

Corporate Governance and Risk-Taking Strategies with D&O Liability Insurance Protection

Abstract

This study provides empirical evidences regarding firm behavior in risk-taking when the top management is covered by directors' and officers' (D&O) insurance. By way of 3SLS simultaneous equations models and eight risk-taking strategies, we test whether insured firms are more aggressive in adopting risky strategies because D&O insurance may affect the quality of corporate governance and influence firm risk-taking. The findings show that D&O insurance has a positive impact on board independence. The empirical evidence also indicates that firm risk-taking strategies are significantly related to board independence and D&O insurance coverage. D&O insurance presents a moderating effect on board independence for risk-taking strategies. The firms with more independent directors are more aggressive in taking risks, which aligns with shareholders' interests and mitigate litigation risk, and thus demand less D&O insurance amount. Additionally, the influential power of the board independence and D&O insurance may vary with the corporate ownership structure and macroeconomic environment.

Keywords: risk-taking strategies, D&O insurance, corporate governance,
managerial incentives

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1. Introduction

Directors and officers (D&O) have fiduciary duties to shareholders and they monitor management and strategic directions for the business. They are very important in corporate governance. However, the recent corporate scandals in the U.S. and other countries have undermined investors' trust on the integrity of directors and officers. If directors do not diligently perform their duties, then agency conflict may arise in the manager-shareholder relationship.¹ In an attempt to recover investors' confidence in management, most countries have implemented corporate governance reforms, e.g., the Sarbanes-Oxley Act of 2002 in the U.S. (SOX). According to these updated regulations, directors can be held personally liable for their performance which may cause them to face significant financial risk. As indicated by Wiseman and Gomez-Mejia (1998), bearing too much risk may increase risk aversion. Risk-averse directors require insurance protection or extra compensation as a condition of service (Core, 1997).

Shareholders would prefer to invest in all positive net present value projects, irrespective of the risk level (Carpenter, Pollock and Leary, 2003). However, top management does not accept some value-enhancing projects simply because these projects may increase firm risk-taking. Wright et al. (2007) assert that officers may be concerned about the loss of their jobs and personal income in the event of underperformance or bankruptcy due to risk-taking activities. Low (2009) further indicates that risk-averse managers might decline risk-increasing but positive net

¹ The dominant source of D&O risk is shareholder litigation. According to Tillinghast-Towers Perrin (2004) survey report, about 57% of directors' and officers' lawsuits for publicly held corporations were brought about by shareholders.

present value projects preferred by shareholders, just to protect their undiversifiable human capital and wealth obtained from the firm. Consequently, underinvestment prevails due to the risk aversion of the top management. Even if risk-taking strategies can increase firms' values and shareholders' wealth, officers may have the propensity to reject these projects to maintain existing benefits (Williams, 1987). This difference in risk preference between managers and shareholders may lead to serious managerial agency conflict.

Since managerial risk aversion is a potential and serious agency problem, incentive compensation contracts are commonly used mechanisms to align the interests of management and shareholders as well as to overcome managerial risk aversion (Low, 2009). Recent incentive compensation literatures have demonstrated that risk incentive effects of compensation components may be broadly divided into fixed salary and cash bonus, stock and options (Cole, Danel, and Naveen, 2006). However, empirical evidence shows that the effect of equity-based compensation in alleviating the risk-related agency conflicts is inconclusive. There are still a number of uncovered factors that significantly influence directors' and managers' risk-taking behavior.

According to Holderness (1990), D&O insurance probably can reduce the cost of compensating risk-averse directors and officers, and consequently may encourage them to take appropriate business risks. D&O insurance protects directors and managers from lawsuits connected to their corporate positions and performance. In general, a typical D&O insurance policy includes three parts of coverage (Chung and Wynn, 2008): personal coverage for directors and officers, reimbursement for firm's indemnities to its directors and officers, and the entity coverage for firm's own liability. Some companies regard D&O insurance as a part of the compensation package in order to attract highly qualified directors and officers to sit on their boards (Core, 1997). Lin et al. (2013)

show that higher levels of D&O insurance coverage are associated with greater credit risk. Consequently, we expect that directors and officers are more willing to take aggressive strategies (or risky projects) and pursue more benefits for shareholders when they are covered by D&O insurance protection.

This paper examines the relationship between D&O insurance coverage, board structure, and firm risk-taking strategies based on data of public firms in Taiwan. We try to study (1) whether D&O insurance has an impact on the quality of corporate governance; (2) whether the quality of corporate governance influences a firm's risk-taking; and (3) whether firms are more active in adopting risk-taking strategies when their directors and officers are covered by D&O insurance. The relationship between firm's risk-taking strategies, corporate governance and D&O insurance is analyzed under COSO-ERM framework (COSO, 2004) because the three elements are connected to one another.

Although numerous studies have investigated the relationship between board structure and firm risk-taking (Akhigbe and Martin, 2008; Pathan, 2009), they have not taken into account the concept of enterprise risk management (ERM) which emphasizes integration of corporate risks. ERM is an innovation of SOX (section 404 of SOX; Chapman, 2006). Under ERM, a firm must achieve its goals of risk-taking strategies with overall consideration of board structure, risk culture and risk management methods such as insurance. Therefore, this paper treats risk-taking strategies, board structure, and D&O insurance as an integrated business decision, and conducts the analysis based on the 3-stage least squares simultaneous equations models (3SLS SEMs). Wooldridge (2002) suggests that system estimation method 3SLS SEMs is generally more efficient than estimating each equation by OLS or 2SLS SEMs when there exists endogeneity among the decision variables.

The risk-taking strategies investigated in this paper include several aspects: (1) risks related to stock price volatility, (2) risky investments such as capital expenditure and R&D expenditure, (3) liquidity and bankruptcy risk, and (4) volatility in business incomes. Because a firm is a nexus of many stakeholders including shareholders, employees, customers, etc., its risk-taking strategies must consider the interests of all stakeholders as indicated in ERM.

The result shows that D&O insurance has a significantly positive relation with the board structure. The firms with higher board independence and less leadership duality will purchase more D&O insurance. The board independence will encourage the firm to take more risky strategies, but D&O insurance amount presents a moderating effect on the risk-taking behavior due to the monitor of insurance underwriting process. The empirical result based on 3SLS SEMs is more consistent with theoretical prediction than that based on traditional multiple regression. The finding implies that corporate governance, risk-taking strategies, and risk management method (D&O insurance) are connected to each other and must be analyzed as a system as suggested by COSO-ERM framework.

This study links firm risk-taking behavior, corporate governance and D&O insurance based on data with civil law origin. Most previous literature is based on the data of North America and UK, where common law is applied. The results of this paper will provide additional comments on the role of D&O insurance in the traditional conflict of interest between directors/officers and stakeholders. According to La Porta et al. (2002), there is usually less investor protection in civil-law countries. This paper extends the literature on corporate insurance demand by giving further evidence on risk-taking motivation.

The remainder of this study is organized as follows. Section 2 provides a review of

literature related to this topic and followed by the testing hypotheses. Section 3 describes the data, variables, and research methodology. The empirical result is presented in Section 4 and followed by a robustness check in section 5. Then the conclusion is in Section 6.

2. Literature Review and Hypotheses Development

How to overcome managerial risk aversion and induce aggressive risk-taking behavior has been extensively studied in previous literature. Wright et al. (2007) suggest that managerial incentive has a significant impact on firm risk-taking strategies. Low (2009) provides empirical evidence that equity-based compensation affects managers' risk-taking behavior and consequently impacts shareholders' benefits. However, the effect the of D&O insurance, which is regarded as a compensation package for directors and managers, on the firm risk-taking strategies is still unknown.

The role of D&O insurance on managerial incentive has been argued for its two contrasting effects: effective monitoring hypothesis and managerial moral hazard hypothesis (Wynn, 2008). Jensen (1993) considers that D&O insurance can alter managers' risk-taking attitudes if they are exposed to litigation risk from stakeholders. Kim (2005) also suggests that D&O insurance protection against litigation can prevent directors and officers from taking overly risk-averse business strategy. Chung and Wynn (2008) indicate that firms tend to use D&O insurance to approximate the expected legal liability and potential future losses resulting from lawsuits against firms and managers. Core (1997) asserts that when firms are protected with D&O insurance, their directors and officers become effectively less risk averse and less likely to reject attractive new risky projects.

On the other hand, Mayers and Smith (1982) argue that insurers scrutinize the

insured firms and play an important monitoring role. Since D&O insurers are the final risk taker in case of litigation, they have incentives to correctly assess the probability of litigation risk which is usually associated with the quality of corporate governance of the insured. Therefore it is expected that D&O insurance may discourage excessive risk-taking to avoid financial distress and litigation risk. Cao and Narayanamoorthy (2009), using D&O insurance as a litigation risk proxy, show that litigation risk has a positive impact on forecasts of management earnings. Core (2000) concludes that D&O insurance premiums influence business risk and corporate governance quality.

In summary, most of the previous literature suggests that D&O insurance has an important impact on corporate governance and firm risk-taking strategies although there is no consistent evidence whether the effect is positive or negative. Therefore, this paper intends to test the following hypotheses.

H1a: Firms will have better corporate governance when their directors are covered by D&O insurance.

H1b: Firms will have better risk-taking strategies when their directors are covered with D&O insurance.

Previous studies also paid attention to the impact of corporate governance on a firm's strategic behavior. Cornett et al. (2008) argue that board structure has an apparent impact on earnings management. The empirical evidence of Cheng (2008) shows that smaller board size is associated with more firm risk-taking. Wang (2012) also finds that smaller board may encourage more risky investment. John, Litvo and Yeung (2008) further indicate that more effective monitoring from strong corporate governance may mitigate manager's risk-averse behavior and results in higher risk-taking and value-enhancing strategies. These evidences imply that board structure is important for deciding firms' risk-taking strategy.

Bargeron, Lehn and Zutter (2010) show that the adoption of SOX is associated with a subsequent decline in corporate risk-taking. Because SOX emphasizes risk management (section 404),² it can create an adverse effect on firm risk-taking. Shadab (2008) shows a negative relation between SOX and corporate risk-taking because SOX enhances the role of independent directors in corporate governance. The increased role for independent directors is likely to adversely affect corporate risk-taking. Previous research showed that new regulations of corporate governance which emphasize on internal control and ERM discourage corporate risk-taking. Wintoki (2007) find evidences consistent with the view that SOX has adversely affected corporate risk-taking.

In summary, the relationship between corporate governance and risk-taking strategies are still inconclusive in the literature. This paper considers the board and the risk-taking strategies are bilaterally associated. A firm prefers more risk-taking may invite more independent directors to mitigate the risk-averseness of inside directors. On the other hand, the board with more independent director will prefer to take more risky strategies.

As the new regulation of governance enhances the role and liability of directors, many public firms purchase D&O insurance for their directors. Priest (1987) indicates that in the US and Canada it is difficult for companies without D&O insurance to have capable independent directors. That is, the board directors may request the firm to purchase D&O insurance for them. However, the existing studies do not have a conclusion on the relationship between D&O insurance and firm risk-taking strategies. Some argue that business strategies may be more active and aggressive if the directors'

² Section 404 of SOX requires public companies to evaluate and disclose the adequacy of their internal controls in annual reports. The companies are required to disclose the information about internal control and enterprise risk management in their annual reports, including (1) a statement of management's responsibility for establishing and maintaining adequate risk management, (2) identification of the framework to evaluate the adequacy of enterprise risk management, and (3) disclosure of any "material weaknesses" in the system of internal controls.

and managers' legal liabilities can be easily reduced with D&O insurance, while others assert that D&O insurance underwriting process will monitor the risky behavior. Since the empirical evidences are inconclusive, this paper intends to conduct further analyses and test the following hypotheses.

H2a: Firms will purchase more D&O insurance when the board structure is stronger.

H2b: Firms will have better risk-taking strategies when the board structure is stronger.

Gutierrez (2003) reminds the moral hazard effect of D&O insurance. Chalmers, Dann and Harford (2002) find that managers' opportunistic behaviors are related to D&O insurance decisions. However, the moral hazard effect of D&O insurance is still unclear because of the limited number of studies on this issue. On the other hand, Core (2000) shows that D&O insurance premium can reflect the quality of corporate governance and business risks. Gillan and Panasian (2014) find that board size and board independence are associated with higher premium. These studies imply that D&O insurance has a monitoring effect on the risk-taking behavior in order to reduce the claim costs because the insurer underwriting process may reject the high-risk board. However, the overall effect of D&O insurance is still unclear because of the limited number of studies on this issue.

One of the problems in previous studies about firm risk-taking behavior is that they separate the effects of D&O insurance and corporate governance. Those papers analyze the impact on risk-taking from either D&O insurance or corporate governance, but not both. Priest (1987) indicates that in the US and Canada it is difficult for companies without D&O insurance to have capable independent directors. That is, the board directors may request the firm to purchase D&O insurance for them. On the other hand, D&O insurers will assess governance structures and firm risk-taking when they sell insurance. Baker and Griffith (2007) show that governance structure plays an

important role on pricing decision of D&O insurers. Therefore, as most of the public firms covered with D&O insurance, the combined effect of D&O insurance and corporate governance on firm risk-taking strategies should not be ignored.

COSO-ERM framework provides an integrated view for the stability of business operation. Risk-taking strategies are to achieve the strategic objective of a firm, which is affected by the board of directors. The directors are crucial for corporate governance and risk-taking, and they also encounter the challenges from stakeholders. It is expected that a firm will have more rational risk-taking strategies if it has better board for corporate governance and pays more attentions to risk management. This paper considers the three elements, D&O insurance, corporate governance, and risk-taking strategies as a system and affecting one another.

In the literature higher-quality corporate governance usually is referred to the board with a higher proportion of outside directors, smaller board size and lower leadership duality. These characteristics imply a greater efficiency in monitoring directors' and officers' behaviors, which in turn encourages better risk-taking strategies in aligning risk preferences among stakeholders. Better risk-taking strategies usually will result in more stable operations and better growth potential. However, better risk-taking strategies should also satisfy the shareholders' preference so as to cause less litigation risk.

Another inconsistent argument in the literature is about the relationship between corporate governance structure and business strategies. Wright et al. (2007) find that higher proportions of outside directors may generate greater pressures for firm's risk-taking and innovation. Pathan (2009) concludes that a strong board structure should relate positively to risk-taking behavior. On the other hand, Barger, Lehn and Zutter (2010) and Shadab (2008) show that SOX is associated with a subsequent decline in corporate risk-taking because SOX enhances the role of independent directors.

Chhaochharia and Grinstein (2007) find that firms less compliant with the SOX provisions earn positive abnormal returns compared with the more compliant firms. That is, these studies imply that the stronger board takes less risky strategies.

One of the reasons for the inconsistent findings about the relationship between risk-taking behavior and governance quality results from the different risk-taking strategies studied in the literature. Therefore, this paper distinguishes risk-taking strategies into four categories to clarify the impact of governance quality. Better risk-taking strategies implies (1) more risky investment for future growth, (2) more stock return volatility, (3) less volatility in business incomes, and (4) less bankruptcy risk. More risky investment and stock return volatility usually can reward more wealth to the shareholders, and consequently result in less litigation from the shareholders and less D&O demand. On the other hand, less volatility in business incomes and less bankruptcy risk imply sound financial management and more protections to the stakeholders, which can reduce the litigation risk and the demand for D&O insurance.

In summary, the relationship between firm risk-taking strategies, board structure, and D&O insurance demand are not conclusive in the literature which probably results from the difference in the risky strategies studied or the methodologies applied. Therefore, this paper would like to reexamine these issues with ERM consideration and study them as an integrated system. The testing hypotheses are as follows.

H3a: Firms will have stronger board when the risk-taking strategies are better.

H3b: Firms will purchase less D&O insurance when the risk-taking strategies are better.

3. Sample and Research Methodology

3.1 Data and Variables

This paper retrieved the annual reports of all the publicly listed and OTC firms in

Taiwan from the public information data bases, including the Taiwan Economic Journal (TEJ), Taiwan Stock Exchange Corp. (TSEC), and Market Observation Post System (MOPS) for year 2007-2010. The total number of firms is 5309. However, financial institutions are excluded because risk management is required by the regulations. Finally the number of firms included in the sample is 5136. The variables for D&O insurance, governance quality, risk-taking strategies, and firm characteristics are retrieved from the public data bases including TEJ, TSEC, and MOPS as indicated in the above.

The firm's risk-taking strategies for business continuation and growth include (1) capital expenditure ratio (*CAPEXr*), (2) research and development expenditure ratio (*R&Dr*), both of them implies risky investment, (3) holding of cash and short term securities ratio (*CASHr*) to maintain liquidity. These three ratios are the dollar amounts divided by total assets to mitigate the effect of firm size as suggested by Barger et al. (2010). According to Panthan (2009), the risk-taking strategies related to volatility of stock returns are (1) total risk of stock returns (standard deviation of daily stock returns, *TR*), (2) idiosyncratic risk of stock returns (standard deviation of error terms in forecasting equation for daily stock returns, *IDIOR*), and (3) systematic risk of stock returns (beta on market portfolio, *SYSR*). The risk-taking strategies related to stability of business operation include (1) volatility of returns on assets (standard deviation of ROA, *StdROA*), and (2) bankruptcy risk. Bankruptcy risk is calculated based on *Z-score* as in Boyd, Graham and Hewitt (1993), where $Z = 1/\{[\text{ROA} + \text{equity/assets}]/\text{StdROA}\}$.

Quality of corporate governance is represented by the board structure because the board is the decision maker. According to Linck, Netter, and Yang (2008), the board structure primarily emphasizes on board independence, leadership duality, and board size. Board independence (*IND*) is defined as the proportion of the outside directors in the board. Leadership duality (*DU*) means the CEO also the chairman of the board

(COB), represented by a dummy variable equal to 1 if CEO=COB and 0 otherwise. Board size (*BSize*) is the total number of directors on the board.

D&O insurance are represented by two measurements. First, a dummy variable *DOyes* is assigned for carrying D&O insurance or not, and equals 1 if the firm with D&O insurance or 0 otherwise. The second measurement is the coverage amount of D&O insurance (*DOamt*). To curtail the influence of nonlinearity, the logarithm of D&O insurance amount (*lnDO*) is used for the regression analyses.

Several firm characteristics variables are included to control the individual differences in firms. The stock-holding percentage by all directors (*DIR*) is selected because they are relevant to corporate governance (Core, 1997). The variable for measuring the financial strength is debt ratio. Debt ratio (*DEBT_r*) is equal to the book value of debts to book value of assets. Firms with potential growth opportunity usually take more risky strategies and thus market-to-book value of equities (*MTB*) is taken as the proxy for growth opportunity as Gaver and Gaver (1993). *AdjROA* is firm i's ROA adjusted by its industry ROA and traditionally an accounting measurement for business returns. *AdjAVGR* is firm i's average stock returns adjusted by its industry average stock returns, which is usually associated with the risk of stock returns. These two variables are applied alternatively for risk strategies related to accounting returns or stock returns, instead of in the same equation. High technology firms usually have more risky investments and higher fluctuations in stock returns or business returns. Therefore, a dummy variable *TECH* is assigned one for high-technology industry and zero for others. The descriptive statistics of the sample are summarized in table 1.

Table 1 Summary of the Sample Statistics

Variable	N	Mean	Std Dev	Minimum	Maximum
<i>DOyes</i>	3683	0.531	0.499	0	1
<i>DOamt</i>	3683	140286	321672	1	6572000
<i>IND</i>	4960	0.460	0.218	0	1
<i>DU</i>	4970	0.283	0.450	0	1
<i>Bsize</i>	4970	9.422	2.312	3	32.
<i>TR</i>	4827	3.001	1.495	0.77	43.99
<i>IDIOR</i>	4827	2.619	1.267	0	26.39
<i>SYSR</i>	4828	0.795	2.313	-121.31	32.5
<i>CAPEXr</i>	4922	0.022	0.068	-1.154	0.83102
<i>R&Dr</i>	5020	0.025	0.041	0	0.64066
<i>CASHr</i>	5029	0.125	0.132	0	0.88495
<i>StdROA</i>	5027	1.706	2.403	0.02	39.33
<i>Z-score</i>	4821	0.094	3.737	-130.731	155.095
<i>DIR</i>	4829	20.309	13.334	0	87.83
<i>DEBTr</i>	5029	0.359	0.175	0.00125	1.236
<i>AdjAVGR</i>	4827	0.039	0.635	-6.9	23.330
<i>AdjROA</i>	4829	0.157	10.133	-107.4	78.51
<i>MTB</i>	4821	3.226	4.500	0.045	89.99
<i>TECH</i>	4829	0.632	0.482	0	1

3.2 Research Methodology

Then firm risk-taking strategies are analyzed under internal risk management environment, including corporate governance and D&O insurance protection. Firm risk-taking strategies include the eight measurements such as capital expenditure ratio, total risk of stock returns, bankruptcy risk, etc. as described in the above.

This paper first compares the board structure, firm characteristics, and risk-taking strategies between the firms with and without D&O insurance protection because insurance protection may have an impact on board structure and firm risk-taking strategies. A firm with D&O insurance protection, no matter what coverage amount, is categorized in the group of *DOyes* =1, otherwise is grouped as firms without insurance

$DOyes = 0$. This method is similar to the matched-sample method used by Chhaochharia and Grinstein (2007). T-test is applied to compare the means of several variables to provide initial knowledge about the influence of D&O insurance protection.

Next, regression analyses are applied to study the relationship among firm risk-taking strategies (RISK), corporate governance (CG), and D&O insurance (DO). The testing models are listed as follows. These three equations are analyzed by 3-stage least squares (3SLS) simultaneous equations models because probably there is endogeneity among the three constructs. According to Wooldridge (2002), 3-stage least squares (3SLS) simultaneous equations models (SEMs) is generally more efficient than estimating each equation by OLS or 2SLS. The equations are shown as follows.

$$\ln DO_{it} = \beta_0 + \beta_1 RISK_{it} + \beta_2 CG_{it} + \sum \beta_j \text{FirmCharacteristics}_{it} + \varepsilon_{it} \quad (1)$$

$$CG_{it} = \lambda_0 + \lambda_1 RISK_{it} + \lambda_2 DOyes_{it} + \sum \lambda_j \text{FirmCharacteristics}_{it} + \nu_{it} \quad (2)$$

$$RISK_{it} = \varphi_0 + \varphi_1 CG_{it} + \varphi_2 \ln DO_{it} + \sum \varphi_j \text{FirmCharacteristics}_{it} + \omega_{it} \quad (3)$$

In equations (1) and (3), the impact of D&O insurance is measured with the coverage amount $\ln DO$ because more risk and stronger board may need more insurance protection. In equation (2) D&O insurance is measured with the dummy variable $DOyes$ because the presence of insurance itself, instead of amount, may affect the invitation of independent directors as indicated by Priest (1987). The insurance coverage amount is purchased with consideration of many factors such as capitals and industry type in addition to board structure. The board independence usually is significantly related with the insurance purchase decision (yes/no) but not the coverage amount although the board size may affect the level of coverage.³

³ The Pearson correlation for the variables of this paper also supports this argument that board independence is related to $DOyes$ but not the coverage amount.

Corporate governance (*CG*) in equation (1) included board independence, duality and board size because all the three may influence the demand of D&O insurance. *CG* in equation (2) is dependent variable and thus simply represented by board independence because the empirical findings in the literature are more consistent for this variable than those for duality and board size (Linck et al., 2008). Again, *CG* in equation (3) is also represented by board independence only since it is the most important governance measurement and too many variables may cause collinearity problem. In all three equations, *RISK* is one of the eight risk strategies and will be studied one by one.

The control variables for firm characteristics are somewhat different in the three equations to avoid the problem of rank in simultaneous equations models where the same instruments cannot be used for every equation (Wooldridge, 2002). The variables of firm characteristics are chosen based on previous literature and selected through OLS and stepwise regression for each equation, and those candidates with higher explanation power (R^2) and consistent prediction sign are taken as final variables for the 3SLS simultaneous equations models. The final models for empirical testing are listed as follows.⁴

$$\ln DO_{it} = \beta_0 + \beta_1 RISK_{it} + \beta_2 IND_{it} + \beta_3 DU_{it} + \beta_4 BSize_{it} + \beta_5 DIR_{it} + \varepsilon_{it} \quad (1')$$

$$IND_{it} = \lambda_0 + \lambda_1 RISK_{it} + \lambda_2 DOyes_{it} + \lambda_3 adjROA_{it} + \lambda_4 TEC_{it} + \nu_{it} \quad (2')$$

$$RISK_{it} = \varphi_0 + \varphi_1 IND_{it} + \varphi_2 \ln DO_{it} + \varphi_3 DEBTr_{it} + \varphi_4 MTB_{it} + \varphi_5 adjROA_{it} + \varphi_6 TEC_{it} + \omega_{it} \quad (3')$$

4. Results

The comparisons for the differences in risk-taking strategies, corporate governance,

⁴ The explanatory variable *adjROA* in equations (2') and (3') is replaced with *adjAVGR* when the dependent variable *RISK* is related to stock returns, such as *TR*, *IDIOR*, and *SYSR*. If *RISK* is related to accounting measurements, such as *CAPEXr*, *R&Dr*, *CASHr*, *StdROA*, and *Z-score*, then *adjROA* is used.

and firm characteristics between the firms with and without D&O insurance are shown in Table 2. The firms with D&O insurance show significantly higher means of board independence and board size, but not duality. This finding supports the argument that D&O insurance helps to invite the independent directors. The difference in share holding % by all directors *DIR* is also significant between two groups of firms. The firms with D&O insurance are less hold by the directors and thus have higher chance to be sued by other shareholders.

Regarding the risk-taking strategies, the finding shows that total risk and idiosyncratic risk of stock returns of firms with D&O insurance are significantly higher, but systematic risk is insignificantly lower. Since systematic risk result from macroeconomic environment, the D&O insurance probably cannot have direct contribution. The means of Capital expenditure and R&D spending are significantly higher in firms with D&O insurance. The mean of cash holding is also significantly higher in firms with D&O insurance. The differences in the means of income volatility (*StdROA*) and bankruptcy risk (*Z-score*) are not significant. These results imply that the D&O insurance protection may encourage the firms taking more risks to pursue the business growth but do not contribute to the stability of operation. However, this is only an initial outcome and more detailed analyses are required to understand the impact of D&O insurance on the risk-taking strategies.

In the financial aspects, the mean of debt ratio for firms with D&O insurance is significantly lower which probably is due to the scrutiny in underwriting process. The firms with poor financial strength may have difficulty in acquiring insurance since the insurer must consider the potential claim cost. *MTB* is significantly higher for the firms with D&O insurance, which again supports the contribution of insurance protection to the business growth. The performance indicators *adjROA* and *adjAVGR* are not significantly different between the two groups of firms. Industry type shows

significant difference between two groups of firms. The group with D&O insurance contains more high technology firms than the other group.

Table 2. Comparisons between the Firms with and without D&O Insurance

Variable	DO-no		DO-yes		t Value	Pr > t
	Mean	(std.dev)	Mean	(std.dev)		
<i>IND</i>	0.408	(0.219)	0.507	(0.205)	-14.13***	(<.001)
<i>DU</i>	0.296	(0.457)	0.284	(0.451)	0.86	(0.390)
<i>Bsize</i>	9.342	(2.598)	9.473	(2.002)	-1.72 ⁺	(0.085)
<i>TR</i>	2.968	(1.549)	3.083	(1.594)	-2.21*	(0.028)
<i>IDIOR</i>	2.567	(1.105)	2.657	(1.442)	-2.10*	(0.036)
<i>SYSR</i>	0.825	(0.963)	0.788	(3.149)	0.47	(0.636)
<i>CAPEXr</i>	0.016	(0.062)	0.024	(0.071)	-3.43***	(<.001)
<i>R&Dr</i>	0.015	(0.028)	0.033	(0.048)	-13.23***	(<.001)
<i>CASHr</i>	0.100	(0.116)	0.152	(0.141)	-12.08***	(<.001)
<i>StdROA</i>	1.738	(2.452)	1.756	(2.383)	-0.22	(0.824)
<i>Z-score</i>	0.021	(1.871)	0.165	(5.340)	-1.06	(0.287)
<i>DIR</i>	21.002	(13.06)	19.496	(13.60)	3.42***	(<.001)
<i>DEBTr</i>	0.366	(0.183)	0.352	(0.172)	2.50*	(0.013)
<i>AdjAVGR</i>	0.054	(0.691)	0.037	(0.695)	0.76	(0.447)
<i>AdjROA</i>	0.028	(8.782)	0.214	(11.01)	-0.56	(0.575)
<i>MTB</i>	2.474	(3.022)	3.712	(5.425)	-8.39***	(<.001)
<i>TECH</i>	0.470	(0.499)	0.789	(0.408)	-21.35***	(<.001)
Sample size	1725		1944			

Significance levels: ⁺ :p<0.10; * :p<0.05; ** :p<0.01; *** :p<0.001.

The empirical results based on OLS regression for the risk strategies are provided in tables 3a for a comparison with those based on 3SLS SEM.⁵ The result of table 3a suggests that D&O insurance coverage amount does not significant influence the volatility of stock returns for all three types of risk. The effect of D&O insurance amount on income stability and bankruptcy risk is not significant either, which implies

⁵ OLS regressions for DO and CG equations are provided in appendix 1.

that D&O insurance does not distinguish the financial strength of the firms. However, D&O insurance has a significant positive impact on capital expenditure, R&D expenditure, and cash holding, which implies that D&O insurance can encourage the firms to take risky investment but also push the firm to keep liquidity. The overall outcomes seem not satisfying and not supported by the literature.

The board independence has a significant and positive impact on risk-taking for total risk and idiosyncratic risk of stock returns, R&D expenditure, and cash holding. This result supports the literature that the board with more independent directors can avoid the risk-averseness of management. The result also shows that board independence can reduce the bankruptcy risk as predicted. However, the board independence has no significant impact on capital expenditure and incomes volatility. Some of these findings seem inconsistent with the previous literature. Pathan (2009) finds that board independence has a negative impact on the risk-taking of stock returns. Barger et al. (2010) find that the stricter corporate governance regulation (implying higher board independence) has an adverse effect on risk-taking strategies for capital expenditure, R&D and income volatility. These inconsistent outcomes are probably caused by the testing methodology without considering the endogeneity among the variables. Therefore this paper conducts the analysis by 3SLS simultaneous equations models to make a comparison.

Regarding the control variables, Debt ratio will increase total risk and idiosyncratic risk of stock returns and reduce R&D expenditure and cash-holding, which in general is consistent with theoretical prediction about poor financial strength. The variable of grow opportunity *MTB* has a positive relationship with systematic risk, R&D expenditure, cash-holding, and income volatility as predicted, but the negative relation with total risk of stock returns seems unreasonable. The average stock returns (*adjAVGR*) is positively related total risk and idiosyncratic risk which is consistent with

portfolio theory. On the other hand, *adjAVGR* is negatively related to systematic risk.

The business income *adjROA* has a positive impact with capital expenditure and cash holding as expected, but a negative relation with R&D expenditure which is probably due to the reduction of earnings by R&D expenditure. Besides, *adjROA* presents a negative relation with business income volatility because profitable firms usually have more stable business operations. Firms in high technology industry are more aggressive in risk-taking strategies and thus present higher total risk and idiosyncratic risk in stock returns and spend more R&D expenditure. Additionally the high technology firms also have higher cash holding to support their liquidity.

In summary, although some of the OLS regression results are consistent with theoretical predictions, most of them are not. The major problem of the OLS analysis is that D&O insurance is not a significant factor for most of the risk-taking strategies. The stock returns volatility, business income stability, and bankruptcy risk (*Z-score*) are very important corporate strategies and concerned by the shareholders and insurers. This result seems not reasonable because D&O insurance coverage usually is relevant to firm risk-taking. Lin et al (2013) shows that D&O insurance coverage is positively associated with greater loan risk and higher probability of financial restatement. That is, the OLS regression cannot tell the whole story of risk management because OLS does not consider the endogeneity among D&O insurance, board structure, and risk-taking strategies. .

Table 3a. OLS Regression for Risk Strategies, Depend Variable = Risk

RISK	TR	IDIOR	SYSR	CAPEXr	R&Dr	CASHr	StdROA	Z-score
<i>Intercept</i>	2.275*** (<.001)	1.747*** (<.001)	0.884*** (<.001)	0.010* (0.011)	0.008*** (<.001)	0.109*** (<.001)	1.518*** (<.001)	0.545* (0.020)
<i>IND</i>	0.323*** (<.001)	0.597*** (<.001)	-0.098 (0.589)	0.006 (0.246)	0.019*** (<.001)	0.056*** (<.001)	0.111 (0.537)	-0.748* (0.026)
<i>lnDO</i>	0.002 (0.511)	-0.005 (0.108)	-0.007 (0.264)	0.001** (0.007)	0.0006*** (<.001)	0.002*** (<.001)	-0.007 (0.282)	0.014 (0.237)
<i>DEBTr</i>	0.983*** (<.001)	1.105*** (<.001)	-0.105 (0.619)	0.005 (0.411)	-0.037*** (<.001)	-0.182*** (<.001)	-0.075 (0.726)	-0.645 (0.107)
<i>MTB</i>	-0.018*** (<.001)	-0.001 (0.7785)	0.022** (0.008)	0.00002 (0.922)	0.001*** (<.001)	0.005*** (<.001)	0.059*** (<.001)	-0.014 (0.398)
<i>adjAVGR</i>	1.654*** (<.001)	0.708*** (<.001)	-1.296*** (<.001)					
<i>adjROA</i>				0.001*** (<.001)	-0.001*** (<.001)	0.0009*** (<.001)	-0.107*** (<.001)	0.012 (0.109)
<i>TECH</i>	0.330*** (<.001)	0.299*** (<.001)	0.057 (0.511)	0.004 (0.128)	0.020*** (<.001)	0.051*** (<.001)	0.114 (0.184)	0.121 (0.448)
adj-R ²	0.5577	0.1973	0.1384	0.0370	0.1845	0.2250	0.1699	0.0018
N	3661	3661	3662	3660	3653	3662	3661	3661

Parameter estimates are listed with p-values in the parentheses. + :p<0.10; * :p<0.05; ** :p<0.01; *** :p<0.001.

Under COSO-ERM framework, the strategic objectives of a firm are built on its internal environment and risk management process. Since the board of directors is the decision center of a firm and D&O insurance is an important tool for risk management, these three elements may influence one another. As the endogeneity among variables is concerned and the 3SLS simultaneous equations models are applied, the empirical result is very different. Tables 4a - 4d present the findings for each of the eight risk-taking strategies. Tables 4a - 4d show that D&O coverage amount has a very significant and positive relation with board independence under all the eight risk-taking

strategies. Besides, it is positively related to the board size and negatively related to duality, although some of the relations are not significant. In general this outcome supports the hypothesis 2a that the firms with a stronger board will purchase more D&O insurance.

The risk-taking strategies also have some impact on the demand for D&O insurance. The insurance amount has a significant and negative relation with total risk, idiosyncratic risk of stock, and R&D expenditure, which is consistent with the literature that shareholders are not satisfied with risk-averse strategies and thus the litigation risk and demand for D&O insurance increase. Besides, the D&O insurance coverage amount increases with the bankruptcy risk as predicted since bankruptcy will result in litigation from stakeholders. However, systematic risk also increases the demand for insurance which indicates that the directors request more insurance protection under fluctuating macroeconomic environment. The strategies of capital expenditure, cash-holding, and income stability do not have a significant impact on the D&O insurance coverage. To sum up, the hypothesis 3b is partly supported.

The empirical evidence in tables 4a - 4d also indicates that board independence is significantly and positively with the D&O insurance purchase decision (*DOyes*) under all the eight risk-taking strategies, which confirm the previous literature and supports the hypothesis 1a that firms will have better governance when the directors are covered with D&O insurance. The result also shows that firms with more risk-taking in stock return, R&D, and income volatility and with less bankruptcy risk will have stronger board (higher board independence), which supports the hypotheses 1b and 3a. The only exception is capital expenditure strategy, which shows a negative relation with board independence.

According to the empirical result of tables 4a - 4d, board independence has a significant impact on the risk-taking strategies except for idiosyncratic risk. The stock

return volatilities are positively related to board independence, while cash-holding and bankruptcy risk is negatively related to board independence. This result indicates that stronger board can make better risk-taking strategies and thus hypothesis 2b is supported. The exceptions are capital expenditure and income stability. The D&O insurance amount has a negative relation with the stock return volatility because the aggressive risk-taking is preferred by the shareholders and thus less litigation and less demand for insurance.

Table 4a 3SLS SEMs for Total Risk and Idiosyncratic Risk

RISK Variable	TR			IDIOR		
	<i>lnDO</i>	<i>IND</i>	<i>TR</i>	<i>lnDO</i>	<i>IND</i>	<i>IDIOR</i>
<i>Intercept</i>	-14.612*** (<.001)	0.274*** (<.001)	1.199*** (<.001)	-12.956*** (<.001)	0.244*** (<.001)	1.754*** (<.001)
<i>Risk</i>	-0.652*** (<.001)	0.020* (0.021)		-1.715*** (<.001)	0.035*** (<.001)	
<i>IND</i>	48.230*** (<.001)		3.559*** (<.001)	49.679*** (<.001)		0.669 (0.404)
<i>DU</i>	-0.298 (0.151)			-0.480* (0.027)		
<i>BSize</i>	0.092* (0.016)			0.128*** (0.001)		
<i>DIR</i>	-0.002 (0.779)			-0.007 (0.287)		
<i>DOyes</i>		0.209*** (<.001)			0.202*** (<.001)	
<i>AdjAVGR</i>		-0.012 (0.381)	1.594*** (<.001)		-0.003 (0.670)	0.699*** (<.001)
<i>TECH</i>		0.027*** (<.001)	0.105 (0.332)		0.028*** (<.001)	0.411*** (<.001)
<i>lnDO</i>			-0.039*** (<.001)			-0.020*** (<.001)
<i>DEBTr</i>			0.992*** (<.001)			1.060*** (<.001)
<i>MTB</i>			-0.020*** (<.001)			-0.002 (0.606)
adj-R2			0.4398			0.3702
Sample size			3660			3660

Parameter estimates are listed with p-values in the parentheses. + :p<0.10; * :p<0.05; ** :p<0.01;

*** :p<0.001.

D&O insurance may encourage capital expenditure for long-term growth, however, it depresses R&D expenditure to avoid extra cost. D&O insurance also

enhances cash-holding for liquidity and reduces income volatility, which implies a safer operation. Furthermore, insurance coverage is positively related to bankruptcy risk since bankruptcy may cause more litigations. The overall result indicates that D&O insurance does provide protection for the firms in taking risky strategies. Besides, the impact of D&O insurance coverage on risk-taking strategies is opposite to that of the board independence, which implies insurance protection has a moderating effect for the board decision.

The relationship between other firm characteristics variables and risk-taking strategies are similar to the OLS result in table 3a, and thus the discussion is omitted.

Table 4b 3SLS SEMs for Systematic Risk and Capital Expenditure Risk

RISK Variable	SYSR			CAPEXr		
	<i>lnDO</i>	<i>IND</i>	<i>SYSR</i>	<i>lnDO</i>	<i>IND</i>	<i>CAPEXr</i>
<i>Intercept</i>	-15.417*** (<.001)	0.277*** (<.001)	-1.712*** (<.001)	-16.328*** (<.001)	0.375*** (<.001)	0.106*** (<.001)
<i>Risk</i>	0.424* (0.031)	0.056+ (0.075)		5.758 (0.710)	-3.699*** (<.001)	
<i>IND</i>	45.554*** (<.001)		7.418*** (<.001)	45.998*** (<.001)		-0.277*** (<.001)
<i>DU</i>	-1.685*** (<.001)			-2.045*** (<.001)		
<i>BSize</i>	0.045 (0.406)			0.136* (0.028)		
<i>DIR</i>	0.027** (0.009)			0.036*** (<.001)		
<i>DOyes</i>		0.199*** (<.001)			0.244*** (<.001)	
<i>AdjAVGR</i>		0.084* (0.039)	-1.413*** (<.001)			
<i>AdjROA</i>					0.004*** (<.001)	0.001*** (<.001)
<i>TECH</i>		0.045*** (<.001)	-0.929*** (<.001)		0.048*** (<.001)	0.018*** (<.001)
<i>DOamt</i>			-0.046*** (<.001)			0.005*** (<.001)
<i>DEBTr</i>			0.105 (0.117)			-0.004*** (<.001)
<i>MTB</i>			0.004 (0.429)			-0.00003 (0.595)
adj-R2			0.2267			0.1179
Sample size			3661			3659

Parameter estimates are listed with p-values in the parentheses. + :p<0.10; * :p<0.05; ** :p<0.01;

*** :p<0.001.

Table 4c 3SLS SEMs for R&D Risk and Liquidity Risk

Variable	R&Dr			CASHr		
	<i>lnDO</i>	<i>IND</i>	<i>R&Dr</i>	<i>lnDO</i>	<i>IND</i>	<i>CASHr</i>
<i>Intercept</i>	-18.576*** (<.001)	0.321*** (<.001)	-0.033*** (<.001)	-16.486*** (<.001)	0.319*** (<.001)	0.291*** (<.001)
<i>Risk</i>	-71.446** (0.001)	1.280*** (<.001)		-9.042+ (0.061)	0.142+ (0.059)	
<i>IND</i>	58.000*** (<.001)		0.139*** (<.001)	51.262*** (<.001)		-0.471*** (<.001)
<i>DU</i>	-0.402 (0.102)			-0.180 (0.437)		
<i>BSize</i>	0.009 (0.826)			0.069+ (0.069)		
<i>DIR</i>	0.003 (0.720)			-0.009 (0.272)		
<i>DOyes</i>		0.191*** (<.001)		0.193*** (<.001)		
<i>AdjROA</i>		0.0001 (0.385)	-0.001*** (<.001)	0.0002 (0.345)	0.001*** (<.001)	
<i>TECH</i>		0.010 (0.338)	0.010** (0.006)	0.031*** (<.001)	0.105*** (<.001)	
<i>lnDO</i>			-0.001*** (<.001)		0.006*** (<.001)	
<i>DEBTr</i>			-0.031*** (<.001)		-0.197*** (<.001)	
<i>MTB</i>			0.002*** (<.001)		0.005*** (<.001)	
adj-R2			0.3705			0.3387
Sample size			3652			3661

Parameter estimates are listed with p-values in the parentheses. + :p<0.10; * :p<0.05; ** :p<0.01;

*** :p<0.001.

Table 4d 3SLS SEMs for StdROA and Bankruptcy Risk

RISK Variable	StdROA			Z-score		
	<i>lnDO</i>	<i>IND</i>	<i>StdROA</i>	<i>lnDO</i>	<i>IND</i>	<i>Z-score</i>
<i>Intercept</i>	-14.209*** (<.001)	0.251*** (<.001)	-1.960*** (<.001)	-13.217*** (<.001)	0.336*** (<.001)	2.375* (0.012)
<i>Risk</i>	-0.030 (0.864)	0.043*** (<.001)		6.137** (0.008)	-0.055* (0.020)	
<i>IND</i>	44.282*** (<.001)		10.468*** (<.001)	40.102*** (<.001)		-7.205** (0.008)
<i>DU</i>	-0.671** (0.006)			1.255* (0.028)		
<i>BSize</i>	0.025 (0.598)			0.094+ (0.077)		
<i>DIR</i>	0.010 (0.173)			-0.035+ (0.068)		
<i>DOyes</i>		0.212*** (<.001)			0.113*** (<.001)	
<i>AdjROA</i>		0.004*** (<.001)	-0.103*** (<.001)		0.0007+ (0.054)	-0.001 (0.882)
<i>TECH</i>		0.032*** (<.001)	-0.938*** (<.001)		0.108*** (<.001)	0.1082 (0.781)
<i>lnDO</i>			-0.097*** (<.001)			0.158*** (<.001)
<i>DEBTr</i>			0.158 (0.229)			-0.197 (0.453)
<i>MTB</i>			0.020* (0.016)			0.011 (0.271)
adj-R2			0.3154			0.1383
Sample size			3660			3660

Parameter estimates are listed with p-values in the parentheses. + :p<0.10; * :p<0.05; ** :p<0.01;

*** :p<0.001.

5. Robustness Check

Jensen and Meckling (1976) suggest that ownership structure can affect firm risk-taking because the insiders with greater ownership become more aligned with shareholders, which may result in more risk-taking behavior. Hill and Snell (1988) indicate that firm ownership structure diversification will be reduced as insider ownership increases, thus raising the overall firm risk level. On the other hand, Wright et al. (1996) suggest that insider ownership has a negative relationship with firm risk-taking behavior due to the undiversified wealth portfolio of insiders. This

inconsistency probably implies that there are other factors influencing the insiders' decision. Jensen and Meckling (1976) argue that firm insiders may enhance firm value by increasing risk-taking with appropriate incentives. Since D&O insurance serves as a protection incentive for directors and officers, we further analyze the impact of D&O insurance on a firm's risk-taking behavior in different insider ownership scenarios.

The empirical analysis is conducted on the subset of the data categorized based on firm's insider ownership.⁶ The firms with insider ownership greater than the sample median are grouped into "high-insiders," otherwise into "low-insiders." Then we conduct the 3SLS SEMs of equations (1') - (3') again. The empirical result of equation (3') for the risk-taking strategies are reported in table 5a and 6a for high-insiders and low-insiders respectively.⁷

The result in table5a for firms with high insider ownership shows that the board independence has a significantly positive impact on all three stock return volatility which implies more aggressive risk-taking strategies and aligning with the shareholders' interest. Additionally, the board independence reduces capital expenditure and bankruptcy risk, but increases cash holding and income volatility. D&O insurance coverage again has a moderating effect to the board independence on the risk-taking strategies. D&O insurance amount has a significant and negative relation with stock return volatility, cash holdings, and income volatility, but a positive relation with capital expenditure and bankruptcy risk. In general, the result of high-insider is similar to that of the whole sample.

⁶ Insider ownership is defined as ownership by COB, CEO, their families, managers of the firm, related enterprises, and foundations.

⁷ The empirical results for equation (1') and (2') for each subset sample are omitted here due to the length constraint of paper, but can be requested from the author.

Table 5a. 3SLS SEM for Risk Strategies in High-Insider Firms , Depend Variable = Risk

RISK	<i>TR</i>	<i>IDIOR</i>	<i>SYSR</i>	<i>CAPEXr</i>	<i>R&Dr</i>	<i>CASHr</i>	<i>StdROA</i>	<i>Z-score</i>
<i>Intercept</i>	0.580 [*] (0.048)	-0.046 (0.880)	-1.566 [*] (0.031)	0.084 ^{***} (<.001)	0.001 (0.939)	-0.118 ^{***} (<.001)	-2.071 ^{***} (<.001)	2.596 ^{***} (<.001)
<i>IND</i>	5.596 ^{***} (<.001)	6.977 ^{***} (<.001)	7.430 ^{**} (0.002)	-0.244 ^{***} (<.001)	0.025 (0.342)	0.745 ^{***} (<.001)	11.880 ^{***} (<.001)	-8.598 ^{***} (<.001)
<i>lnDO</i>	-0.062 ^{***} (<.001)	-0.093 ^{***} (<.001)	-0.027 ⁺ (0.078)	0.005 ^{***} (<.001)	-0.0002 (0.144)	-0.007 ^{***} (<.001)	-0.095 ^{***} (<.001)	0.180 ^{***} (<.001)
<i>DEBTr</i>	1.132 ^{***} (<.001)	0.763 ^{***} (<.001)	0.377 (0.134)	0.006 (0.427)	-0.012 ^{***} (<.001)	-0.116 ^{***} (<.001)	0.093 (0.330)	-0.096 (0.352)
<i>MTB</i>	-0.016 [*] (0.012)	0.004 (0.472)	0.013 (0.444)	0.00002 (0.955)	0.001 ^{***} (<.001)	0.002 ^{**} (0.005)	-0.002 (0.804)	-0.004 (0.480)
<i>adjAVGR</i>	1.534 ^{***} (<.001)	0.105 ^{**} (0.002)	-1.729 ^{***} (<.001)					
<i>adjROA</i>				0.001 ^{***} (<.001)	-0.0003 ^{***} (<.001)	0.001 ^{**} (0.003)	-0.082 ^{***} (<.001)	0.005 (0.407)
<i>TECH</i>	-0.057 (0.667)	-0.073 (0.587)	-1.192 ^{***} (<.001)	0.008 (0.293)	0.019 ^{***} (<.001)	0.006 (0.662)	-1.090 ^{***} (<.001)	0.042 (0.830)
adj-R2	0.4404	0.3325	0.3136	0.3396	0.1842	0.3362	0.2429	0.1009
N	1832	1832	1832	1831	1828	1833	1832	1832

Parameter estimates are listed with p-values in the parentheses. ⁺:p<0.10; ^{*}:p<0.05; ^{**}:p<0.01; ^{***}:p<0.001.

On the other hand, the result of low-insider firms is somewhat different from the previous analysis. Table 6a shows that board independence is not an important determinant for the risk-taking strategies. The board independence is significantly and positively related to idiosyncratic risk of stock returns, but not total risk or systematic risk. Although it has a negative impact on capital expenditure and cash holding and a positive impact on R&D, the significance levels are much lower than the previous case. Besides, the board independence has a significant and positive relation with bankruptcy risk, and has insignificant relation with income volatility, which is very different from the high-insider case.

The effect of D&O insurance on stock return volatility is significant and negative, which is similar to the case of high-insider firms. However, the significantly positive impact of D&O insurance coverage on R&D expenditure and cash holding is different from that of high-insider firms. Besides, the moderating effect of D&O insurance for the board independence disappears on the risk-taking strategies, such as systematic risk, R&D, income volatility, and bankruptcy. This empirical evidence supports the previous literature that that ownership structure can affect firm risk-taking.

Table 6a. 3SLS SEM for Risk Strategies in Low-Insider Firm, Depend Variable = Risk

RISK	<i>TR</i>	<i>IDIOR</i>	<i>SYSR</i>	<i>CAPEXr</i>	<i>R&Dr</i>	<i>CASHr</i>	<i>StdROA</i>	<i>Z-score</i>
<i>Intercept</i>	1.769* (0.038)	-0.658 (0.442)	0.217 (0.847)	0.123* (0.011)	-0.059+ (0.061)	0.333*** (<.001)	1.721 (0.329)	-8.790*** (<.001)
<i>IND</i>	2.193 (0.271)	7.051*** (<.001)	1.709 (0.517)	-0.265* (0.019)	0.183* (0.013)	-0.464* (0.043)	-0.132 (0.975)	19.83*** (<.001)
<i>lnDO</i>	-0.029*** (<.001)	-0.077*** (<.001)	0.012 (0.238)	0.001* (0.015)	0.001*** (<.001)	0.006*** (<.001)	-0.002 (0.880)	0.067** (0.003)
<i>DEBTr</i>	0.724*** (<.001)	0.924*** (<.001)	-0.380+ (0.071)	-0.008 (0.308)	-0.044*** (<.001)	-0.218*** (<.001)	-0.064 (0.856)	0.760* (0.027)
<i>MTB</i>	-0.022*** (<.001)	-0.015** (0.006)	0.014* (0.037)	0.0001 (0.679)	0.001*** (<.001)	0.006*** (<.001)	0.061*** (<.001)	-0.003 (0.821)
<i>adjAVGR</i>	1.660*** (<.001)	1.235*** (<.001)	-0.885*** (<.001)					
<i>adjROA</i>				0.001*** (<.001)	-0.001*** (<.001)	0.001** (0.004)	-0.125*** (<.001)	-0.014 (0.134)
<i>TECH</i>	0.246 (0.277)	-0.080 (0.728)	-0.252 (0.402)	0.041** (0.002)	-0.0006 (0.945)	0.085** (0.001)	0.045 (0.924)	-2.828*** (<.001)
adj-R ²	0.3757	0.3615	0.2809	0.2082	0.3624	0.2907	0.3008	0.1000
N	1828	1828	1828	1828	1824	1828	1828	1828

Parameter estimates are listed with p-values in the parentheses. + :p<0.10; * :p<0.05; ** :p<0.01; *** :p<0.001.

The empirical results in the above suggest that the board and D&O insurance both play an important role in firm risk-taking strategies. To further investigate their effect, an event study is conducted by using the experience of year 2008 when the global financial crisis occurred. The result of the event study in Table 7a shows that board independence has a significantly positive impact on total risk and systematic risk but not the idiosyncratic risk; besides it has a negative impact on capital expenditure and cash holding. These findings are the same as those in tables 4a - 4d. However, the board independence is not significantly related to R&D and income volatility, and it increase bankruptcy risk. These evidences imply that independent directors are not helpful in stabilizing the business operation during the financial crisis.

D&O insurance has a significantly negative impact on total risk and systematic risk as before. However, the idiosyncratic risk is not significantly influenced by D&O insurance protection during the time of financial crisis. Compared to the previous cases where idiosyncratic risk is negatively related to D&O insurance, the finding implies that the demand for insurance during the crisis is not to cover idiosyncratic. The impact of D&O insurance on capital expenditure and cash holding is significantly positive and similar to the result of tables 4a – 4d. However, the effect of D&O insurance on R&D changes from negative to positive, and the effect on income stability becomes insignificant.

In summary, during the period of financial crisis the major changes in the effect on risk-taking strategies due to corporate governance and D&O insurance primarily fall on R&D expenditure and income volatility. D&O insurance protection encourage the firms to increase R&D even in the bad time, while the board independence becomes not relevant for R&D decision. Both the board structure and D&O insurance protection have no significant impact on income stability during the crisis since the macroeconomic environment is the major determinant of business profitability.

Additionally, the firm characteristics variable for industry type *TECH* also loses its influence on risk-taking strategies in this case because all types of firms suffered during the financial crisis.

Table 7a. 3SLS SEM for Risk Strategies with for Year 2008 , Depend Variable = Risk

RISK	<i>TR</i>	<i>IDIOR</i>	<i>SYSR</i>	<i>CAPEXr</i>	<i>R&Dr</i>	<i>CASHr</i>	<i>StdROA</i>	<i>Z-score</i>
Intercept	0.310 (0.520)	2.011*** (<.001)	-0.376* (0.022)	0.142*** (<.001)	-0.00004 (0.998)	0.431*** (<.001)	2.905* (0.016)	-2.699*** (<.001)
<i>IND</i>	7.657*** (<.001)	0.655 (0.636)	3.365*** (<.001)	-0.393*** (<.001)	0.050 (0.377)	-0.960*** (<.001)	-3.040 (0.388)	7.761*** (<.001)
<i>lnDO</i>	-0.075*** (<.001)	-0.0006 (0.939)	-0.039*** (<.001)	0.007*** (<.001)	0.001** (0.005)	0.012*** (<.001)	0.030 (0.118)	0.043*** (0.001)
<i>DEBTr</i>	0.856*** (<.001)	1.075*** (<.001)	0.025 (0.577)	-0.008 (0.390)	-0.042*** (<.001)	-0.170*** (<.001)	-0.126 (0.745)	-0.012 (0.886)
<i>MTB</i>	-0.0006 (0.958)	0.007 (0.561)	0.004 (0.264)	-0.0004 (0.592)	0.004*** (<.001)	0.008*** (<.001)	0.238*** (<.001)	0.015+ (0.095)
<i>adjAVGR</i>	1.512*** (<.001)	-0.014 (0.709)	0.445*** (<.001)					
<i>adjROA</i>				0.001*** (<.001)	-0.001*** (<.001)	0.001** (0.004)	-0.194*** (<.001)	-0.002 (0.698)
<i>TECH</i>	-0.440* (0.033)	0.066 (0.744)	-0.129 (0.104)	0.024+ (0.056)	0.012 (0.146)	0.149*** (<.001)	0.273 (0.599)	-1.539*** (<.001)
adj-R2	0.4349	0.3624	0.3842	0.2931	0.4057	0.3081	0.4152	0.1653
N	1165	1165	1166	1166	1166	1166	1166	1166

Parameter estimates are listed with p-values in the parentheses. + :p<0.10; * :p<0.05; ** :p<0.01; *** :p<0.001.

6. Conclusion

Corporations treat D&O insurance as a part of a compensation package to attract capable directors and officers. Because D&O insurance can provide protection for litigation risk from stakeholders, it may offer the directors and managers an incentive to adopt more aggressive business strategies to enhance their firm's value. The empirical

evidences in this paper confirm these predictions and indicate that D&O insurance is an important determinant on firm risk-taking strategies. That is, D&O insurance is a risk management mechanism related to firm risk-taking and stakeholders' interests.

The empirical results show that the independent directors increase when the directors are covered with D&O insurance and the board independence significantly and positively contributes to firm risk-taking. When the firms take more aggressive risky strategies to satisfy the shareholders' preference, the D&O insurance coverage amount can be reduced because of less litigation risk. Therefore, the presence of D&O insurance is important for the firms to invite the capable directors, while the coverage amount of insurance plays a moderating effect on the board independence for the risk-taking strategies.

The methodology of 3SLS SEMs used in this paper provides the empirical evidence more consistent with the theoretical prediction than the traditional approach of multiple regression analysis because the endogeneity among variables is taken into consideration. The empirical result of this paper supports the literature that the board independence has a positive impact on aggressive risk-taking strategies. The result also suggests that D&O insurance is an important tool for the firms to invite independent directors and to manage the business risk.

The empirical result of this paper also shows that ownership structure can influence the risk-taking strategies as predicted in literature. The impact of board independence on risk-taking is more prominent in the firms with higher insider-holdings than that of other firms. Furthermore this paper also shows that the board independence and D&O insurance have less influential power for idiosyncratic risk and income stability during the financial crisis because the macroeconomic environment is more critical during that period.

This study has certain implications for incentive compensation packages and

regulatory policies. The results suggest that D&O insurance can be a compensation package to encourage aggressive risk-taking strategies and consequently align directors' and shareholders' interests.

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Appendix 1.

Table 3b. OLS Regression for Risk Strategies, Depend Variable = IND

RISK	TR	IDIOR	SYSR	CAPEXr	R&Dr	CASHr	StdROA	Z-score
<i>Intercept</i>	0.309 ^{***} (<.001)	0.297 ^{***} (<.001)	0.341 ^{***} (<.001)	0.340 ^{***} (<.001)	0.339 ^{***} (<.001)	0.330 ^{***} (<.001)	0.339 ^{***} (<.001)	0.341 ^{***} (<.001)
<i>RISK</i>	0.012 ^{***} (<.001)	0.018 ^{***} (<.001)	-0.0003 (0.837)	0.058 (0.252)	0.561 ^{***} (<.001)	0.163 ^{***} (<.001)	0.001 (0.364)	-0.002 [*] (0.023)
<i>DOyes</i>	0.054 ^{***} (<.001)	0.055 ^{***} (<.001)	0.055 ^{***} (<.001)	0.053 ^{***} (<.001)	0.048 ^{***} (<.001)	0.049 ^{***} (<.001)	0.054 ^{***} (<.001)	0.054 ^{***} (<.001)
<i>adjAVGR</i>	-0.003 (0.658)	0.003 (0.587)	0.017 ^{***} (<.001)					
<i>adjROA</i>				0.0005 (0.162)	0.001 [*] (0.030)	0.0001 (0.704)	0.0007 ⁺ (0.063)	0.0006 ⁺ (0.089)
<i>TECH</i>	0.136 ^{***} (<.001)	0.134 ^{***} (<.001)	0.140 ^{***} (<.001)	0.141 ^{***} (<.001)	0.127 ^{***} (<.001)	0.129 ^{***} (<.001)	0.141 ^{***} (<.001)	0.141 ^{***} (<.001)
adj-R ²	0.1427	0.1493	0.1399	0.1388	0.1493	0.1470	0.1386	0.1397
N	3667	3667	3668	3661	3654	3663	3662	3662

Table 3c. OLS Regression for Risk Strategies, Depend Variable = lnDO

RISK	TR	IDIOR	SYSR	CAPEXr	R&Dr	CASHr	StdROA	Z-score
<i>Intercept</i>	3.172 ^{***} (<.001)	3.297 ^{***} (<.001)	3.315 ^{***} (<.001)	3.317 ^{***} (<.001)	3.020 ^{***} (<.001)	2.753 ^{***} (<.001)	3.297 ^{***} (<.001)	3.323 ^{***} (<.001)
<i>RISK</i>	0.043 (0.490)	0.001 (0.986)	0.001 (0.978)	4.580 ^{**} (0.002)	25.26 ^{***} (<.001)	7.101 ^{***} (<.001)	0.012 (0.770)	0.033 (0.166)
<i>IND</i>	5.766 ^{***} (<.001)	5.799 ^{***} (<.001)	5.775 ^{***} (<.001)	5.694 ^{***} (<.001)	4.755 ^{***} (<.001)	4.834 ^{***} (<.001)	5.777 ^{***} (<.001)	5.795 ^{***} (<.001)
<i>DU</i>	-0.550 [*] (0.011)	-0.550 [*] (0.012)	-0.540 [*] (0.013)	-0.486 [*] (0.026)	-0.608 ^{**} (0.005)	-0.528 [*] (0.014)	-0.550 [*] (0.012)	-0.547 [*] (0.012)
<i>BSize</i>	0.103 [*] (0.017)	0.101 [*] (0.019)	0.100 [*] (0.019)	0.096 [*] (0.025)	0.113 ^{**} (0.008)	0.120 ^{**} (0.005)	0.102 [*] (0.018)	0.100 [*] (0.019)
<i>DIR</i>	-0.021 ^{**} (0.005)	-0.021 ^{**} (0.005)	-0.021 ^{**} (0.005)	-0.022 ^{**} (0.003)	-0.019 [*] (0.010)	-0.025 ^{***} (<.001)	-0.021 ^{**} (0.004)	-0.022 ^{**} (0.004)
adj-R ²	0.0476	0.0475	0.0471	0.0498	0.0753	0.0704	0.0473	0.0478
N	3666	3666	3667	3660	3653	3662	3661	3661

Parameter estimates are listed with p-values in the parentheses. ⁺:p<0.10; ^{*}:p<0.05; ^{**}:p<0.01; ^{***}:p<0.001.