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THE INFLUENCE OF BOARD SIZE AND CEO DUALITY ON FIRM PERFORMANCE: A RESEARCH ON TAIWAN LISTED FIRMS

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Abstract. *This paper aims to determine the impact of board size and CEO duality jointly on firm performance instead of unilateral aspect researched by most extant literature. Using a sample of 449 listed firms and 1651 firm-year observations for the period of 2010 to 2019 from Taiwan Economic Journal (TEJ) Database, this study employs proposed hierarchical regression models to tackle this issue. From the perspective of agency theory, stewardship theory as well as resource dependence theory, the empirical findings suggests that both board size and CEO duality of firms negatively relate to firm performance. Moreover, R&D intensity negatively moderates the relationship between CEO duality and firm performance. This model can be applied to tackling comparable issues in relevant settings.*

Keywords: CEO duality, Board size, Firm performance, R&D intensity, Agency theory, Stewardship theory, Resource dependence theory

1. **Introduction.** Research issues related to CEO and corporate boards are widely discussed in the field of strategic management, among which CEO duality is a focus since it crosses these two domains [1]. CEO duality means that the same individual serves two roles – CEO as well as chairman of the board simultaneously. Firms operated under CEO duality are readily increasing in recent years globally. Acting as monitor and resource provider, sometimes strategy-implementing participants, board not only plays a vital role in the firm, but also mitigates the agency problems [2]. Since board is extremely important in shaping firm's decision-making process, researchers naturally go for a further reasoning process of board characteristics, inside which board size accounts for a seat [3]. Antecedents prove that they are involved in firm performance of various facets.

Although extant relevant studies are not rare, they have hardly reached a consensus. Regarding duality-performance relationship, Lam and Lee [4] address that for family businesses, non-duality is better but for non-family businesses, duality is better; Mubeen et al. [5] find the relationship as negative; Dalton and Dalton [6] suggest no evidence of such relationship; whereas Pucheta-Martínez and Gallego-Álvarez [3] demonstrate a positive relationship between CEO duality and firm performance. A similar situation also comes to board size-performance relationship. Empirical findings are divided into several sorts, including a positive relationship [3], a negative relationship [7], and an inverted U-shaped relationship with the optimal choice of 10 directors on boards [8].

Most current studies normally concern the impact of a single relationship (duality-performance or board size-performance), which means there lacks a comprehensive perspective to evaluate firm performance based on both of the relationships in collaboration. Board size and CEO duality are two vital components of board attributes which heavily affect firm performance in practice [3]. Hence, the author intends to fill the gap via

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re-examining the issues with a more recent dataset of Taiwan compared to prior research and endeavors to do a more comprehensive analysis by bringing CEO duality, board size and a moderating role of firm heterogeneity (R&D intensity) jointly to investigate the latest trend of these relationships in a stable development period. The sample of this paper contains 449 Taiwan listed firms and 1651 firm-year observations for the period of 2010 to 2019, primarily from the TEJ database.

Agency theory, stewardship theory and resource dependence theory (RDT) are selected to develop hypotheses due to their close relevance to the targeted relationships detecting. Agency theory emphasizes "individualistic, opportunistic, and self-serving" with respect to top executives; nevertheless, stewardship theory stresses "collectivists, pro-organizational, and trustworthy" [9]. As for the resource dependence theory, boards of directors are viewed as critical external resource providers and thus board size is connected tightly with RDT to evaluate resource amount that the board can contribute. Same as part of the predictions, both board size and CEO duality of firms negatively relate to firm performance under the analysis of hierarchical regression in this study. Moreover, R&D intensity negatively moderates the relationship between CEO duality and firm performance.

The structures of this paper are as follows. Firstly, the author develops 6 hypotheses based on relevant theoretical background. Secondly, sample, variables and analysis design are specified, followed by the analysis of correlation and regression, which is the third step. Finally, discussions and conclusions are demonstrated with academic and managerial implications.

2. **Perspectives and Hypothesis Development.**

2.1. **Agency theory.**

Basically, an agency relationship is that a *principal* delegates work to an *agent* and believes this will contribute to value generation [10]. As a typical topic, agency theory emphasizes the effective monitoring, control and interaction in the CEO-chairman relationship, thereby enhancing firm performance under the separation between CEO and chairman. Agency theorists assume that CEO duality would compromise board's ability to monitor CEO; thus,

Hypothesis 1. CEO duality is negatively related to firm performance.

As Wang et al. indicate, agency problems may happen when the board size is large, and it comes with problematic negotiation and coordination among directors, hence weakening their responsibilities of monitoring. This is also the reason why a considerable portion of former research inclines to smaller board [8].

Hypothesis 2. Board size is negatively related to firm performance.

2.2. **Stewardship theory.**

Stewardship theory implies that the top manager has a willingness and ample motivation to do a conscientious job without serving his/her own interest (no inherent issues); he/she only needs support from the organizational structure to mobilize resources for firm's success. Thus, CEO duality promotes high performance because "power and authority are concentrated in on person" [11]. The efficiency and effectiveness of the transmission of CEO's decisions are beneficial for firm performance.

Hypothesis 3. CEO duality is positively related to firm performance.

2.3. **Resource dependence theory (RDT).**

RDT is an effective lens to perceive boards' capacities; as one of board's attributes, board size is regarded as an indicator to evaluate resource provider ability, which allows the firm to avoid dependence on external environment [3]. Jiang et al. also suggest that resource endowment (social capital and human capital) of directors attaches great value to the firm. With a larger board size, the resource endowment would be a competitive advantage for the firm with more expertise

in diversity, external links and better monitoring, assessment and advice abilities [12]. Therefore,

Hypothesis 4. Board size is positively related to firm performance.

2.4. **R&D intensity.** Hirschey argues that as one major part of "intangible capital", R&D and market value are closely linked [13]. R&D intensity represents advantageous technology-focused absorptive capacity, which motivates better use of knowledge and remote collaborations [14]. However, when some R&D programs are supported by top managers (especially under the situation of CEO duality), but the expenditure is too high with uncertain R&D results, it may raise doubt or objection from other directors; besides, it needs time to monetize. The analogical situation happens with a larger board size. In the sample, the top 3 industries are semiconductor, elec. parts & comp. and computer & peripheral, which are all knowledge-intensive with frequent R&D programs; thus, its moderating effect on the targeted relationship needs to be figured out.

Hypothesis 5. R&D intensity negatively moderates the relationship between CEO duality and firm performance.

Hypothesis 6. R&D intensity negatively moderates the relationship between board size and firm performance.

3. Research Methods.

3.1. **Data and sample.** The major part of the sample data is collected from TEJ which is the most authoritative and comprehensive database of Taiwan listed firms. Firms' official websites, annual reports as well as press release are ancillary sources for data supplement and verification. In addition, the information of listed firms is much more reliable and convincing than non-listed firms, from which solid results can be achieved. Out of the expectation of analyzing the relationship during a period of steady development, the author chooses 1 year after the financial crisis in 2008, which begins from 2010 and ends in 2019 to follow the recent situation before 2020, the year which was "annoyed" by COVID-19, and 10-year analysis is consistent with organizational literature [15].

The dataset has been narrowed down scrupulously if any financial data, board information or CEO clues are not available or unreasonable after confirmation with supplement resources. The final dataset involves 449 firms and 1651 firm-year observations; each firm presents 3.7 years, which is quite coherent with previous research, such as 3.8 years in Wang and Choi [15]. Compared to literature investigating restricted industries, this paper expects to detect the targeted relationships across industries with universal applicability [15]. According to the New Industry Categories of Taiwan Stock Exchange, which consists of M and 4 digits (e.g., M2100 represents Rubber industry), the sample covers 30 industries.

3.2. **Dependent variable (DV).** *Firm performance* is measured as the return on assets (ROA) after tax and before interest. ROA is a widely employed measure because of its connections with other performance indicators; keeping consistent with other strategic management studies is requisite to compare and cumulate the findings with prior or future studies in relevant themes [16].

3.3. **Independent variables (IVs).** *Board size* and *CEO duality* collectively play the role of IV. *Board size* is calculated as the total number of directors on the board [3]. The phenomenon of *CEO duality* is common in Taiwan due to the limited size of firms and high power distance culture [16]; it is coded as a dummy variable, in which 1 represents CEO duality while 0 represents the opposite (two individuals of CEO and chairman).

3.4. **Moderator.** *R&D intensity* is measured by the ratio of R&D expenditures scaled by total firm sales [12]. Missing values take a small part of the observations of R&D ratio, which conveys the assumption that such firms invest restricted or no money on the R&D sector; hence, the blanks were filled with 0. In other words, most of the firms in the sample connect tightly with R&D activities, which also makes it necessary to detect the moderating effect on the targeted relationship.

3.5. **Control variables.** Other variables that may influence firm performance on the regression output are controlled. *Leverage ratio* is conducted as total liabilities to total assets [16]. It is an important index to evaluate the firm's capital structure related to firm performance. Measured as the natural logarithm of net sales [16], *firm size* is assumed to be a vital factor in various operations of corporate governance due to changes in organizational strategy and firm performance [17]. *Board independence* is calculated by the proportion of the total number of independent directors to the total number of board directors [18]. *Multinational board construction* is also controlled and measured by the proportion of foreign directors' numbers to the total number of board directors. The last two variables are controlled on account of their potential impact on firm performance due to the findings of previous research (e.g., [19]).

3.6. **Analysis design.** It is critical to identify the attributes of data and determine the usability and applicability before to run in the model [2]. Since the data-release date of each year fell on a specific date at the end of that year (Dec. 28 to 31), 10-year panel data can be attributed to a multi-year cross-sectional dataset; as a consequence, hierarchical regression is an acceptable analysis approach to this study. In addition, by deducting the mean value, the proxy of the moderator (R&D intensity) was centered in case of multicollinearity problem according to Aiken and West [21]. The basic hierarchical regression model is as below:

$$\begin{aligned}
&\textit{Firm performance } (\textit{ROA}) \\
&= \beta_0 + \beta_1(\textit{leverage ratio}) + \beta_2(\textit{board independence}) \\
&\quad + \beta_3(\textit{multinational board construction}) + \beta_4(\textit{firm size}) + \beta_5(\textit{board size}) \\
&\quad + \beta_6(\textit{CEO duality}) + \beta_7(\textit{R\&D intensity}) + \beta_8(\textit{CEO duality} \times \textit{R\&D intensity}) \\
&\quad + \beta_9(\textit{board size} \times \textit{R\&D intensity}) + \varepsilon
\end{aligned}$$

where β is the parameter vector to be calculated, ε is the standard error and distributed normally with zero mean and constant variance [22], and other notations in the parentheses are clarified in Sections 3.2 to 3.5.

4. **Analysis and Results.** Table 1 demonstrates descriptive statistics and correlations among all variables. To further detect the multicollinearity, this paper finds variance inflation factors located in 1 to 2.5 (less than 10) in regression; thus, it is not a concern in the following analysis. Table 2 presents the outcomes of 7 models by hierarchical regression, and all models have reasonable explanatory power. Model 1 contains control variables and one IV, CEO duality. Results show that leverage ratio and CEO duality each has a significant negative relationship with DV ($p < 0.001$ and $p < 0.01$), while firm size and multinational board construction show significant positive relationships with DV ($p < 0.001$ and $p < 0.01$). From the negative relationship between CEO duality and firm performance, Hypothesis 1 is supported but Hypothesis 3 is rejected. Control variables in Model 2 to Model 7 present consistent results with Model 1.

Model 2 investigates the relationship between board size and DV, and the results are statistically significant in a negative relationship ($p < 0.001$) supporting Hypothesis 2 and rejecting Hypothesis 4. In Model 3, two IVs are both put into the regression and R^2 increased comparing to Models 1 and 2 with other results similar, indicating a better

Table 1. The result of descriptive statistics and correlation matrix

	M	SD	1	2	3	4
Firm performance	6.816	8.565	1.000			
Leverage ratio	39.218	16.711	−0.239***	1.000		
Board independence	30.100	14.774	0.040	−0.116***	1.000	
Multinational board construction	4.036	11.422	0.079***	0.008	0.134***	1.000
Firm size	15.256	1.603	0.070**	0.381***	−0.200***	0.056*
Board size	7.619	2.157	−0.047*	0.051*	−0.157***	0.035
CEO duality	0.439	0.496	−0.088***	0.001	0.134***	0.023
R&D intensity	4.866	10.315	−0.087***	−0.266***	0.123***	0.003
R&D intensity × CEO duality	0.204	7.550	−0.104***	−0.166***	0.094***	−0.018
R&D intensity × Board Size	−0.683	80.341	−0.084***	−0.258***	0.117***	0.004
	5	6	7	8	9	10
Firm size	1.000					
Board size	0.378***	1.000				
CEO duality	−0.171***	−0.122***	1.000			
R&D intensity	−0.223***	−0.031	0.040	1.000		
R&D intensity × CEO duality	−0.141***	−0.035	0.031	0.732***	1.000	
R&D intensity × Board Size	−0.235***	−0.054*	0.032	0.983***	0.735***	1.000

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 2. Hierarchical regression results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	−2.065	−3.101	−1.785	−0.448	0.057	0.212	0.438
	(2.150)	(2.093)	(2.136)	(2.137)	(2.175)	(2.161)	(2.176)
Leverage ratio	−0.155***	−0.165***	−0.162***	−0.179***	−0.169***	−0.175***	−0.176***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Firm size	0.954***	1.271***	1.211***	1.167***	0.863***	1.114***	1.123***
	(0.140)	(0.148)	(0.149)	(0.148)	(0.139)	(0.148)	(0.149)
Multinational board construction	0.051**	0.052**	0.054**	0.052**	0.050**	0.052**	0.052**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Board independence	0.023	0.013	0.017	0.019	0.029*	0.023	0.024
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
R&D intensity				−0.195	−0.074*	−0.067*	−0.157
				(0.105)	(0.029)	(0.029)	(0.105)
CEO duality	−1.105**		−1.198**		−1.080**	−1.170**	−1.148**
	(0.414)		(0.411)		(0.409)	(0.407)	(0.408)
Board size		−0.474***	−0.488***	−0.439***		−0.468***	−0.458***
		(0.101)	(0.101)	(0.101)		(0.100)	(0.101)
R&D intensity × CEO duality					−0.082*	−0.461*	−0.092*
					(0.039)	(0.102)	(0.039)
R&D intensity × Board Size				0.010			0.012
				(0.013)			(0.014)
Adjusted R^2	0.095	0.103	0.107	0.119	0.115	0.126	0.126
F value	35.478***	38.751***	33.854***	32.955***	31.511***	30.652***	27.332***

Unstandardized Coefficients (B) & Std. Error in the parentheses
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

explanatory power of the model by adding these two IVs simultaneously. Models 4 and 5 are aiming to examine the interaction of IVs and moderator respectively. The interaction coefficient of board size and R&D intensity in Model 4 is insignificant which fails to support Hypothesis 6. Meantime, Hypothesis 5 gains support from Model 5 since the interaction of CEO duality and R&D intensity is negative and statistically significant ($p < 0.05$). In Model 6, all the IVs and moderator are put in the regression and run by *stepwise* method, which leads to the highest R^2 of Models 1 to 6. The variable of board size and R&D intensity's interaction is automatically hidden and the author attempts to further explore the interaction through *enter* method, which is the Model 7 with no change of R^2 and gains the smaller F value, thus further confirming the rejection of Hypothesis 6.

In line with Wang and Choi [15] and Hsu et al. [16], this paper also plots the two-way interaction result of IV (CEO duality) and moderator following the instructions of Aiken and West [21]. The result of simple slope analysis shown in Figure 1 intuitively proves the finding that R&D intensity negatively moderates the relationship between CEO duality and firm performance. This paper further adopts subgroup analysis along with the proxy substitution to verify the findings, and in general, the results are consistent with the findings above.

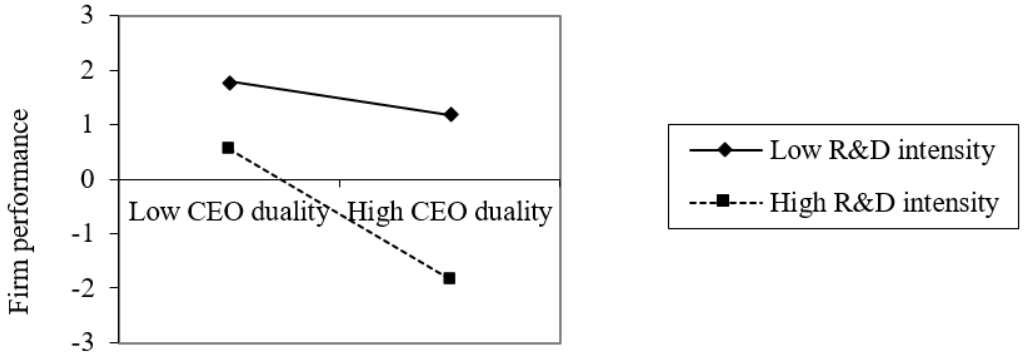

FIGURE 1. Interaction plot for the moderating effect of R&D intensity on the relationship between CEO duality and firm performance

5. **Discussion and Conclusion.** Following antecedents, this study pays close attention to CEO and board issues within the field of organizational strategic management by testing a sample of Taiwan listed firms. Specifically, the IVs' selection of CEO duality and board size seems to be a relatively new point since others usually address a single one. According to the analysis, the hypotheses derived from agency theory win considerable support from the regression results, which both CEO duality and board size "enjoy" significant negative relationships with firm performance and R&D intensity negatively moderates the relationship between CEO duality and firm performance.

This paper shows implications to both researchers and managers. For researchers, there is a little tip on the sample selection that smaller economies with completed and transparent financial details are also ideal objectives for empirical investigation. It can replenish/verify the findings based on major countries and refine relevant theories. For managers especially in knowledge-intensive firms, the separation of CEO and chairman seems to be an effective way to avoid agency problems and benefit firm performance. Meanwhile, controlling the size of the board can not only attain related human capital and necessary resources brought by directors, but also avoid redundancies.

There are also some limitations and future research directions of the paper. The sample is from a relatively small economic entity and whether the findings can apply to the situations in a larger district might be a direction of future study. Moreover, the regression method can be also optimized if regarding this ten-year panel data as longitudinal; thus, further studies can also try PLS, GLS, GMM, etc.

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