OVERLAPDUMMY} = \beta_0 + \beta_1 PID_i + \beta_2 LNMV_i + \beta_3 BSIZE_i + \beta_4 FCF_i + \varepsilon_i \quad (3)$$
$$\text{INTERLOCKDUMMY} = \beta_0 + \beta_1 LNMV_i + \beta_2 FCF_i + \beta_3 BM_i + \beta_4 FA_i \quad (4)$$
$$\text{CEODUAL} = \beta_0 + \beta_1 PID_i + \beta_2 LNMV_i + \beta_3 FCF_i + \beta_4 OMARGIN_i + \beta_5 CI_i + \varepsilon_i \quad (5)$$

Where: OVERLAPDUMMY = 1 if the average number of committee positions held by the same independent board member at least two, 0 otherwise; INTERLOCKDUMMY = 1 if the average number of across-firms directorships held by independent directors is at least three, 0 otherwise
CEODUAL = CEO Duality (1 for duality, 0 otherwise); PID = Proportion of independent directors in the board; BSIZE = Board size = Log of total number of directors in board; BM = Book-to-market ratio = total equity / (common shares outstanding * fiscal close price); FCF = Free cash flows = (cash flows from operations - dividends) / total assets; LNMV = Log of market value = Log of (common shares outstanding * fiscal close price); OMARGIN = Operating margin = Operating income / revenue; CI = Capital Intensity = Net fixed assets / total assets

The independent variables of selection equations are supported by previous literature, and suggest that committee overlap, board interlock and CEO duality are determined by a set of firm and board characteristics. Karim et al. (2015) finds that committee overlap varies according to contextual variables including the proportion of independent directors (PID), log of firms' market value (LNMV), board size (BSIZE) and free cash flows (FCF). Kiel and Nicholson (2003) and Fich and Shivdasani (2006) find that LNMV and firm age (FA) act as determinants of whether independent directors hold board seats in other firms. In order to investigate the determinants of CEO duality, this study incorporates independent variables including PID, LNMV and capital intensity (CI) as a solution to corporations' internal complexity. This follows from Kiel and Nicholson (2003), Elsayed (2010) and Iyengar and Zampelli (2009) who argue that these variables have strong explanatory power of board leadership structure. Other explanatory variables related to firm characteristics such as FCF, and book-to-market ratio (BM) are also incorporated in the selection model of board interlock and CEO duality.

Our research design provides a more particularized and precise measure of board independence. Second, the stepwise method we use determines the best model to test the relationship between board independence, CEO duality and firm performance. Third, unlike other studies' identification of board interlock, our regression model captures the percentage of independent directors that hold three or more directorships across firms, which could avoid a problem with likely wide dispersion. As a result, our model significantly improves upon models used in other studies. Lastly, we use a treatment effect approach to address endogeneity and the shortfalls of OLS estimates. This resolves issues where there are observed variables affecting both the treatment and the outcome. This method will produce less biased and clearer evidence.

EMPIRICAL TESTS AND RESULTS

Descriptive Statistics
Descriptive statistics for the variables described above are included in Table 3. The dependent variable in the model, ROA, has a mean (median) of 0.144 (0.134), with a standard deviation of 0.103. Our remaining analysis employs two measures of board independence: OVERLAP (the average number of committee positions of the same board held by independent directors), and INTERLOCK (the proportion of independent directors with three or more directorships across firms). OVERLAP has a mean (standard deviation) of 1.786 (0.446). That is, independent directors on committees hold an average of 1.78 committee positions within the same board. The statistics for INTERLOCK show approximately 60% of independent directors serve as directors in three or more firms. For some sample firms, all independent directors held three or more board seats across firms. The mean of CEODUAL indicates that for 35.5% of sample firms the CEO holds the position of chairman. These statistics are comparable to the results found by Ramdani and Witteloostuijn (2010) certain Asian countries.

TABLE 3
DESCRIPTIVE STATISTICS
DEPENDENT, INDEPENDENT, AND CONTROL VARIABLES

	N	Mean	Median	Std. Dev.	Minimum	Maximum
ROA	470	0.1444	0.1339	0.1030	-0.4025	0.5278
OVERLAP	470	1.7760	1.7500	0.4460	1.0000	3.0000
INTERLOCK	470	0.5966	0.6000	0.2014	0.0000	1.0000
CEODUAL	470	0.3553	0.0000	0.4791	0.0000	1.0000
FSIZE	470	8.7798	8.6999	1.2010	4.7600	12.1161
FAPS	470	0.4929	0.3221	0.5388	0.0000	4.3073
CR	470	2.5318	2.1088	1.7222	0.2195	11.8818
BSIZE	470	2.2751	2.3026	0.1960	1.6094	2.7081
FA	470	31.9362	27.0000	20.9113	1.0000	110.0000
EPR	470	0.0447	0.0436	0.0486	-0.1675	0.5086

Correlations

Table 4 presents the Pearson correlation coefficients between variables. ROA (firm performance) and OVERLAP have a significant positive correlation of 0.096 ($p < 0.037$). This is consistent with $H2_a$ that predicts committee overlap is positively related to firm performance. The correlation results indicate that ROA and INTERLOCK (board interlock) have a significant negative correlation of -0.093 ($p < 0.001$). This is contrary to the prediction of no significant relationship. ROA is not found to be significantly correlated with CEO duality (CEODUAL) with a coefficient of -0.039 ($p < 0.399$). These results imply that both multiple committee positions and multiple directorships of independent directors might be essential determinants of firm performance. Furthermore, except for FSIZE (coefficient = 0.076, $p < 0.099$), each of the firm-level control indicators have a significant relationship with ROA (at $p < 0.029$ or better).

Multivariate Analysis

We examine the effect of board independence and CEO duality on firm performance in a multivariate regression with standard errors robust to heteroscedasticity and autocorrelation. Two independent variables capture the effect of board independence (OVERLAP, and INTERLOCK). Table 5 shows the results of estimating Equation 2 without endogenous controls. The effects of OVERLAP, INTERLOCK and CEODUAL on firm performance are estimated in Models (I), (II), and (III), respectively (see Table 5, Panel A). Model (IV) examines the combined effects of all three independent variables. Models (V), (VI), (VII), and (VIII) are equivalent to (I) through (IV), except an additional control variable (EPR) is added as the proxy for the growth opportunity (see Table 5, Panel B).

The coefficient for OVERLAP in Model (I) is 0.028 ($t = 3.42$; $p < 0.001$), and R^2 for the model is 25.3%. The relationship between each of the five control variables and firm performance is significant at $p < 0.05$ or better. These results support Hypothesis 2_a, and indicate that independent-director committee overlap is an effective way to improve firm performance (i.e., firm performance will be higher with more committee appointments on the same board held by independent directors).

Table 5, Panel A, finds the coefficient INTERLOCK in Model (II) is negative and significant (-0.087; $t = -3.91$; $p < 0.001$). The R^2 for the model is 26.7%. Hypothesis 3_0 predicts that there is no effect from independent directors' board interlock, but this is not supported by the data. Rather, the alternative hypothesis is suggested that as more independent directors hold three or more directorships across firms, the firms experience lower ROA.

TABLE 4
PEARSON CORRELATIONS – DEPENDENT, INDEPENDENT, AND CONTROL VARIABLES
(p-values in parentheses)

	ROA	PID	OVERLAP	INTERLOCK	CEODUAL	FSIZE	FAPS	CR	BSIZE	FA	EPR
ROA	1										
PID	.038 (.407)	1									
OVERLAP	.096* (.037)	-.314** (.000)	1								
INTERLOCK	-.193** (.000)	.071 (.123)	- .160** (.001)	1							
CEODUAL	-.039 (.399)	.172** (.000)	.092* (.046)	.008 (.867)	1						
FSIZE	.076 (.099)	.056 (.224)	-.165** (.000)	.058 (.207)	.115* (.012)	1					
FAPS	-.378** (.000)	-.080 (.082)	.108* (.019)	-.075 (.102)	-.054 (.244)	-.107* (.020)	1				
CR	.202** (.000)	.089 (.053)	-.051 (.267)	-.080 (.082)	-.026 (.573)	-.314** (.000)	-.148** (.001)	1			
BSIZE	-.101* (.029)	.099* (.031)	-.266** (.000)	.070 (.127)	-.060 (.194)	.363** (.000)	-.108* (.019)	-.180** (.000)	1		
FA	.242** (.000)	.202** (.000)	.025 (.585)	-.165** (.000)	.177** (.000)	.183** (.000)	-.145** (.002)	-.116* (.012)	.130** (.005)	1	
EPR	.326** (.000)	.070 (.131)	.005 (.909)	-.055 (.236)	.033 (.473)	.241** (.000)	-.230** (.000)	.025 (.583)	.096* (.038)	.147** (.001)	1

 * Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

The coefficient for CEODUAL (Table 5, Panel A, Model (III)) is negative and significant (-0.026; t = -2.41; p < 0.05). The R^2 for the model is 25.4%. Hypothesis 4_0 predicts no significant effect from CEO duality on firm performance, but this is not supported by our data. Rather, an alternative hypothesis is supported where the existence of CEO duality is associated with reduced firm performance. The control variables are statistically significant, and consistent with previous studies on CEO duality (c.f., Lam & Lee, 2008; Ramdani & Witteloostuijn, 2010).

Table 5, Panel A, Model (IV) shows results with all independent variables (OVERLAP, INTERLOCK and CEODUAL) included. The results are similar to Models (I) through (III). The coefficients for OVERLAP, INTERLOCK and CEODUAL are 0.026, -0.077, and -0.027 (t = 2.96, -3.45 and -2.60, respectively). All coefficients are significant at $p < 0.01$, or better. As expected, R^2 improves to 29.1%. Thus, this implies that OVERLAP, INTERLOCK and CEODUAL are not redundant measurements.

Additional tests are provided in Panel B of Table 5. Models (V) through (VIII) include an added control, EPR, as the proxy for the growth opportunity. This modification follows from findings that the relationship between firm performance and CEO duality or board independence may be influenced by growth opportunity; and that growth opportunity may be proxied by EPR (Fich and Shivdasani, 2006; Ahmed & Duellman, 2007).

The results indicate that the coefficient values and the significance levels for the three independent variables (OVERLAP, INTERLOCK and CEODUAL) are essentially the same as in the previous models without controlling for EPR. The coefficient for EPR is positive and significant in all four models. For Model (VIII), t = 2.60, and $p < 0.01$. The R^2 improves slightly from 29.1% in Model (IV) to 32.9% in Model (VIII). Generally, it appears that the effects of board independence and CEO duality on firm performance are partially explained by EPR.

TABLE 5
MULTIVARIATE REGRESSION RESULTS:
WITHOUT ENDOGENEITY CONTROLS

PANEL A – WITHOUT ADDITIONAL CONTROL FOR EPR

Dependent variable	ROA	ROA	ROA	ROA
Model =>	(I)	(II)	(III)	(IV)
Variables				
OVERLAP	**0.028*****			**0.026****
	(3.42)			**(2.96)**
INTERLOCK		**-0.087*****		**-0.077*****
		(-3.91)		**(-3.45)**
CEODUAL			**-0.026***	**-0.027****
			(-2.41)	**(-2.60)**
FSIZE	0.012*	0.011	0.012*	0.014*
	(2.03)	(1.91)	(2.00)	(2.35)
FAPS	-0.063***	-0.066***	-0.063***	-0.067***
	(-5.91)	(-6.51)	(-6.12)	(-6.79)
CR	0.012***	0.010***	0.011***	0.011***
	(4.21)	(3.66)	(3.97)	(4.21)
BSIZE	-0.077**	-0.087***	-0.101***	-0.082***
	(-3.19)	(-3.58)	(-4.13)	(-3.32)
FA	0.001***	0.001***	0.001***	0.001***
	(5.09)	(4.42)	(5.47)	(4.83)
Constant	0.133	0.275***	0.242***	0.196**
	(1.96)	(4.34)	(3.81)	(3.05)
N	470	470	470	470
R^2	0.253	0.267	0.254	0.291

TABLE 5 (CONTINUED)

PANEL B – WITH ADDITIONAL CONTROL FOR EPR

Dependent variable	ROA	ROA	ROA	ROA
Model =>	(V)	(VI)	(VII)	(VIII)
Variables				
OVERLAP	**0.024****			**0.022****
	(3.05)			**(2.68)**
INTERLOCK		**-0.080*****		**-0.071*****
		(-3.83)		**(-3.39)**
CEODUAL			**-0.025***	**-0.026****
			(-2.45)	**(-2.61)**
FSIZE	0.007	0.007	0.007	0.009
	(1.37)	(1.26)	(1.36)	(1.73)
FAPS	-0.056***	-0.058***	-0.055***	-0.060***
	(-5.46)	(-5.95)	(-5.64)	(-6.28)
CR	0.011***	0.009***	0.010***	0.010***
	(3.90)	(3.38)	(3.68)	(3.85)
BSIZE	-0.078***	-0.087***	-0.010***	-0.083***
	(-3.35)	(-3.67)	(-4.25)	(-3.49)
FA	0.001***	0.001***	0.001***	0.001***
	(4.56)	(3.95)	(4.94)	(4.35)
EPR	0.465**	0.459*	0.476**	0.441**
	(2.60)	(2.54)	(2.78)	(2.60)
Constant	0.163*	0.290***	0.261***	0.220***
	(2.50)	(4.63)	(4.23)	(3.50)
N	470	470	470	470
R^2	0.296	0.309	0.299	0.329

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Standard errors are robust to heteroskedasticity and autocorrelation.

Controls for Endogeneity

The endogenous treatment effects approach is used to control for endogeneity. Previous studies reveal that board leadership structure and board independence might be endogenous outcomes. For example, Chen et al. (2008) finds that companies endogenously determine their choice of dual or non-dual leadership, in light of firm and ownership characteristics. There is also evidence that board interlocks and board overlaps are endogenous determined (Fich and Shivdasani, 2006; Karim et al., 2015).

The endogeneity issue suggests that using OLS regression may produce biased results. Thus, following Tucker (2010), we employ the endogenous treatment effects model (maximum likelihood estimates). The estimation of the models is conducted by including selection models for OVERLAP, INTERLOCK, and CEODUAL, and the treatment effect model (maximum likelihood estimates) also proceeds with and without the additional control, EPR.

Table 6 presents results from the endogenous treatment effects model for committee overlap. The selection model (OVERLAPDUMMY) is presented in Panel A (See Equation 3). The results suggest that when the proportion of independent directors is low (PID), market value is low (LNMV), board size is small (BSIZE), and free cash flows are high (FCF), then firms are likely to have independent directors with more committee positions. All coefficients are significant at $p < 0.01$, or better.

Panel A - Selection equation

Dependent variable	(1)[a] OVERLAPDUMMY	(2)[b] OVERLAPDUMMY
Variables		
PID	-0.986***	-1.065***
	(-3.64)	(-3.86)
LNMV	-0.156***	-0.124**
	(-3.33)	(-2.64)
BSIZE	-1.081***	-1.131***
	(-3.70)	(-3.87)
FCF	6.735***	6.394***
	(13.19)	(12.75)
Constant	3.674***	3.590***
	(4.70)	(4.56)

[a] Without control for EPR in the test model
[b] With control for EPR in the test model

Panel B - Test models

Dependent variables	(1) ROA	(2) ROA
Variables		
OVERLAPDUMMY	**0.182*****	**0.177*****
	(20.08)	**(19.95)**
FSIZE	0.008	0.004
	(1.96)	(0.88)
FAPS	-0.039***	-0.034***
	(-7.38)	(-6.36)
CR	0.011***	0.010***
	(5.93)	(5.32)
BSIZE	0.050	0.050
	(1.70)	(1.71)
FA	0.001***	0.001***
	(7.55)	(6.98)
EPR		0.355***
		(4.87)
Constant	-0.152*	-0.122
	(-2.15)	(-1.76)
athrho	-1.974***	-1.983***
	(-15.34)	(-15.02)
lnsigma	-2.138***	-2.160***
	(-54.26)	(-54.47)
N	470	470
Wald χ^2	503.14	548.77

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6, Panel B, shows the estimation of the test models. It documents a significant positive coefficient for OVERLAPDUMMY for both specifications. The results in Column (1) show that OVERLAPDUMMY is positive and significantly related to ROA (coefficient = 0.182; t = 20.08; p < 0.001). In Column (2), when incorporating an additional control (EPR) in this test, the coefficient of OVERLAPDUMMY is robust (coefficient = 0.177; t = 19.95; p < 0.001), showing the similar results to Column (1).

The coefficients for athrho are significant at p < 0.001 in both Column (1) and (2). This indicates a high probability that there is an endogeneity issue. That is, companies endogenously choose committee overlap, which supports the argument that committee overlap is endogenously influenced by the firm and board characteristics (Brandes, et al., 2015; Karim et al., 2015). Overall, committee overlap is found to be positively associated with firm performance.

Table 7, Panel A shows the selection model for board interlock (INTERLOCKDUMMY) (See Equation 4). The results show that firms with a larger market value (LNMV), greater free cash flow (FCF), smaller book-to-market ratio (BM), and less firm age (FM) are more likely to have independent directors that are appointed to three or more different boards. All coefficients are significant at p < 0.05, or better, indicating that they are significant in explaining board interlock. The positive relationship found between LNMV and INTERLOCKDUMMY provides some support for the contention that more successful companies are capable of attracting directors who have multiple board positions (Bhagat & Black, 1999).

Table 7, Panel B, shows estimates of the test model. In Column (1), the estimated coefficient of INTERLOCKDUMMY is positive and significant (coefficient = 0.126; t = 13.47; p < 0.001). These results are surprising in that they are opposite to our results without endogeneity control. The alternative hypothesis to $H3_0$ suggested from these results is that firms having a higher proportion of independent directors holding three or more directorships are likely to experience higher ROA. As suggested by resource dependence theory, more board interlocks may reduce environmental dependence and uncertainty, and provide greater resources which can improve firm performance (Zona et al., 2015). The effect of INTERLOCKDUMMY is robust as indicated by Column (2) after incorporating an additional control (EPR). The coefficient for INTERLOCKDUMMY remains positive and significant (coefficient = 0.129; t = 14.48; p < 0.001). EPR is a significant contributor to the model in Column (2).

TABLE 7
BOARD INTERLOCK AND FIRM PERFORMANCE
WITH ENDOGENEITY CONTROLS

Panel A - Selection equation

	(1)[a]	(2)[b]
Dependent variable	INTERLOCKDUMMY	INTERLOCKDUMMY
Variables		
LNMV	0.133[*]	0.133[**]
	(2.54)	(2.65)
FCF	5.219[***]	4.683[***]
	(9.57)	(8.94)
BM	-0.623[***]	-0.958[***]
	(-3.56)	(-5.47)
FA	-0.012[***]	-0.013[***]
	(-3.93)	(-4.17)
Constant	-1.047[*]	-0.867
	(-1.96)	(-1.71)

[a] Without control for EPR in the test model
[b] With control for EPR in the test model

TABLE 7 (CONTINUED)

Panel B - Test models

Dependent variables	(1) ROA	(2) ROA
Variables		
INTERLOCKDUMMY	0.126***	0.129***
	(13.47)	(14.48)
FSIZE	0.005	0.001
	(1.13)	(0.17)
FAPS	-0.044***	-0.035***
	(-6.15)	(-5.23)
CR	0.009***	0.008***
	(3.83)	(3.55)
BSIZE	-0.074***	-0.073***
	(-3.69)	(-3.83)
FA	0.002***	0.002***
	(6.75)	(6.50)
EPR		0.515***
		(6.76)
Constant	0.132*	0.139**
	(2.41)	(2.67)
athrho	-1.610***	-1.738***
	(-16.79)	(-16.58)
lnsigma	-2.178***	-2.198***
	(-54.55)	(-55.56)
N	470	470
Wald χ^2	281.97	332.82

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The coefficients for athrho are significant at $p < 0.001$ in both Column (1) and (2), indicating a high probability that multiple directorships of independent directors are endogenously determined. Overall, board interlock by independent directors is found to be positively associated with firm performance when controlling for endogeneity.

Table 8, Panel A reports results for the selection model of CEODUAL (See Equation 5). The results indicate that when the proportion of independent directors (PID) and market value (LNMV) are high, and free cash flows (FCF), operating margin (OMARGIN), and capital intensity (CI) are low then firms are more likely to have the same person holding both the CEO and chairman position. The results are similar both with and without controlling for EPR.

The results of test models are presented in Table 8, Panel B. CEODUAL has significant negative interaction with ROA in both specifications. Column (1) shows that CEODUAL is negative and significantly related to ROA (coefficient = -0.162; t = -18.76; $p < 0.001$). Column (2) shows that this relationship is robust to the addition of a control for EPR where the results are similar (coefficient = -0.160; t = -18.39; $p < 0.001$). EPR is a significant ($p < 0.05$) contributor to the model in Column (2). The significance of CEODUAL in this test is much higher than for our tests without control for endogeneity (absolute value of t is > 18, versus < 3 earlier tests). The coefficients for all control variables are significant in both Column (1) and (2).

TABLE 8
CEO DUALITY AND FIRM PERFORMANCE - WITH ENDOGENEITY CONTROLS

Panel A - Selection equation

	(1)[a]	(2)[b]
Dependent variable	CEODUAL	CEODUAL
Variables		
PID	0.945*	0.884*
	(2.57)	(2.38)
LNMV	0.231***	0.213***
	(5.06)	(4.56)
FCF	-2.194***	-2.333***
	(-5.06)	(-5.17)
OMARGIN	-3.663***	-3.594***
	(-11.38)	(-10.84)
CI	-2.385***	-2.440***
	(-7.84)	(-7.81)
Constant	-1.878***	-1.636**
	(-3.66)	(-3.09)

[a] Without control for EPR in the test model
[b] With control for EPR in the test model

Panel B - Test model

	(1)	(2)
Dependent variable	ROA	ROA
Variables		
CEODUAL	**-0.162*****	**-0.160*****
	(-18.76)	**(-18.39)**
FSIZE	0.017***	0.014***
	(4.23)	(3.49)
FAPS	-0.064***	-0.063***
	(-10.80)	(-10.49)
CR	0.010***	0.010***
	(5.31)	(5.26)
BSIZE	-0.061***	-0.059***
	(-3.57)	(-3.40)
FA	0.001***	0.001***
	(6.94)	(6.89)
EPR		0.134*
		(2.25)
Constant	0.164***	0.174***
	(3.43)	(3.63)
athrho	1.851***	1.804***
	(15.64)	(15.24)
lnsigma	-2.200***	-2.215***
	(-56.22)	(-55.69)
N	470	470
Wald χ^2	512.72	513.86

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The coefficients for athrho are significant at p < 0.001 in both Column (1) and (2), indicating a high probability that CEO duality (board leadership structure) is endogenously determined. Overall, CEO duality is found to be negatively associated with firm performance.

Robustness Test

Tests of robustness were performed and the results are presented in Table 9. Using the treatment effect approach (maximum likelihood estimates) with and without the additional control for EPR, we enter alternative measures of the control variables in the test models presented in Tables 6, 7, and 8, The natural log of assets (LNASSETS) is entered as an alternative to natural log of sales (FSIZE) to control for firm size (see Fich & Shivdasani, 2006), and debt-to-equity (DE) replaces the current ratio (CR) as an alternative measure of leverage (see Lam & Lee, 2008). Board size (BSIZE) is removed from the test models.

TABLE 9
ROBUSTNESS TEST

	Without control for EPR			With control for EPR		
Dependent variables	ROA	ROA	ROA	ROA	ROA	ROA
Variables	(1)	(2)	(3)	(4)	(5)	(6)
OVERLAPDUMMY	**0.172*****			**0.164*****		
	(18.75)			**(18.50)**		
INTERLOCKDUMMY		**0.124*****			**0.125*****	
		(13.59)			**(14.67)**	
CEODUAL			**-0.153*****			**-0.150*****
			(-18.37)			**(-18.16)**
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.135***	0.220***	0.327***	0.180***	0.236***	0.359***
	(3.46)	(5.02)	(8.84)	(4.76)	(5.70)	(9.78)
athrho	-1.865***	-1.585***	1.782***	-1.871***	-1.672***	1.744***
	(-16.27)	(-17.71)	(17.56)	(-15.99)	(-18.02)	(16.97)
lnsigma	-2.132***	-2.173***	-2.190***	-2.169***	-2.215***	-2.217***
	(-53.88)	(-55.28)	(-56.85)	(-54.42)	(-57.03)	(-56.62)
N	470	470	470	470	470	470
Wald χ^2	476.57	287.35	489.05	558.30	371.15	523.20

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Without and with control for EPR, the coefficients for OVERLAPDUMMY are 0.172 and 0.164 (t = 18.75 and 18.50; p < 0.001 and 0.001), respectively. This is reasonably similar to the results shown in Table 6, thus providing consistent inferences. For INTERLOCKDUMMY (without and with control for EPR), the coefficients are 0.124 and 0.125 (t = 13.59 and 14.67; p < 0.001 and 0.001, respectively). These results are similar to those shown in Table 7. Lastly, CEODUAL has coefficients without and with EPR of -0.153 and -0.150 (t = -18.37 and -18.16; p < 0.001 and 0.001, respectively), which are similar to those reported in Table 8. Overall, results in Tables 6 through 8 are robust, even after replacement or exclusion of control variables.

CONCLUSIONS AND IMPLICATIONS

Research Objectives and Findings

Independent directors are regarded as significant monitors and advisors on boards. CEO duality is a central factor in the leadership structure of the board and management team. These two corporate governance elements have become hotly debated among researchers and policy makers. The objective of this study is to explore to what extent does board independence and CEO duality impact firm performance, specifically for firms listed on the NASDAQ-100 during the period 2010 to 2014. Three dominant theoretical perspectives (agency theory, stewardship theory, and resource dependence theory) are integrated to develop testable hypotheses.

Initially, board independence was proxied by three variables: (1) the proportion of independent directors in the board (PID); the average number of committee positions of the same board held by independent directors (OVERLAP); and the proportion of independent directors with three or more directorships across firms (INTERLOCK).

The first hypothesis in the null form ($H1_0$) is not rejected because a significant relationship is not found between the proportion of independent board members (PID) and firm performance in the initial linear regression, and PID did not enter our stepwise model.

Independent director committee overlap and independent director interlocks remain as measures of board independence. Answers to the research questions are provided by applying multivariate regression and controlling for endogeneity. When using the treatment effect approach to control endogenous issues, the results indicate that committee overlap has a significant positive effect on firm performance. This result supports $H2_a$, which predicts firm performance will be higher with more committee appointments on the same board held by independent directors. This result is consistent with agency theory where intra-board information transfers by independent directors reduces information asymmetry and improves monitoring effectiveness (Brandes et al, 2015).

$H3_0$, the null that independent-director board interlock is not related to ROI, is not supported when endogeneity is controlled using the treatment effect approach. Rather, the alternative supported by our analysis is that as more independent directors hold three or more directorships across firms, the firms experience increased ROA. This is consistent with resource dependence theory where the ability to use valuable resources from other firms (e.g., independent board members of other firms) improves performance.

The final hypothesis ($H4_0$) predicts no effect from CEO duality on firm performance, but this is not supported by our data analysis. An alternative hypothesis is supported where the existence of CEO duality is associated with reduced firm performance. This result performance is supported by agency theory which suggests that CEO duality strengthens the CEO's ability to increase their self-utility, and may impair firm performance (Iyengar & Zampelli, 2009).

In summary, the results show that independence (as measured by independent-director committee overlap and board interlock) is associated with higher firm performance, and CEO duality is associated with lower firm performance.

This study demonstrates that no single theory is able to provide a complete explanation of the effects of board independence and CEO duality on firm performance. Each theoretical perspective in capable of being applied in different governance elements and make contribution to the governance debates. Furthermore, we find evidence that there exists endogeneity in committee overlap, board interlock and CEO duality, signaling that they are endogenously determined by the firm and board characteristics. Our results are demonstrated to be robust even with the replacement and exclusion of the control variables.

Implications for Policies, Research and Practice

The findings in this study have implications for policies, research, and corporate governance practices; particularly for firms in the NASDAQ-100 index, as well as other high-tech, high-growth firms. Evidence from this study suggests that for these companies, the optimal board design is likely to be one

with a higher reliance on independent directors holding multiple committee positions in the same board. The findings also suggest that corporations should appoint independent directors that already hold multiple directorships with other firms.

A more thorough examination provides additional implications. Agency theory suggests that the positive effect of independent-director committee overlap on firm performance is attributed to the intra-board information transfers and reduced information asymmetry. Resource dependence theory interprets that the positive effect of board interlock on firm performance is due to greater external resources brought by independent directors. Thus, it may not be solely the numbers of committee or board positions per se that are essential. Rather, it may be the availability of needed information and resources for the firm. This is highly relevant from a policy perspective. Policies should be formulated to motivate firms to strengthen the communication at the committee level and/or between different firms through committee overlap or board interlock, and thus improve firm performance.

This study also recommends that NASDAQ-100 Index firms have the roles of CEO and chairman held separately. This is because we find negative effects of firm performance resulting from CEO duality. Boards should be alert for agency issues (e.g., pursuit of CEO self-interests) which are likely to occur in firms with CEO duality. Lastly, the findings are informative to future researchers. Empirical research examining the effects of corporate governance on corporate performance should explicitly consider the likelihood of endogenous issues.

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