THE EFFECTS OF CORPORATE GOVERNANCE MECHANISMS AND INVESTMENT OPPORTUNITY SET ON FIRM PERFORMANCE

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Abstract

This study uses investment opportunity set (IOS) as an environmental factor, and investigates its moderating effect on the relationships between corporate governance mechanisms (including internal and external corporate governance mechanisms) and firm performance. The empirical results using regression analysis show: (1) The IOS does not have a moderating effect on audit quality and firm performance. (2) The negative relationship between institutional investor ownership and firm performance is stronger for firms with higher investment opportunities. (3) When CEO is the chairman of the board, high growth firms can lead to better firm performance. (4) The relationship between the IOS and pledged shares ratio of directors and supervisors has positive influence on firm performance.

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1. Introduction

Firm value consists of two main elements: the assets-in-place and the growth options (Myers, 1977). The assets-in-place are valued independently of firms' investment opportunities, while the growth options are valued on the basis of firms' future discretionary investment decisions. That is, the value of growth options is the present value of firms' options to make future investments.[1] When growth opportunities are related to the management's discretionary investments, there is greater opportunity for opportunistic behavior. The opportunistic behavior may manifest itself as the under-investment problem associated with growth firms (Gaver and Gaver, 1993; Smith and Watts, 1992) or empire building where managers make diversified acquisitions (Hossain et al., 2000). Consequently, growth firms adopt particular control mechanisms to motivate and compensate managers (Hutchinson and Gul, 2004), which in turn enhance firm performance.[2]

The issues of corporate governance have received widespread attention in recent years. According to the agency theory, agency problems occur when the objectives of principals and agents are not identical, and information asymmetry exists (Lin, 2005). Corporate governance encompasses a set of external and internal control mechanisms which can induce self-interested agents to maximize firm value on behalf of their principals (Denis, 2001). In other words, control mechanisms can reduce agency costs between principals (through monitoring) and agents (through bonding) (Jensen and Payne, 2003).

With respect to the relationship between corporate governance mechanisms and firm performance, prior research results are mixed and weak. Hutchinson and Gul (2004) point out a potential explanation for these inconsistent results. That is, these studies do not consider that the association between corporate governance mechanisms and firm performance may be affected by firms' environmental factors. Because different investment opportunity sets (IOS) imply variations in levels of agency costs (Hossain et al., 2000), firms will choose several control mechanisms to efficiently mitigate these costs. Therefore, following Hutchinson and Gul (2004), this study uses the IOS as an environmental factor.

In addition, previous research focuses on the effects of external corporate governance mechanisms and the IOS on firm performance. For example, Hutchinson and Gul (2004) use the composition of the board, management share ownership and management remuneration as corporate governance variables. However, relatively few studies examine the moderating effect of the IOS on the relationship

between "external" corporate governance mechanisms and firm performance. As a result, this study develops a framework that includes external (e.g. audit quality and institutional investor ownership) and internal (e.g. CEO duality and pledged shares ratio of the directors) corporate governance mechanisms, and then investigates whether the IOS moderates the relationship between corporate governance mechanisms and firm performance.

The empirical results indicate that the interaction between the IOS and audit quality does not have a significant impact on firm performance. Second, the relationship between the IOS and institutional investor ownership is negatively associated with firm performance. In addition, firm performance is affected by the joint impact of the IOS and CEO duality. Finally, the relationship between the IOS and pledged shares ratio of directors and supervisors has positive influence on firm performance.

The rest of this paper is organized as follows. In section 2, we develop hypotheses based on prior literature. Section 3 provides the sample description and variable measurements. Next, the descriptive statistics, the main empirical results and the results of sensitivity analysis are discussed in section 4. Finally, section 5 summarizes and concludes this paper.

2. Literature Review and Hypotheses Development

2.1. External Corporate Governance Mechanisms

2.1.1. Audit quality

The demand for control derives primarily from the presence of agency costs (Jensen and Meckling, 1976).[3] In other words, the management have many control mechanisms from which to choose as they regulate the overall level of control in their firms (Abernethy and Chua, 1996). These mechanisms are comprised of internal and external control components (Eilifsen et al., 2001). Based on prior studies, both of them can reduce agency costs.

Several studies have suggested that independent audit, one of external control mechanisms, can reduce information asymmetry existed between the management and firm stakeholders by allowing outsiders to verify the validity of financial reports (DeAngelo, 1981), and in this case can facilitate market efficiency (Beaver, 1998). The related audit credibility model also suggests that the management select external auditors with a view to signaling their honesty and quality to accounting users. Therefore, the effectiveness of auditing and its ability to constrain the earnings management is expected to vary with the quality of the auditor (DeAngelo, 1981).[4] In addition, DeAngelo (1981), Watts and Zimmerman (1986) and Becker et al. (1998) suggest

that big auditing firms are usually identified as high-quality auditors in the literature. Based on these studies, we use Big 4 auditing firms as the surrogate of audit quality.[5]

As to the relationship between audit quality and firm performance, Teoh and Wong (1993) find that the earnings response coefficients of Big 8 auditing firms are significantly higher than those for non-Big 8 auditing firms, and show that the auditors' reputation lends credibility to the earnings report they audit. Gul et al. (2003) also find that the positive market reaction to increase in earnings is stronger for firms audited by high quality auditors in China. However, much of this research has not examined how the IOS affects the relationship between audit quality and firm performance. Besides, as agency costs increase with the growth options, there is a demand for higher quality audits, either voluntarily undertaken by the management as a bonding mechanism or externally imposed as a monitoring mechanism by stockholders and/or debt holders (Watts and Zimmerman, 1986). Hutchinson and Gul (2004) also indicate that the role of corporate governance variables in firm performance should be evaluated in the context of growth opportunities.[6] Thus, we expect that the IOS can affect the association between audit quality and firm performance. The related hypothesis is established as follows:

H1: The relation between investment opportunity set and audit quality has a positive effect on firm performance.

2.1.2. Institutional investor ownership

Institutional investors with substantial shareholdings in firms have the resources and incentives to monitor and influence management decisions. Whether the institutions actually monitor and exert pressure on the management is an empirical question. Previous studies have reported inconclusive results on this research topic (Chung et al., 2002).

Some researchers argue that the increase in the level of institutional holdings is associated with a decline in competitiveness and long-term performance of firms (e.g. Graves and Waddock, 1994). This viewpoint is due in part to institutional fund managers' need to show improved results frequently and regularly. Because their own rewards are based on quarterly results, they pursue short-term gains (Johnson and Greening, 1999). Such short investment horizon deters institutional investors from incurring monitoring costs, as the benefits of governing the portfolio firms are unlikely to accrue to investors in the short run. That is, they exhibit a strong preference for near-term earnings, which translates into misevaluation of stock price where the near-term earnings are over-weighted (Bushee, 2001). To be responsive, the management of firms have incentives to manage earnings upwards (Porter, 1992).

Accordingly, institutional investors' short-term orientation is harmful to firms.

In contrast, some researchers indicate that institutional shareholdings can lead to superior long-term performance (e.g. McConnell and Servaes, 1990). When institutional investors hold large amounts of firm equity, they can not easily divest their holdings without severely affecting share price (Pound, 1992). In this circumstance, they have greater incentives to collect information, monitor management actions, and urge better performance (Chung et al., 2002). In other words, such long-term oriented institutional investors can mitigate the management's earnings management discretion (Koh, 2003). Therefore, institutional investors can influence the management to manage for the long term interests of shareholders as a result (Johnson and Greening, 1999).

Overall, these two opposite opinions lead researchers to hypothesize inconsistent relationships between institutional investors and performance (Johnson and Greening, 1999). In other words, some institutional investors act more as traders concerned with short-term performance, while the others act as long-term investors concerned with firms' long-term performance. In addition, when institutional investors have a sufficiently high ownership level, they are more involved in corporate governance matters (Koh, 2003). Nevertheless, although there is a lot of research examining the relationship between institutional investors and firm performance, there are very few studies that consider whether the relationship is related to the characteristics of firms, for example, the IOS. Further, when growth firms have a higher proportion of institutional investor ownership, it is likely to limit the management's earnings management discretion. Upon this, the management have more incentives to invest these discretionary expenditures based on firms' long-term value. As mentioned in Bushee's (1998) research, institutional investors can reduce managerial incentives to manage earnings upwards through R&D spending cuts. Hence, the related hypothesis is established as follows:

H2: The relation between investment opportunity set and ownership of institutional investors has a negative effect on firm performance.

2.2. Internal Corporate Governance Mechanisms

2.2.1. CEO duality
One of the corporate governance issues that give rise to concern is role duality or the "dominant personality" phenomenon where the chief executive officer (CEO) is also the chairman of the board (Rahman and Haniffa, 2005). A number of studies have examined the effect of duality on performance.

This literature encompasses two opposing theoretical perspectives as follows (Kang and Zardkoohi, 2005).

Agency theorists suggest that the chairman has to be independent in order to check on the possibility of the over-ambitious plans of the CEO (Rahman and Haniffa, 2005). The separation of the two roles is necessary so as to provide the essential check and balance over management's performance (Blackburn, 1994) because someone who holds two top positions is more likely to pursue strategies which advance personal interests to the detriment of the firm as a whole (Jensen and Meckling, 1976). Bacon (1993) also points out that separating the position of chairman from the CEO can enhance the board's effectiveness in following three ways: (1) the board's chief responsibility to look after shareholder interests will be clarified; (2) the board's role as an overseer and monitor of management also will be clarified, and its hand in dealing with management will be strengthened; and (3) the board will be organized better and more effectively by virtue of having its own leadership. Therefore, agency theory suggests that duality decreases firm performance due to CEO entrenchment and a decline in board independence from corporate management (Mizruchi, 1983; Kang and Zardkoohi, 2005).

On the other hand, stewardship theorists argue that role duality enhances decision making process because it permits a sharper focus on company objectives and promotes more rapid implementation of operational decisions (Stewart, 1991). Dahya et al. (1996) also assert that role duality allows the CEO with strategic visions to shape the destiny of the firm with minimum board interference which leads to improved performance resulting from clear unfettered leadership of the boards (Rahman and Haniffa, 2005). In addition, another benefit of CEO duality stems from the considerable firm-specific knowledge and experience retained by the CEO (Brickley et al., 1997). The associated cost of transferring this knowledge to a separate chairman of the board is high. Combining the two roles can reduce these costs (Dahya and Travlos, 2000). Thus, stewardship theory suggests that duality enhances firm performance (Donaldson and Davis, 1991; Kang and Zardkoohi, 2005).

Kang and Zardkoohi (2005) indicate that the lack of a clear-cut relationship between CEO duality and firm performance may be attributed to the failure of existing paradigms to shed light on the moderating effects of other variables. Although prior studies have investigated moderating effects on the duality-performance relationship, no research takes the IOS as the moderating variable. As a result, this study considers that the relationship between CEO duality and performance may be influenced by the IOS. Specifically, we expect that for high growth firms, CEO duality can enhance decision making process

(Stewart, 1991), which in turn promote firm performance. The related hypothesis is established as follows:

H3: The relation between investment opportunity set and CEO duality has a positive effect on firm performance.

2.2.2. Pledged shares ratio of the directors and supervisors

Although traditional agency theory assumes that ownership of firms is well diversified among shareholders and that managers of firms have control over it (Jensen and Meckling, 1976), few firms are widely held by general shareholders (Kao et al., 2004). The so-called controlling shareholders have control rights over cash flow rights through pyramidal structure of shareholdings or participation in corporate management (Kao et al., 2004) without being monitored by other outside shareholders (La Porta et al., 1999). Hence, another kind of agency problem derives from the conflicts between the outside shareholders and the controlling shareholders (Shleifer and Vishny, 1997).

Shares collateralized by boards of directors or other shareholders should be considered as personal conducts and should be irrelevant to the operations of the firm under the separation of ownership and control. However, the separation of ownership and control does not apply to firms in general. Thus, personal pledged share may be related to firm performance. Kao et al. (2004) indicate the agency problem between controlling shareholders and outside shareholders is more severe when there are collateralized shares. Lee and Yeh (2004) also show that a higher percentage of shares pledged probably represents a difficult financial position for the controlling shareholders, and a tendency to illegally use corporate funds for a stock price support scheme. La Porta et al. (1999) and Claessens et al. (2000) suggest that pledged shares exacerbate the deviation of cash flow rights and control rights held by controlling shareholders, inducing more severe agency problems between controlling shareholders and outside shareholders. In Taiwan, directors' and supervisors' share collateralization is very common (Kao et al., 2004). If directors and supervisors collateralize shares for funds, they would encounter risks of replenishing deposits or feel pressured to sell stock when the stock price drops. The derived agency problem is that managers would expropriate minority interests during the stock market slump (Chiou et al., 2002). Therefore, Taiwan SEC asks the firms with their directors and supervisors pledged shares at financial institutions to disclose the details of share collateralization on the website of Taiwan Stock Exchange every day. When a firm with directors' and supervisors' share collateralization would like to issue equity offerings, the details of share collateralization

must be also disclosed in the prospectus (Kao et al., 2004). Accordingly, the issue of directors' and supervisors' pledged shares is one of the corporate governance scopes. Most studies indicate that pledged shares have a negative impact on firm performance (e.g. Chiou et al., 2002; Kao et al., 2004). It is because directors and supervisors may demand more capital or corporate protection through collateral under the stock slump. Hence, the directors and supervisors would not put effort in managing the corporation, they would rather expropriate corporate resources for personal benefits (Chiou et al., 2002). However, these studies do not consider whether the IOS can affect the relationship between directors' pledged shares and firm performance. The management of firms with large IOS will be motivated to make substantial capital expenditures to improve firm performance (Gupta and Bailey, 2001). Therefore, we expect that the IOS may moderate the negative association. Thus, the related hypothesis is established as follows:

H4: The relation between investment opportunity set and pledged shares ratio of the directors and supervisors has a positive effect on firm performance.

3. Research Design

3.1. Sample selection and data sources

The sample used to test the hypotheses consists of firms listed in the Taiwan Stock Exchange (TSE) and Over-The-Counter (OTC) in fiscal 2005, excluding financial institutions.[7] Table 1 shows the industry distribution of the sample companies. The electronics industry firms represent the highest percentage (52.85%).

Table 1. Industry Distribution of the Sample Companies

Industry	Frequency	Percent (%)
Cement	8	0.80
Food	24	2.40
Plastics	26	2.60
Textiles	61	6.11
Electric and machinery	47	4.71
Appliance and cable	15	1.50
Chemicals	57	5.71
Glass and ceramics	8	0.80
Paper and pulp	7	0.70
Steel and iron	32	3.20
Rubber	10	1.00
Automobile	4	0.40
Electronics	528	52.85
Construction	54	5.41
Transportation	22	2.20
Tourism	10	1.00
Department stores	16	1.60
Composite	1	0.10
Miscellaneous	69	6.91
Total	999	100.00

In addition, except the IOS and CEO duality, other variables used in our model are available in the Taiwan Economic Journal (TEJ) and the Market Observation Post System of the Taiwan Security Exchange Corporation (TSEC).[8] First, the IOS is computed with the defined procedure as next section describes. Second, we get the information of CEO duality by accessing firms' websites and financial reports.

3.2. Regression model and variable measurement

We carry out the multiple regression analysis to test hypotheses. The following model is estimated:

$$ROE_{05} = \beta_0 + \beta_1 AUDITOR + \beta_2 INST + \beta_3 DUAL + \beta_4 PLEDGED + \beta_5 IOS$$
$$+ \beta_6 IOS \times AUDITOR + \beta_7 IOS \times INST + \beta_8 IOS \times DUAL$$
$$+ \beta_9 IOS \times PLEDGED + \beta_{10} LNASSET + \beta_{11} LEVERAGE$$
$$+ \beta_{12} R \& D + \beta_{13} ROE_{04} + \varepsilon$$

Where:

ROE_{05}	the return on equity for year 2005
$AUDITOR$	Audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise
$INST$	The ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors
$DUAL$	CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise
$PLEDGED$	Pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors
IOS	Investment opportunity set, the factor score of MBVA, MBVE and PPEMVA
$LNASSET$	natural log of assets
$LEVERAGE$	total debts divided by total assets
$R \& D$	the ratio of R&D expenditures divided by sales
ROE_{04}	lagged return on equity for the previous year 2004

3.2.1. Independent Variables

The IOS is unobservable because it is related to discretionary expenditures and firm-specific and macroeconomic factors (Kallapur and Trombley, 1999). Therefore, any individual proxy is unlikely to be a perfect measure (Hutchinson and Gul, 2004). Kallapur and Trombley (1999) organize accounting

and finance literature, and classify these measures as price-based proxies, investment-based proxies and variance measures.[9] They find that among the commonly used proxies, market-to-book value ratios are the most highly correlated with future growth. According to Kallapur and Trombley (1999), Hutchinson and Gul (2004) use three variables as proxy measures of growth: market value of assets to book value of assets ratio (MBVA), the market-to-book value of equity ratio (MBVE) and the ratio of gross plant, property and equipment to market value of the firm (PPEMVA).

Following Hutchinson and Gul (2004), we conduct factor analysis to measure the IOS. That is, because investment opportunities can take alternative forms, we reduce a variety of observable variables (e.g. MBVA, MBVE and PPEMVA) to a single factor. Table 2 reports the results of the factor analysis. Panel A shows communalities of the individual IOS measures. In Panel B, the eigenvalues of the correlation matrix of the three individual measures of the IOS are reported. Panel C presents the correlations between the common factor and the three individual measures of the IOS. The common factor is positively and significantly correlated with MBVA and MBVE, and negatively correlated with PPEMVA. This result suggests that the common factor captures the underlying construct of the three proxies. Panel D reports the descriptive statistics for the common factor.

Besides, audit quality is measured in terms of a dummy variable that takes the value of 1 if the company auditor is from the Big 4 auditing firms, and takes value of 0 otherwise. The proxy for institutional investor ownership is calculated as the total shares held by institutional investors (including shares of QFII and investment trust companies) divided by outstanding shares of the firm. CEO duality is also a dummy variable, equal to 1 if the CEO is not the chairman of the board, and zero otherwise. Pledged shares ratio of directors and supervisors is measured as the pledged shares of directors and supervisors divided by the total shares of directors and supervisors.

3.2.2. Dependent variable-ROE_{05}

Since the objective of this research is to investigate whether the IOS can influence the relationship between corporate governance control mechanisms and firm performance, we use one of the traditional financial performance measures, ROE, to evaluate the consequence of corporate governance. ROE is measured as net profit after tax before abnormal items divided by ordinary shareholders' funds.

Table 2. Common factor analysis of the three measures of the IOS (n=999)

	MBVA	MBVE	PPEMVA
Panel A: Estimated communality of the three IOS measures	0.899	0.872	0.273
Panel B: Eigenvalues	2.044	0.841	0.116
Panel C: Correlations between common factor and three IOS measures	0.948[*]	0.934[**]	-0.523[**]
Panel D: Descriptive statistics of the common factor---IOS			
Mean	0.0000		
Median	-0.2409		
Maximum	7.8528		
Minimum	-6.3394		

a. MBVA= 〔(total assets- total common equity)+shares outstanding*share closing price〕/ total assets

MBVE=(shares outstanding*share closing price) / total common equity

PPEMVA= gross plant, property and equipment / (market value of the firm+ non-current liabilities)

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

3.2.3. Control variables

Based on previous research, this study comprises four control variables. They are firm size, leverage, R&D expenditures and ROE_{04}. Because company performance may be a function of size (larger firms are more profitable than smaller firms) (Ghosh, 1998), we use the natural log of assets as a proxy to control the probable effect. Second, because creditors, interested in protecting their investment in firms, are more likely to actively monitor firms when firms' capital structures are highly levered (Hutchinson and Gul, 2004), we consider the leverage effect on firm performance. Leverage here is measured by the percentage of total debts to total assets. In addition, the R&D expenditures have a significant and positive relationship with firm performance. Therefore, the ratio of R&D expenditures divided by the sales is used as a control variable in this study. Finally, according to Hutchinson and Gul (2004), the current financial performance of firms is likely to be associated with future performance. Hence, ROE_{04} is included in our regression model. This lagged variable can capture, at least in part, the dynamic adjustment of ROE.

4. Empirical Results

4.1. Descriptive statistics

Table 3 contains the distribution of the audit quality and CEO duality variables for our entire sample.

More than 80 percent (82.3%) of firms' auditors are from the Big 4 auditing firms. 673 firms choose to separate the role of CEO and the chairman of the board. In addition, the majority of our sample belongs to the electronics industry. Thus, the sample is then split into two sub-samples, the electronics industry firms and the non-electronics industry firms. Table 4 and Table 5 present the frequency and percentage of the audit quality and CEO duality for the two sub-samples, respectively. About 90.7 percent of the electronics industry firms hire Big 4 auditors, while only 72.8 percent of the non-electronics industry firms do. Nearly 38.4 percent of the electronics industry firms' CEOs are the chairmen of the board, while only 26.1 percent of the non-electronics industry firms' CEOs are. These findings show that the electronics industry firms are likely to have higher audit quality and CEO duality.

Table 6 reports descriptive statistics for the variables in all industries in our sample. The average institutional investor ownership is 8.89%, with a maximum value of 73.82% and a minimum value of −2.02%. The average pledged shares ratio of directors and supervisors is 10.43%, with a maximum value of 100% (1 firm) and a minimum value of 0% (607 firms). The firms' average size (total assets) is NT$ 11,045,402,000 and average R&D expenditures are NT$153,524,000. ROE in 2005 and 2004 is 5.62% and 4.96%, respectively, and leverage is 42.59%. Furthermore, Table 7 and Table 8 show descriptive statistics in the electronics industry and the non-electronics industry firms, respectively.

Table 3. Frequency distribution (for all industry firms)

	1	0	Total
Audit quality	822(82.3%)	177(17.7%)	999
CEO duality	673(67.4%)	326(32.6%)	999

a. For audit quality variable, equal to 1 if the auditor is from the Big 4 auditing firms and zero otherwise.
b. For CEO duality variable, equal to 1 if the CEO is not the chairman of the board and zero otherwise.

Table 4. Frequency distribution (for the electronics industry firms)

	1	0	Total
Audit quality	479(90.7%)	49(9.3%)	528
CEO duality	325(61.6%)	203(38.4%)	528

a. For audit quality variable, equal to 1 if the auditor is from the Big 4 auditing firms and zero otherwise.
b. For CEO duality variable, equal to 1 if the CEO is not the chairman of the board and zero otherwise.

Table 5. Frequency distribution (for the non-electronics industry firms)

	1	0	Total
Audit quality	343(72.8%)	128(27.2%)	471
CEO duality	348(73.9%)	123(26.1%)	471

a. For audit quality variable, equal to 1 if the auditor is from the Big 4 auditing firms and zero otherwise.
b. For CEO duality variable, equal to 1 if the CEO is not the chairman of the board and zero otherwise.

Table 6. Descriptive statistics (n=999)—all industry firms

Dependent variable	Mean	S. D.	Minimum	Maximum	Q1	Median	Q3
ROE_{05}	0.0562	21.6070	-2.0648	0.6256	0.0087	0.0726	0.1638
Independent variable							
AUDITOR			0.0000	1.0000			
DUAL			0.0000	1.0000			
INST	0.0889	0.1248	-0.0202	0.7382	0.0018	0.0391	0.1167
PLEDGED	0.1043	20.0796	0.0000	1.0000	0.0000	0.0000	0.0000
IOS	0.0000	1.0000	-6.3394	7.8528	-0.5755	-0.2409	0.3596
ASSESTS (in thousands)	11,045,402	32,884,726	243,416	460,824,641	1,236,403	3,110,572	7,114,798
R&D (in thousands)	153,524	608,879	0	12,712,700	0	23,317	74,222
LEVERAGE	0.4259	0.1710	0.0250	0.9767	0.3055	0.4257	0.5363
ROE_{04}	0.0496	21.3988	-1.6142	0.7910	0.0009	0.0681	0.1571

ROE_{05} is the return on equity for year 2005; AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; IOS is a factor score for the investment opportunity set; ASSETS is total asset in N.T.$000's; LEVERAGE is total debts divided by total assets; ROE_{04} is lagged return on equity for the previous year 2004; and R&D is R&D expenditures in N.T.$000's.

Table 7. Descriptive statistics (n=528)—the electronics industry firms

Dependent variable	Mean	S. D.	Minimum	Maximum	Q1	Median	Q3
ROE_{05}	0.0802	19.3878	-1.1258	0.5518	0.0149	0.1015	0.1947
Independent variable							
AUDITOR			0.0000	1.0000			
DUAL			0.0000	1.0000			
INST	0.1008	0.1246	-0.0200	0.6116	0.0074	0.0493	0.1424
PLEDGED	0.0655	0.1465	0.0000	1.0000	0.0000	0.0000	0.0326
IOS	0.0000	1.0000	-2.7606	6.3298	-0.5713	-0.1544	0.4484
ASSESTS (in thousands)	11,273,935	3,609,446	284,943	460,824,641	1,397,155	2,678,741	6,205,933
R&D (in thousands)	255,524	811,082	0	12,712,695	18,248	54,395	141,745
LEVERAGE	0.4087	0.1580	0.0499	0.9041	0.2978	0.4116	0.5168
ROE_{04}	0.0858	0.1939	-1.1258	0.5518	0.0110	0.1015	0.1947

ROE_{05} is the return on equity for year 2005; AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; IOS is a factor score for the investment opportunity set; ASSETS is total asset in N.T.$000's; LEVERAGE is total debts divided by total assets; ROE_{04} is lagged return on equity for the previous year 2004; and R&D is R&D expenditures in N.T.$000's.

Table 8. Descriptive statistics (n=471)—the non-electronics industry firms

Dependent variable	Mean	S. D.	Minimum	Maximum	Q1	Median	Q3
ROE_{05}	0.0293	23.5828	-2.0648	0.6256	0.0053	0.0536	0.1204
Independent variable							
AUDITOR			0.0000	1.0000			
DUAL			0.0000	1.0000			
INST	0.0800	0.1240	0.0000	1.0000	0.0000	0.0200	0.0900
PLEDGED	0.1479	0.2407	0.0000	0.9900	0.0000	0.0000	0.2139
IOS	0.0000	1.0000	-4.6114	6.7937	-0.5542	-0.2487	0.3519
ASSESTS (in thousands)	10,789,212	28,902,018	243,416	328,168,036	1,801,524	3,533,981	8,404,960
R&D (in thousands)	39,179	157,450	0	2,381,440	0	1,681	25,746
LEVERAGE	0.4451	0.1828	0.0250	0.9767	0.3098	0.4382	0.5577
ROE_{04}	0.0090	0.2261	-1.6142	0.7145	-0.0097	0.0434	0.1073

ROE_{05} is the return on equity for year 2005; AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; IOS is a factor score for the investment opportunity set; ASSETS is total asset in N.T.$000's; LEVERAGE is total debts divided by total assets; ROE_{04} is lagged return on equity for the previous year 2004; and R&D is R&D expenditures in N.T.$000's.

4.2. Correlation analysis

Table 9 presents Pearson correlations between variables. ROE_{05} is positively correlated with the IOS (γ=0.631), audit quality (γ=0.092), institutional investor ownership (γ=0.220) and LNASSET (γ=0.065). Furthermore, ROE_{05} is negatively correlated with pledged shares ratio of directors and supervisors (γ=-0.259) and LEVERAGE (γ=-0.404).

4.3. Regression analysis

Table 10 shows the effects of four corporate governance variables (including audit quality, institutional investor ownership, CEO duality and pledged shares ratio of directors and supervisors) on firm performance with the IOS in all industry firms. The interaction term IOS*Auditor is not significant (β=-0.068, p=0.253), indicating that the linkage between the IOS and audit quality does not have an influence on firm performance.

Therefore, hypothesis 1 is not supported. The coefficient of IOS*Inst is negative and significant (β=-0.108, p=0.001), indicating that increase in the IOS when institutional investor ownership increases is lower for firm performance. This result supports hypothesis 2.

Table 9. Pearson correlation analysis (n=999)—all industry firms

	1	2	3	4	5	6	7	8	9	10
1. AUDITOR	1.000									
2. DUAL	-0.071[*]	1.000								
3. INST	0.150[**]	-0.018	1.000							
4. PLEDGED	-0.031	0.062	0.001	1.000						
5. LEVERAGE	-0.067[*]	0.011	-0.009[**]	0.241[**]	1.000					
6. ROE_{05}	0.092[**]	0.007	0.220[**]	-0.259[**]	-0.404[**]	1.000				
7. ROE_{04}	0.104[**]	-0.002	0.100[**]	-0.280[**]	-0.379[**]	0.610[**]	1.000			
8. IOS	0.112[**]	-0.052	0.215[**]	-0.260[**]	-0.333[**]	0.631[**]	0.587[**]	1.000		
9. R&D	0.089[**]	-0.032	0.034	-0.103[**]	-0.257[**]	0.042	-0.001[**]	0.128[**]	1.000	
10.LNASSET	0.070[*]	0.158[**]	0.196[**]	0.258[**]	0.112[**]	0.065[*]	-0.005	0.031	0.174[**]	1.000

AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; LEVERAGE is total debts divided by total assets; ROE_{05} is the return on equity for year 2005; ROE_{04} is lagged return on equity for the previous year 2004; IOS is a factor score for the investment opportunity set; R&D is the ratio of R&D expenditures divided by sales; and LNASSETS is nature log of assets in N.T.$000's.

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

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

The interaction term IOS*Dual is negative and significant (β= -0.156, p= 0.000), which suggests that there is a significant difference whether CEO is also the chairman of the board on the effect of the IOS on firm performance. Thus, hypothesis 3 is supported.

The IOS*Pledged coefficient is positive and significant (β=0.105, p=0.000), suggesting that the relationship between the IOS and Pledged shares ratio of directors and supervisors has an effect on firm performance. Thus, this result supports hypothesis 4.

Table 10. Regression results for corporate governance variables and IOS for all industry firms

Independent variable	Coefficient	t	Significance (p)
(Constant)		-0.580	0.562
AUDITOR	0.007	0.306	0.760
INST	-0.044	-1.729	0.084
DUAL	0.027	1.221	0.222
PLEDGED	-0.006	-0.221	0.825
IOS	0.666	8.924	0.000[***]
LNASSET	0.072	3.011	0.003[***]
LEVERAGE	-0.178	-7.221	0.000[***]
ROE_{04}	0.255	8.937	0.000[***]
R&D	-0.139	-6.605	0.000[***]
IOS*AUDITOR	-0.068	-1.145	0.253
IOS*INST	-0.108	-3.347	0.001[***]
IOS*DUAL	-0.156	-3.780	0.000[***]
IOS*PLEDGED	0.105	3.749	0.000[***]
R^2	0.550		
Adjusted R^2	0.544		
F	92.497		0.000[***]
n=999			

ROE_{05} is the return on equity for year 2005; AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; IOS is a factor score for the investment opportunity set; LNASSETS is nature log of assets in N.T.$000's; LEVERAGE is total debts divided by total assets; ROE_{04} is lagged return on equity for the previous year 2004; R&D is the ratio of R&D expenditures divided by sales; IOS*AUDITOR is the interaction between IOS and AUDITOR; IOS*INST is the interaction between IOS and INST; IOS*DUAL is the interaction between IOS and DUAL; and IOS*PLEDGED is the interaction between IOS and PLEDGED.

* Correlation is significant at the 0.10 level (2-tailed).

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

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

In order to further examine whether the interaction between the IOS and corporate governance mechanisms on firm performance has differences according to the industry factor, separate regressions are conducted for the electronics industry firms versus the non-electronics industry firms. The regression analysis results for the two sub-samples are shown in Table 11 and Table 12, respectively.

For the electronics industry firms, the IOS*Auditor term is positive and non-significant (β=0.131, p=0.123). Thus, this result shows that the interaction between the IOS and audit quality does not have an impact on firm performance for the electronics industry firms. The coefficient for the interaction term IOS*Inst is negative and significant (β=-0,152, p=0.000), suggesting that the relationship between the IOS and institutional investor ownership has an impact on firm performance. The coefficient of

IOS*Dual is negative and significant (β=-0.151, p=0.001). This evidence shows that the firms' performance of the electronics industry is influenced by the interaction between the IOS and CEO duality. The IOS*Pledged coefficient is positive and significant (β=0.154, p=0.000), indicating that firm performance is affected by the interaction between the IOS and pledged shares ratio of directors and supervisors for the electronics industry firms.

For the non-electronics industry firms, the IOS*Auditor term is not significant (β=-0.093, p= 0.171). This result shows that the interaction between the IOS and Auditor does not have an influence on firm performance. The coefficient of IOS*Inst is negative and significant (β=-0.094, p=0.04). This result reveals that the interaction between the IOS and institutional investor ownership has an impact on firm performance for the non-electronics industry firms.

Table 11. Regression results for corporate governance variables and IOS factor scores for the electronics industry firms

Independent variable	Coefficient	t	Significance (p)
(Constant)		0.955	0.340
AUDITOR	-0.004	-0.152	0.879
INST	0.008	0.261	0.794
DUAL	-0.001	0.051	0.959
PLEDGED	0.023	0.723	0.470
IOS	0.547	5.392	0.000***
LNASSET	0.039	1.325	0.186
LEVERAGE	-0.140	-4.973	0.000***
ROE_{04}	0.313	8.752	0.000***
R&D	-0.155	-5.784	0.000***
IOS*AUDITOR	0.131	1.546	0.123
IOS*INST	-0.152	-3.679	0.000***
IOS*DUAL	-0.151	-3.256	0.001***
IOS*PLEDGED	0.154	4.801	0.000***
R^2	0.683		
Adjusted R^2	0.675		
F	85.093		0.000***
n=999			

ROE_{05} is the return on equity for year 2005; AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; IOS is a factor score for the investment opportunity set; LNASSETS is nature log of assets in N.T.$000's; LEVERAGE is total debts divided by total assets; ROE_{04} is lagged return on equity for the previous year 2004; R&D is the ratio of R&D expenditures divided by sales; IOS*AUDITOR is the interaction between IOS and AUDITOR; IOS*INST is the interaction between IOS and INST; IOS*DUAL is the interaction between IOS and DUAL; and IOS*PLEDGED is the interaction between IOS and PLEDGED.
* Correlation is significant at the 0.10 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).
*** Correlation is significant at the 0.01 level (2-tailed).

The coefficient of IOS*Dual is negative and significant (β=-0.136, p=0.063). That is, the relationship between the IOS and CEO duality has an impact on firm performance. The IOS*Pledged coefficient is positive and significant (β=0.177, p=0.000). This result suggests that the level of pledged shares ratio of directors and supervisors

would change the association between the IOS and firm performance for the non-electronics industry firms.

In sum, the regression results consistently demonstrate the following results. First, the IOS does not find a moderating effect on the relationship between audit quality and firm performance. Second,

the negative relationship between institutional investor ownership and firm performance is stronger for firms with higher investment opportunities. In addition, when CEO is also the chairman of the board, high growth firms can lead to better firm performance. Finally, as the proportion of pledged shares ratio of directors and supervisors increases with high growth opportunities, firm performance increases.

Table 12. Regression results for corporate governance variables and IOS for the non-electronics industry firms

Independent variable	Coefficient	t	Significance (p)
(Constant)		-1.131	0.259
AUDITOR	0.032	0.910	0.363
INST	-0.003	-0.091	0.928
DUAL	0.035	1.016	0.310
PLEDGED	-0.002	-0.051	0.960
IOS	0.594	5.887	0.000***
LNASSET	0.089	2.353	0.019
LEVERAGE	-0.210	-5.245	0.000***
ROE_{04}	0.161	3.648	0.000***
R&D	-0.099	-2.772	0.006***
IOS*AUDITOR	-0.093	-1.370	0.171
IOS*INST	-0.094	-2.063	0.040**
IOS*DUAL	-0.136	-1.860	0.063*
IOS*PLEDGED	0.177	3.868	0.000***
R^2	0.479		
Adjusted R^2	0.464		
F	32.262		0.000***
n=999			

ROE_{05} is the return on equity for year 2005; AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; IOS is a factor score for the investment opportunity set; LNASSETS is nature log of assets in N.T.\$000's; LEVERAGE is total debts divided by total assets; ROE_{04} is lagged return on equity for the previous year 2004; R&D is the ratio of R&D expenditures divided by sales; IOS*AUDITOR is the interaction between IOS and AUDITOR; IOS*INST is the interaction between IOS and INST; IOS*DUAL is the interaction between IOS and DUAL; and IOS*PLEDGED is the interaction between IOS and PLEDGED.
* Correlation is significant at the 0.10 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).
*** Correlation is significant at the 0.01 level (2-tailed).

Table 13. Regression results for corporate governance variables and IOS for all industry firms

Independent variable	Coefficient	t	Significance (p)
(Constant)		-3.602	0.000
AUDITOR	0.030	0.640	0.522
INST	0.175	3.087	0.002***
DUAL	0.086	1.817	0.007***
PLEDGED	-0.413	-7.882	0.000***
MBVA	0.519	7.545	0.000***
LNASSET	0.069	2.853	0.004***
LEVERAGE	-0.148	-5.950	0.000***
ROE_{04}	0.266	9.403	0.000***
R&D	-0.142	-6.212	0.000***
MBVA*AUDITOR	-0.040	-0.541	0.589
MBVA*INST	-0.230	-3.520	0.000***
MBVA*DUAL	-0.091	-1.651	0.099*
MBVA*PLEDGED	0.367	7.205	0.000***
R^2	0.550		
Adjusted R^2	0.544		
F	92.454		0.000***
n=999			

ROE_{05} is the return on equity for year 2005; AUDITOR is audit quality, equal to 1 if the auditor is from Big 4 auditing firms, 0 otherwise; INST is the ownership of institutional investor, represented by the percentage of outstanding shares held by institutional investors; DUAL is CEO duality, equal to 1 when CEO is not the chairman of the board, 0 otherwise; PLEDGED is pledged shares ratio, represented by the percentage of shares as collateral held by directors and supervisors; MBVA is 〔(total assets- total common equity)+shares outstanding*share closing price〕/ total assets; LNASSETS is nature log of assets in N.T.$000's;LEVERAGE is total debts divided by total assets; ROE_{04} is lagged return on equity for the previous year 2004; R&D is the ratio of R&D expenditures divided by sales; MBVA*AUDITOR is the interaction between MBVA and AUDITOR; MBVA*INST is the interaction between MBVA and INST; MBVA*DUAL is the interaction between MBVA and DUAL; and MBVA*PLEDGED is the interaction between MBVA and PLEDGED.

* Correlation is significant at the 0.10 level (2-tailed).

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

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

4.4. Sensitivity analysis

In order to assure that the research results are not caused by measurement errors, an alternative measure of the IOS is used to test the hypotheses. As mentioned in section 3, MBVA is one of the most common variables used as a surrogate in previous research. Therefore, we replace the environmental variable IOS from Hutchinson and Gul's (2004) measurement with MBVA. The sensitivity analysis results are shown in Table 13. These results are consistent with our above results. Taken together with our earlier tests, the results for the IOS appear to be robust.

5. Conclusion

This study examines whether the linkages between corporate governance variables (including external and internal control mechanisms) and the environmental factor can affect firm performance. Following Hutchinson and Gul (2004), we use the IOS as an environmental factor. More specifically, we develop a framework that includes external (e.g. audit quality and institutional investor ownership) and internal (e.g. CEO duality and pledged shares ratio of the directors and supervisors) corporate governance mechanisms, and then investigate the moderating effect of the IOS on the relationships between corporate governance mechanisms and firm performance.

Our results indicate the following findings and implications. First, the interaction between institutional investor ownership and the IOS has negative influence on firm performance. This is perhaps because institutional investors involve more in corporate governance matters and so are concerned with firms' long-term performance, which in turn reduces the management's incentives to manage earnings upwards (e.g. through the decreases in R&D spending). As a result, the management invest their capital based on firms' long-term value regardless of current performance. Moreover, when CEO is also the chairman of the board, higher investment opportunities have higher firm performance.

According to the stewardship theory, role duality can enhance decision making process (Stewart, 1991). Once firms with greater investment opportunities have CEO duality, they can implement decisions rapidly and then promote firm performance. Finally, the negative association between the pledged shares ratio of directors and supervisors and firm performance is weaker for firms with higher growth opportunities. Maybe it is due to that the directors and supervisors of high growth firms need some incentives to make substantial capital expenditures to improve firm performance. Higher pledged shares ratio of directors and supervisors, by providing incentives, can ensure that directors and supervisors make firm value-enhancing decisions.

Although upmost care has been taken, this study has the following limitations. First, this study is essentially a single period, and therefore the results reported here might not contain the long-term effects. Future studies may use time series data to investigate the relevant issues. Second, there may be other important control mechanism variables that could be added to the model. Therefore, future studies may consider the effect of other variables on the whole model in this study.

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Notes

[1] The growth options are similar to call options whose value depends on the likelihood that the management exercise them, including capacity expansion projects, new product introduction, business acquisition, marketing programs and maintenance and replacement of existing assets (Gaver and Gaver, 1993).

[2] Prior researchers point out that growth firms have higher compensation and greater use of stock options (Collins et al.,1995; Gaver and Gaver, 1993; Smith and Watts, 1992), incur higher monitoring costs (Anderson et al.,1993) and have incentives to adopt alternative accounting measures of performance (Bushman et al.,1996; Skinner, 1993) and reporting (Bradbury, 1992).

[3] Agency costs are generated by the conflicting interests and information asymmetries among parties (Jensen and Meckling, 1976).

[4] A high quality audit is generally regarded as one where the auditor both discovers misstatements (discovery) and is willing to report those misstatements (independence) (DeAngelo, 1981).

[5] The Big 4 includes: Deloitte & Touche, Ernst & Young, KPMG and Price Waterhouse & Coopers.

[6] Hutchinson and Gul (2004) examine whether corporate governance variables (including composition of the board, management share ownership and management remuneration) affect the linkages between the IOS and firm performance. They demonstrate the importance of corporate governance for firms with more growth opportunities.

[7] Firms in banking, insurance and security industries are excluded in our sample because of their special characteristics and practices.

[8] The Market Observation Post System of the Taiwan Security Exchange Corporation, the website of the Taiwan Securities and Future Information Center, discloses the required relevant information of the public companies in Taiwan.

[9] The price-based proxies are based on the assumption that growth firms have higher market values, including market value of assets to book value of assets ratio, the market-to-book value of equity ratio and the ratio of gross plant, property and equipment to market value of the firm. The investment-based proxies are based on the assumption that a high level of investment activity is positively related to the IOS, including R&D and sales. Finally, the variance measures are based on the assumption that options become more valuable as the variability of returns on the underlying assets increases, including variance of returns (Hutchinson and Gul, 2004).