

# “Effect of board monitoring on corporate investment and firm performance: Taiwan evidence”

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## Effect of board monitoring on corporate investment and firm performance: Taiwan evidence

### Abstract

This paper examines the monitoring of listed-companies' independent directors. Our evidence from Taiwan shows that board monitoring could be an important factor in investment behavior and firm performance. But the association among those board monitoring, investment and firm performance variables may not exist in linear relationships for the full sample. We therefore apply OLS regression to the whole sample and specify subsamples according to different levels of financial constraints to investigate the fine effect of board monitoring. This study shows that strong board monitoring for firms with few financial constraints is significantly related to the promotion of corporate investment and to the improvement of firm performance in Taiwan. Firms with many financial constraints have little sensitivity between investment and cash flow, and have worse profitability, consistent with the prior literature (Kaplan et al., 1997; Lamont et al., 2001). However, we empirically find that the adoption of independent directors may lower the agency problem for those highly constrained firms, thus resulting in higher investment sensitivity to cash flow and mitigating the association between firm performance and financial constraints. Our findings support that the introduction of independent director rules in Taiwan affects investment behavior and firm performance, particularly among few financial constrained firms.

**Keywords:** independent directors, firm performance, investment behavior.

**JEL Classification:** G30, G34, G38.

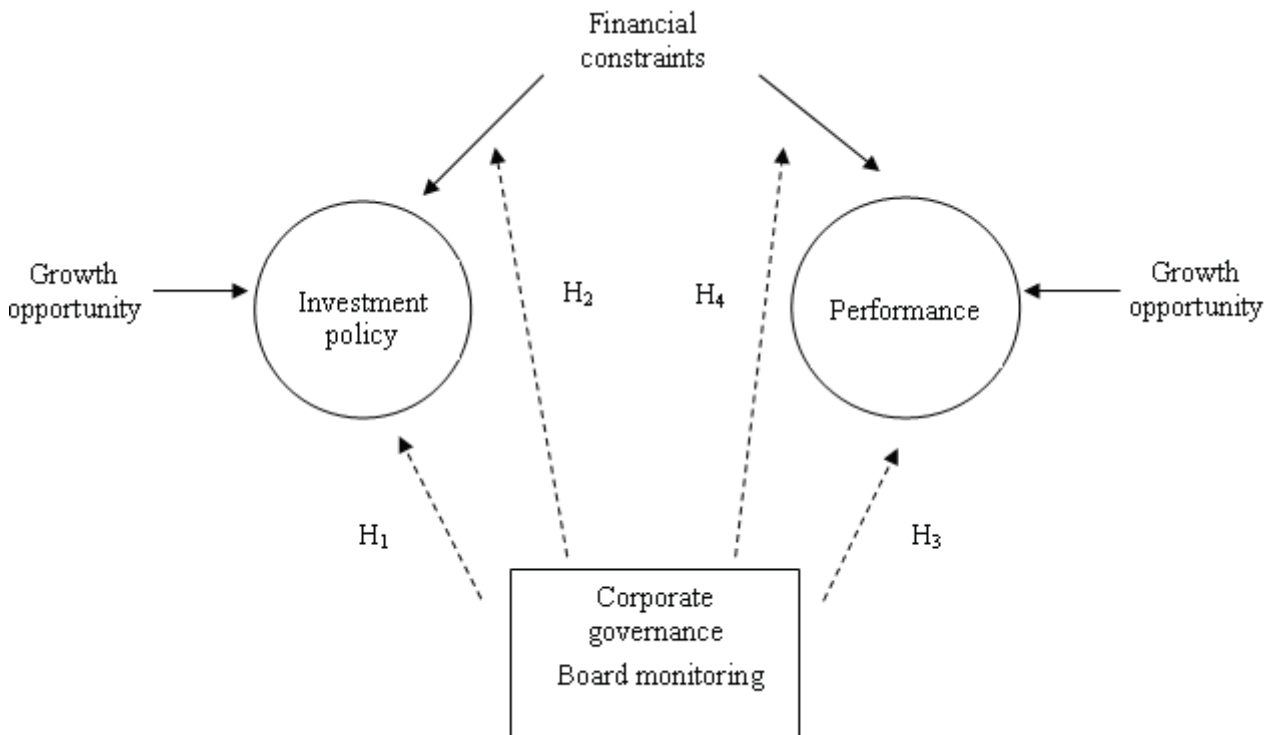
### Introduction

A growing body of literature, building on Myers and Majluf (1984), documents that financial status of firms in an imperfect capital market defined as having asymmetric information, tax and agency problems has been a significant determinant of corporate investment since 1980 (Fazzari et al., 1988; Hoshi et al., 1991; Kaplan et al., 1997; Cleary, 1999). That means that neither expected profitability (growing opportunity) nor financial constraints should be omitted from investment decision models. Since 2001, Enron, WorldCom, Merck and many large corporations have endured a series of scandals. The scandals exposed the weakness of misgoverned firms and then put a new emphasis on corporate governance. Almeida and Campello (2001), Malmendier and Tate (2005) and Chan et al. (2007) all incorporate the variables of moral hazard and corporate governance in their theoretical or empirical investment models. Kang et al. (2006) even point out that models of corporate investment neglecting the role of agency costs are incomplete and find the positive relationship between managers' compensation and corporate investment.

Moreover, previous research has found that an outside director mechanism is helpful for curtailing managers' opportunistic behaviors and affecting firm performance. Researchers propose that the greater proportions of outside directors reduce the possibility of crime and fraudulent reports (Beasley, 1996; Alexander & Cohen, 1999); the greater proportions of outside director benefit firm performance (Rosenstein & Wyatt, 1990; Mayers, Shivdasani & Smith, 1997; Rodriguez

& Anson, 2001 and Hermalin & Weisbach, 2003). We are interested in testing it to see if it is generally applied. Few empirical studies have explored whether financial constraints will influence firm performance. When a firm considers the need for growth and takes the positive net present value (NPV) project, we expect an optimal effect on firm performance. However, financially constrained companies facing higher external capital cost might sacrifice those good investment proposals due to very limited internal capital and lower their performance. This study, therefore, integrates the factors affecting investment spending and firm performance and then examines the effects of strong board monitoring (the adoption of independent director rules as proxies) on corporate investment and corporate performance (see Figure 1).

The results of this study show that board monitoring plays a role in firms' investment behavior and performance. With lower or non-financial constraints, firms invest more as long as they expect investment growth or when there is strong board monitoring (low agency conflict). In addition, those fewer financially constrained firms have significantly positive performance caused by strong board monitoring. Conversely, firms with greater financial constraints perform worse than those with fewer financial constraints, and have less investment-cash flow sensitivity because of their neglect of positive NPV projects. However, the introduction of independent directors may mitigate the investment sensitivity to cash flow and the association between financial constraint and firm performance for those high-constrained firms. This paper investigates the impact of independent director monitoring on investment and performance in relation to financial constraints.



Note: H<sub>1</sub> – H<sub>4</sub>: four hypotheses in this study.

**Fig. 1. Research structure for the effect of strong board monitoring on corporate investment and corporate performance**

The rest of the paper is organized as follows. Section 1 presents a literature review and the hypotheses. Section 2 illustrates the data source and describes the sample. Section 3 analyzes and discusses the empirical results. The last section concludes.

## 1. Hypotheses

Agency problems arise from the conflict of interest between management and stockholders. The board of directors, therefore, should monitor and control management (Fama & Jensen, 1983). Since the Asian financial crisis of 1997, many countries have adopted an independent director to enhance the board's function. Taiwanese government began to introduce regulations for independent directors in 2002. We wonder if the regulation has reduced agency conflict. Under the asymmetric information circumstances, inside managers have more information than outside stockholders and might take investment projects based on their own instead of their shareholders' interest. Can this monitoring mechanism correct investment behavior and improve firm performance?

### 1.1. Agency conflict and corporate investment.

Past investment models include growth opportunity and cash flow as determinants of investment policy (Kaplan et al., 1997; Fazzari et al., 1988). In normal situations, when growth opportunity is good (profitable), firms will invest more money; when cash flow is sufficient, firms also may take positive NPV

projects and increase investment spending. Recent empirical literature asserts that CEO characteristics and agency conflict may also affect investment spending (Malmendier & Tate, 2005; Kang et al., 2006). Therefore, a monitoring and incentive mechanism, designed to encourage investment that is more consistent with shareholder preferences, can lead to increases in firm value. Kang et al. (2006) consider the role of executive compensation structure on investment spending and find that the greater equity-based compensation results in the larger investment spending.

If a good compensation contract (incentive mechanism) mitigates agency conflict and benefits investment behavior, board independence (monitoring mechanism) is expected as a similar contract. Independent directors are expected to protect shareholders' interest and reduce the possibility of moral hazard from managers. Therefore, firms with independent directors will increase investment spending as long as those projects can benefit shareholders. Thus, we hypothesize:

*H1: Ceteris paribus, the adoption of independent directors on the board will be positively related to investment spending.*

**1.2. Cash flow and corporate investment.** A large body of literature investigates the sensitivity of investment to cash flow under financial constraints. Fazzari et al. (1988) contend that financially con-

strained firms need to retain more internal capital in order to meet their investment needs. Therefore, those firms tend to have higher investment-cash flow sensitivity. However, Kaplan et al. (1997) found that firms subject to limited internal capitals and expensive external capital cost may reject the positive net-present-value (NPV) projects, and thus show less investment-cash flow sensitivity than firms with fewer financial constraints. Taking into account the agency problem, Chan et al. (2007) found that firms with fewer agency problems have less possibility of moral hazard, so the investment spending is more sensitive when cash flow increases than those firms with higher agency conflict in terms of high financial constraints.

Important investment proposals need to be approved by a corporate board of directors, so the shareholding percentage of directors, a strong incentive aligning with interest of shareholders, often becomes the measurement of level of agency problem in most of the literature. This study takes the strong board monitoring, adoption of independent director mechanism, as proxies of low agency conflict. Therefore, if a company is financially constrained, the company may reject positive NPV projects and have lower sensitivity between investment and cash flow (Kaplan et al., 1997; Chan et al., 2007). But having independent directors may mitigate this effect. We hypothesize:

*H2: Ceteris paribus, the adoption of independent directors on the board strengthens the association between investment spending and cash flow in terms of higher financial constraints.*

**1.3. Independent director mechanism and firm performance.** Past literature shows mixed results in the relationship between independent directors and firm performance (Rosenstein and Wyatt, 1990; Prevost et al., 2002; Dalton et al., 1998; Rodriguez and Anson, 2001; Bhagat and Black, 2002; Peng, 2004). However, Mayers et al. (1997) and Hermalin and Weisbach (2003) argue that strong board monitoring can promote corporate policy and even improve firm performance. Chhaochharia and Grinstein (2007) investigate the impact of 2002 governance rules in U.S. and find two major phenomena. First, firms which are less compliant with regulations earn positive abnormal returns compared to firms which are more compliant. Secondly, some corporate governance provisions are detrimental to small firms. Wintoki (2007) also asserts that independent director regulation is beneficial to firm value. However, it is harmful to young, small, growth firms operating in uncertain business environments, and that have high monitoring cost from outsiders. Most researchers support the positive

effect of independent directors and many countries implement independent director regulations by legal mandate. Thus, we hypothesize:

*H3: Ceteris paribus, the adoption of independent directors on the board is positively related to firm performance.*

#### **1.4. Financial constraint and firm performance.**

Lamont et al. (2001) find that financially constrained firms have lower stock return than non-financially constrained ones. Previous research has found that the outside director mechanism is helpful for managers' opportunistic behaviors. Beasley (1996) proposes that the more outside directors result in a lower possibility of fraudulent reports. Alexander and Cohen (1999) add that the possibility of crime is significantly weaker if a board is composed of more independent directors. Thus, we expect financially constrained corporations with independent directors to gain a higher credit line due to the possibility of less moral hazard and more transparent information. Therefore, we make the following hypotheses:

*H4: Ceteris paribus, the adoption of independent directors on the board can improve the association between firm performance and financial constraints.*

## **2. Research design**

**2.1. Sample selection.** To analyze the impact of independent board monitoring on investment behavior, we select 362 Taiwan listed companies as a sample, covering the prior and post four years around the introduction of independent director rules (1998-2005). To be included in the sample, only the companies that went public before February 2002 are selected to represent voluntary independent director appointments. Therefore, those newly listed companies complying with a legal mandate will be eliminated. In addition, all financial companies are excluded from the sample subject to the regulatory effects. Sources of the research data are the independent director records in public information observation websites of the Taiwan Stock Exchange Corporations, annual reports of listed companies and the databank of *Taiwan Economic Journal* (TEJ).

According to the grouping method and financial constraint index of Maestro et al. (2003), we first divide the full sample into five groups, highest constrained, higher constrained, average constrained, lower constrained and lowest constrained samples. Based on the descending order of financial constraint index, we set the specific range among the whole financial constraint index and separate one group from others (Appendix). The highest and the

lowest financially constrained firms are selected to make comparative descriptive statistics for all variables. This study then employs multiple regression of least square method to analyze full sample and sub-sample data for testing all hypotheses.

**2.2. Variables.** Independent directors are one of several internal mechanisms (e.g., stock option plan, auditing, insider shareholding and voluntary disclosures) that a firm could use to control agency problems and improve corporate investment and firm performance. Because corporate investment and firm performance may be correlated with other corporate governance and firm-specific factors, we specify the relation using an Ordinary Least Squares (OLS) model where the adoption of independent directors on the board is the independent variable and corporate investment (or firm performance) is a dependent variable. However, because the adoption of independent directors is not the only determinant of corporate investment and firm performance, we control for other determinants of investment policy and firm performance in our OLS model. Furthermore, we separately consider the effect of board monitoring on investment and performance under lowest and highest financial constraints.

*2.2.1. Dependent variable.* In line with Kang et al. (2006), we define investment spending (I+R&D) as the sum of capital expenditure and R&D expenditures (acquisition is excluded due to data being unavailable) in the model specified the relation between corporate investment and board monitoring. In addition, we define firm performance as the industry-adjusted return on total assets (ROA). For the robustness test, we also use industry-adjusted return on total equity (ROE) as a performance indicator. So we have one dependent variable for investment in equation (1) and two variables for performance in equation (2).

*2.2.2. Independent variable and control variables.* In this study, we investigate whether or not improved board oversight has influenced corporate investment and performance. Strong board monitoring is measured by various proxies employed in the prior research, such as independent director ratio, director shareholding percentage and dummy variable of independent director. We use one of the most common: the adoption of independent director regulations (e.g., Dahya et al., 2002). This measure assumes that firms that have independent directors will have stronger board monitoring than firms that do not. The adoption of independent directors on a board (Adopt) is measured as a dummy variable. Adopt is coded 1 if the listed firm has one or more independent directors, and 0 otherwise.

In testing H1 and H2, we control for other factors that may affect investment behavior. For example, growth opportunity and cash flow. Tobin's q often proxies for growth opportunity and it is computed as the market value of equity plus total debt divided by book value of total assets, where the market value of equity is defined as the outstanding market share times stock price per share. Firms with high levels of growth opportunities will have more demand for investment spending (Chapman, Junor & Stegman, 1996; Shin & Park, 1999). Cash flow (CF) is defined as the after tax profit plus depreciation and deferred tax. The relationship between investment and cash flow is mixed due to the different level of financial constraint (Fazzari et al., 1988; Kaplan & Zingales, 1997; Moyen, 2004). Fazzari (1988) suggests that firms with many financial constraints tend to retain more internal capital to cope with the investment need, resulting in higher investment-cash flow sensitivities. However, Kaplan and Zingales (1997) contend that firms with higher financial constraints should have lower investment-cash flow sensitivity due to external expensive capital cost and very limited internal capital. In addition, manager equity-based compensation has been shown to affect investment decision. Kang et al. (2006) find that higher equity-based compensation is positively related to larger investment spending. This study takes independent director monitoring as a mechanism of low agency cost and analyzes its impact on corporate investment and sensitivity of investment to cash flow.

In testing H3 and H4, we control for other factors that may affect firm performance. We first include prior investment spending (the sum of capital expenditure and R&D expenditures) and financial constraints as independent variables. The financial constraints are measured by dummy variables. Lamont et al. (2001) argue that firms that have financial constraints are likely to have lower market returns. Consequently, we use a dichotomous measure D1 for highest financial constraints. D1 is coded 1 if firms belong to the group of highest financial constraint index, and 0 otherwise. Likewise, D2 is coded 1 if firms fall in the group of lowest financial constraint index among all five groups, and 0 otherwise. We separate one group from another by using the order of financial constraint index. A firm having higher financial constraint index will have larger financial constraint (see Appendix). In addition, Firm age (LnFirmage) is measured by the logarithm of the number of years since the firm was listed in Taiwan. Firm size is included as a control variable in the analysis because it has been found to be associated with other firm characteristics (Peng, 2004; Smith & Watts, 1992). Firm size is measured as the book value of total assets, which is logged to normalize the variable and labelled LnAssets. The current financial performance of the firm is likely to be associ-

ated with past performance (Hutchinson & Gul, 2004; Peng, 2004). Prior performance (PriorPerf) is measured by previous years' ROA and ROE. To the extent that debt imposes fixed costs on the firm and increases the possibility of bankruptcy, firm performance should be negatively related to levels of debt. We include leverage as a control variable where leverage is defined as the book value of total liabilities divided by total assets (Debt).

2.2.3. *Model specification.* We test H1 and H2 using the following OLS model:

$$\left[ \frac{(I + R \& D)}{K} \right]_{i,t} = \beta_0 + \beta_1 Adopt_{i,t} + \beta_2 \left[ \frac{CF}{K} \right]_{i,t} + \beta_3 Tobin' q_{i,t} + \beta_4 \left[ \frac{CF}{K} \right]_{i,t} \cdot Tobin' q_{i,t} + \beta_5 \left[ \frac{CF}{K} \right]_{i,t} \cdot Adopt_{i,t} + \varepsilon,$$

where  $(I+R\&D)$ ,  $Adopt$ ,  $CF$ ,  $Tobin'q$  are described in sections 2.2.1.-2.2.2 and  $K$  is defined as net property, plant and equipment.  $\beta_0$  is the intercept and  $\varepsilon$  is an error term which is assumed to be normally distributed with zero mean.

We test H3 and H4 using the following OLS model:

$$Performance_{i,t} = \beta_0 + \beta_1 \left[ \frac{(I + R \& D)}{K} \right]_{i,t-1} +$$

$$+ \beta_2 Adopt_{i,t} + \beta_3 DI_{i,t} + \beta_4 D2_{i,t} + \beta_5 LnFirmage_{i,t} + \beta_6 LnAssets_{i,t} + \beta_7 PriorPerf_{i,t} + \beta_8 Debt_{i,t} + \varepsilon$$

where all dependent, independent and control variables are described in sections 2.2.1.-2.2.2 and  $\beta_0$  is the intercept and  $\varepsilon$  is an error term which is assumed to be normally distributed with zero mean.

### 3. Results

**3.1. Main statistical tests.** Table 1 provides descriptive statistics for all variables related to firm investment and performance. According to the grouping method of Maestro et al. (2003), we use years 1990-1997 as the estimated periods and formulate the financial constraint index from the result of logit analysis in estimated periods. Then we input the data of years 1998-2005 into the formulated equation of financial constraint index to obtain the actual index number for each firm. All index numbers are sorted to five groups based on the order of number, from the highest financial constrained to the lowest financial constrained level (see Appendix). The mean differences between firms with the highest and lowest financial constraints are depicted in Table 1. Interestingly, the mean difference in investment spending between highest and lowest financial constraint has no significance. However, the means of other variables in the least financially constrained firms are significantly higher than those in highest constrained firms except firm age (LnFirmage) and debt ratio (Debt) factors.

Table 1. Descriptive statistics

	Full sample		Subsample Highest financial constraints		Subsample Lowest financial constraints		Statistics	
	Mean	Std.Err.	Mean	Std.Err.	Mean	Std.Err.	T value	P-value
(I+R&D)/k	-0.1111	5.07150	-0.5179	10.9522	0.13230	0.51710	1.32350	0.1860
CF/K	0.40260	10.8283	-0.5915	6.2939	2.25660	21.0824	2.88900	0.0039***
Tobin'q	0.81200	0.75850	0.51000	0.4933	1.06480	1.01860	10.9512	0.0000***
Adopt	0.17130	0.37680	0.13830	0.3455	0.27050	0.44470	5.24650	0.0000***
Rel-ROA	-1.2600	7.57270	-5.7569	9.1567	0.51330	7.34150	11.9344	0.0000***
(I+R&D)/Kt-1	-0.1252	5.44840	-0.2419	3.2643	0.11420	0.59020	2.24330	0.0251**
LnFirmage	2.27510	0.75330	2.37510	0.6427	2.16500	0.63760	-5.1689	0.0000***
LnAssets	15.8451	1.14990	15.7222	1.0979	16.1805	1.28800	6.04890	0.0000***
PriorPerf	-1.0268	7.45740	-3.7562	8.5891	-0.1753	8.19150	6.73940	0.0000***
Debt	0.40860	0.16050	0.45590	0.1873	0.43170	0.15290	-2.2374	0.0255**

Table 2 shows the impact of independent board monitoring on investment behavior. At first, the adoption of the independent director mechanism negatively affects the corporate investment for the full sample. It seems not to support Hypothesis 1. However, financial constraint is a key factor to af-

fect investment policy. The specific effect for firms with different level of financial constraint might be written off in the OLS regression of the full sample. So, we further analyze the impact based on subgroups with different financial constraint. Only for firms with lowest financial constraints, independent

directors support investment spending, and the growth opportunity is also positively significant with corporate investment. These imply that investment behavior is encouraged by independent directors as long as the external financing needs do not constitute a barrier. Thus, we posit that strong board monitoring positively influences corporate investment in terms of few financial constraints. Hypothesis 1 is therefore partially supported. In other words, firms with independent directors alone did not promote corporate investment without considering financial constraints.

More interestingly, the sensitivity of investment to cash flow is significantly positive for low financial constrained firms, consistent with the views of Kaplan et al. (1997) suggesting that those firms would invest in more projects when internal funds are injected and external funds are readily available. However, under high financial constraints, investment spending will not be affected even when cash flow increases, as noted by Almeida and Campello (2001). The higher the growth opportunity is, the lower the investment spending is for those firms. This result implies that high financial constrained firms may sacrifice some investment projects due to the insufficient capital resource.

Nevertheless, considering the interaction of independent directors and cash flow on investment, we find that independent directors significantly increase the sensitivity of investment to cash flow for high financial constrained firms. As long as cash flow increases under the independent director's intervention, those firms will increase investment spending. Our findings empirically clarify that firms with fewer agency problems have less possibility of moral hazard, so their investment spending is more sensitive when cash flow increases than among firms with higher agency conflict in terms of high financial constraints (Chan et al., 2007). In Table 2, the estimated coefficient of investment-cash flow sensitivity for highest financial constrained sample is only -0.0009 with no significance. However, having independent directors (CF/K \*Adop) significantly increases the sensitivity to 3.4726. Therefore, Hypothesis 2 is fully supported.

Table 2. Impact of independent board monitoring on investment behavior

	Full-sample	Highest financial-constrained sample	Lowest financial-constrained sample
Cons	-0.0537 (0.707)	0.0846 (0.157)	-0.0094 (0.675)
CF/K	-0.0498 (0.001)***	-0.0009 (0.935)	0.0431 (0.000)***
Tobin'q	-0.0118 (0.936)	-0.2538 (0.006)***	0.0602 (0.000)***

CF/K *Adop	0.3912 (0.000)***	3.4726 (0.000)***	-0.0689 (0.000)***
CF/K *Tonin'q	0.0581 (0.151)	0.0949 (0.168)	0.0102 (0.008)***
Adopt	-0.7886 (0.002)***	-0.5164 (0.000)***	0.0983 (0.005)***
<i>adj.R</i> <sup>2</sup>	0.1064	0.9932	0.6068

Table 3 provides the multiple regression results for equation 2. At first, we could not find a significant relationship between the adoption of independent directors and performance in full sample. However, similar with the opinions of Wintoki (2007) asserting that independent director regulation is harmful to specific firms, we consider the specific characteristic as financial constraint and find a sub-sample of firms with few financial constraints improved their performance by introducing the independent directors while those with high financial constraint did not. Therefore, Hypothesis 3 is partially supported. In other words, firms with independent directors alone did not definitely perform well without considering firm characteristics like financial constraints. One alternative explanation is that independent director regulation is not beneficial to high financially constrained firms. It provides support for the limitation of "one size fits all" on independent director regulations.

In addition, our study shows that the level of financial constraints may influence the firm performance in Table 3 (4). The lowest financial-constrained firms (D2) perform significantly well and the highest financial-constrained firms (D1) perform poorly, similar to the market-based results of a prior study (Lamont et al., 2001). We want to examine if strong board monitoring can mitigate the association between financial constraints and performance. Since it is not appropriate to multiply two dummy variables, e.g., D1 (2) times Adopt (1, 0), we divide the full sample into two sub-groups: with and without independent directors in Table 4. Although there is still a significant relationship between financial constraints and corporate performance, the adoption of independent directors strengthens the positive relation between D2 and performance and reduces the negative impact between D1 and performance in both their economic and statistical meaning. Therefore, for sub-sample firms with independent directors (Table 4), the coefficient of D2 (lowest financial constraints) is 2.9167, much higher than 0.6676 of the sub-sample firms without independent directors; the coefficient of D1 (highest financial constraints) is -2.4869, less than -2.8511 of sub-sample firms without independent directors.

Moreover, the positive significance between D2 and performance is stronger in firms with independent directors. The former is 0.000, but the latter is 0.072. These results imply that adoption of independent directors can enhance the performance for few financial constrained firms and improve the association between firm performance and financial constraints. Therefore, Hypothesis 4 is supported. Finally, no matter the level of financial constraints, the significant relationship between prior performance or debt proportion and performance remains the same. The higher the prior performance, the better the performance; the larger the debt proportion, the worse the performance.

Table 3. Impact of strong board monitoring on firm performance

	Full sample	Highest financially-constrained sample	Lowest financially-constrained sample
Cons	-4.4008 (0.015)**	-12.4249 (0.034)**	3.3467 (0.357)
(I+R&D)/Kt-1	-0.0294 (0.204)	-0.0566 (0.637)	0.1010 (0.832)
Adopt	0.1741 (0.618)	-0.1324 (0.909)	1.5822 (0.015)**
D1	-2.7666 (0.000)***		
D2	1.1619 (0.001)***		
LnFirmage	-0.6770 (0.003)***	-0.6349 (0.326)	-0.2211 (0.670)
LnAssets	0.5452 (0.000)***	0.8329 (0.025)**	0.1666 (0.469)
PriorPerf	0.4656 (0.000)***	0.4194 (0.000)***	0.4656 (0.000)***
Debt	-8.3555 (0.000)***	-7.2992 (0.034)**	-12.5912 (0.000)***
<i>adj.R</i> <sup>2</sup>	0.3922	0.2394	0.4141

**3.2. Additional tests.** Table 5 replaces the performance variable (i.e., ROA) with ROE. The results are consistent with the empirical findings presented in the preceding section. Therefore, we suggest that strong board monitoring is effective in promoting corporate investment and performance for firms having fewer financial constraints.

Table 4. Effect of strong board monitoring on the association between financial constraints and firm performance

	Full sample	Adopt = 1	Adopt = 0
Cons	-4.4008 (0.015)**	3.2435 (0.429)	-6.9652 (0.001)***

(I+R&D)/Kt-1	-0.0294	-0.0281	-0.0530
	(0.204)	(0.277)	(0.531)
Adopt	0.1741		
	(0.618)		
D1	-2.7666	-2.4869	-2.8511
	(0.000)***	(0.008)***	(0.000)***
D2	1.1619	2.9167	0.6676
	(0.001)***	(0.000)***	(0.072)*
LnFirmage	-0.677	-0.1789	-0.8160
	(0.003)***	(0.784)	(0.001)***
LnAssets	0.5452	-0.0582	0.7446
	(0.000)***	(0.830)	(0.000)***
PriorPerf	0.4656	0.5886	0.4255
	(0.000)***	(0.000)***	(0.000)***
Debt	-8.3555	-7.1942	-8.8881
	(0.000)***	(0.002)***	(0.000)***
<i>adj.R</i> <sup>2</sup>	0.3922	0.4264	0.3867

Table 5. Impact of board monitoring and financial constraint on firm performance

	Full sample	High financial-constrained sample	Low financial-constrained sample
Cons	-12.1110 (0.006)***	-43.0398 (0.003)**	-3.1487 (0.712)
(I+R&D)/Kt-1	-0.08356 (0.138)	-0.0287 (0.924)	1.6374 (0.143)
Adopt	0.9512 (0.262)	0.1957 (0.946)	2.9312 (0.053)*
D1	-6.8392 (0.000)***		
D2	2.6141 (0.001)***		
LnFirmage	-1.3755 (0.012)***	-0.4588 (0.775)	-1.6410 (0.177)
LnAssets	1.5386 (0.000)***	3.5872 (0.000)**	0.8467 (0.118)
PriorPerf	0.4258 (0.000)***	0.3378 (0.000)***	0.4181 (0.000)***
Debt	-27.5529 (0.000)***	-51.8118 (0.000)**	-16.6961 (0.000)***

**Conclusion**

This study has examined the impact of independent board monitoring on investment and firm performance in Taiwan. We have arrived at four findings. Firstly, our results show that strong board monitoring significantly affects investment behavior. We thus add more evidence that agency cost can influence corporate investment, consistent with Kang et al. (2006). Secondly, we establish that high finan-



cially constrained firms with lower agency conflict can mitigate the sensitivity between investment and cash flow, which is only theoretically suggested by Almeida and Campello (2001) and Chan et al. (2007). Third, we find that the introduction of independent directors is beneficial to firms subject to low financial constraints. Finally, this study shows that strong board monitoring can improve the association between financial constraints and firm per-

formance. The empirical results obtained from cross-sectional tests of 362 Taiwan listed firms indicate that the adoption of the independent directors indeed influences corporate investment and performance, particularly for the firms with the fewest financial constraints. Our evidence suggests that firms with fewer financial constraints can enhance their board monitoring to promote investment and performance.

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**Appendix**

Based on the grouping standard of Maestro et al. (2003, p. 28), we utilize the data of 1990-1997, which are specified as financially constrained and financially unconstrained firms, to test the following formula of financial constraint by using binominal logit regression.

$$FC = \beta_0 + \beta_1 PR + \beta_2 SIZE_t + \beta_3 SLACK + \beta_4 WCV_t + \beta_5 INTCOV + \beta_6 GROWTH + \beta_7 CFV,$$

where *FC* represents financial constraint. If the firms belong to the financially constrained group, we code 1 for *FC*; if the firms belong to financially unconstrained group, we code 0 for *FC*. The definitions of related variables are explained as follows:

(1) *PR*: It represents payout ratio. The reduction in dividend payments is calculated as the difference between the value of the funds that should have been distributed so as to maintain the payout ratio of the previous period (*MPR<sub>t</sub>*), and the dividend payments in period *t* (*DIV<sub>t</sub>*). Consequently,  $\Delta MPR_t = MPR_t - DIV_t$ , where *MPR<sub>t</sub>* may be obtained from equating the payout ratio of the current period with the payout ratio of the previous one, that is:

$$\frac{MPR_t}{BN_t} = \frac{DIV_{t-1}}{BN_{t-1}}$$

then

$$MPR_t = \frac{DIV_t}{BN_{t-1}} * BN_t = PR_{t-1} * BN_t.$$

(2) *SIZE* is often used to discriminate between financially constrained and unconstrained firms. Thus, firm size could be considered a proxy for transaction costs, that is:

$$SIZE_t = LN(TA_t)$$

*TA* : Total asset

$$(3) SLACK_t = \frac{\Delta FAS_t - (\Delta LTD_t + \Delta S_t)}{TA_t}$$

$\Delta FAS_t = FAS_t - FAS_{t-1}$ , *FAS*: Financial assets

$$(4) WCV_t = (Current\ assets - Current\ liabilities) / TA_t$$

$$(5) INTCOV_t = earnings\ before\ interest\ and\ taxes / interest\ expense$$

$$(6) GROWTH_t = (SALES_t - SALES_{t-1}) / SALES_{t-1}$$

$$(7) CFV_t = CF_t / TA_t, CF: Cash\ flow$$

We obtain the coefficient of  $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$  and  $\beta_7$  respectively in Table 6 and find that all independent variables are significantly related to financial constraint index (*FC*) except *INTCOV*.

Table 6. The relationship between financial constraints and related variables

FC	Coef.	Std. err.	z	P>z	[95%	Conf. interval
CONS	-12.0369	0.948525	-12.69	0	-13.8959	-10.1778

Table 6 (cont.). The relationship between financial constraints and related variables

PR	-5.5536	0.472869	-11.74	0	-6.48044	-4.62682
SIZE	0.7773	6.25E-02	12.44	0	6.55E-01	9.00E-01
SLACK	-0.000000085	2.81E-08	-3.01	0.003	-1.40E-07	-2.96E-08
WCV	1.8739	0.352168	5.32	0	1.183623	2.564095
INTCOV	0.000002920	0.000017	0.17	0.864	-3.1E-05	3.63E-05
GROWTH	-0.9658	0.185627	-5.2	0	-1.32962	-0.60197
CFV	-3.7977	0.82684	-4.59	0	-5.41831	-2.17716

Therefore, we can formulate the estimated equation of financial constrain index as follows:

$$FC = -12.0369 - 5.5536PR + 0.7773SIZE_t - 0.000000085SLACK + 1.8739WCV_t + 0.000002920INTCOV - 0.9658GROWTH - 3.7977CFV$$

This study then inputs the data of 1998-2005 to gain the actual financial constraint index (from maximum 95.7586 to minimum -1402.41, total 2495 observations) and accordingly divides those numbers into five groups. We separate one group from others by sorting the index number, e.g., from lowest constrained firms to highest constrained ones.