Managerial Overconfidence and Directors' and Officers' Liability Insurance

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Abstract

Using a net purchase measure for managerial overconfidence, we investigate how CEO overconfidence impacts a firm's directors' and officers' (D&O) liability insurance decisions over the 2008-2014 period in Taiwan nonfinancial listed firms. We find that the effect of CEO overconfidence on the D&O decision is significantly different in family and non-family controlled firms. In family firms, firms with confident CEOs have higher demand for D&O insurance, especially when the CEOs are family members, and in non-family firms, firms with confident CEOs tend to purchase less D&O insurance. The significant negative relationship between CEO overconfidence and the purchase level of D&O insurance in non-family firms is demonstrated by the fact that overconfident CEOs tend to take on higher risk through overinvestment and underweight that risk. These results are robust to the consideration of endogeneity concerns, an alternative definition of family-controlled firms, alternative measures of CEO overconfidence, and different measures of D&O insurance coverage. This study provides the first empirical evidence in the literature regarding the role of the managerial overconfidence in corporate D&O insurance decisions.

Keywords: Overconfidence, D&O liability insurance, Family control, Overinvestment

1. Introduction

D&O insurance is a type of insurance that is purchased by a company to protect its directors and officers from personal liability that may stem from litigation brought by shareholders or other stakeholders (e.g., creditors) alleging wrongdoing in discharging their duties. The wealth of directors and officers is at risk when faced with lawsuits in connection to their roles and responsibilities to their company, and their company correspondingly buys insurance on their behalf to safeguard their wealth. D&O insurance contains valuable information for shareholders and investors regarding firm risk because the amount of D&O insurance purchased is associated with the level of firm risk. Therefore, it is important to understand the factors that influence the demand for D&O insurance, including managerial characteristics.

The literature documents that managerial overconfidence, which is measured based on psychological factors and personal characteristics, influences firm risk-taking in major corporate decisions, including investments, financing, mergers and acquisitions, and innovation (Malmendier and Tate, 2005a, 2005b, 2008; Goel and Thakor, 2008; Campbell et al., 2011; Gervais, Heaton, and Odean, 2011; Malmendier, Tate and Yan, 2011; Hirshleifer, Low and Toeh, 2012). Accordingly, this study extends this research stream to investigate the relationship between CEO overconfidence and D&O insurance decisions. In addition, the effects of managers' psychological biases have not been examined in emerging markets, where information asymmetry is high and shareholder rights are not well protected by legal systems.

This study is designed to fill these gaps by contributing to the literature in three areas. First, the study focuses on linking CEO overconfidence to the corporate demand for D&O insurance. Behavioral decision theory suggests that overconfidence, as one type of cognitive bias, encourages decision makers to overestimate their own information and problem-solving capabilities and underestimates the uncertainties facing their firms and the potential losses from litigation associated with claims against them. Therefore, an overconfident CEO tends to underestimate the demand for D&O insurance and purchases less D&O insurance than a non-overconfident CEO.

On the other hand, Core (1997, 2000) finds that entrenched managers are likely to buy more D&O insurance, which is consistent with the argument that D&O insurance decisions reveal opportunistic behavior by managers. Additionally, Lin, Officer and Zou (2011) and Lin et al. (2013) find that higher D&O insurance coverage is associated

with higher firm risk. Therefore, if overconfident managers are behaving more opportunistically in risk-taking activities, we expect to find that purchases of D&O insurance coverage by firms with overconfident CEOs are significantly higher than those with rational CEOs. Whether the underestimation of risk or opportunism in risk taking induced by CEO overconfidence provides a stronger impact on D&O insurance decisions is still an unanswered question that we will try to explore.

Recent studies provide evidence that corporate governance could restrain the detrimental impacts of overconfident CEOs on corporate policy (Campbell et al., 2011; Banerjee, Humphery-Jennr, and Nanda, 2015). Compared to western countries such as the US and the UK, investor protection is weaker and external governance mechanisms are more inefficient in emerging markets. It is also notable that the ownership structures in emerging markets and western countries are quite different. Firms in Taiwan are characterized by personal networks, and they tend to connect to each other through informal relationships such as cross-holdings, pyramidal structures, mutual board representation, and family businesses. By contrast, the dispersed ownership in the US results in greater agency problems between shareholders and managers. The concentrated ownership of Taiwanese firms causes a decrease in the agency problem between shareholders and managers and an increase in conflicts between controlling and minority shareholders. All of these factors suggest that the concentrated ownership of family firms may influence managerial entrenchment and D&O insurance decisions for Taiwanese firms. Hence, the second goal of this study is to evaluate whether the influence of managerial overconfidence on the demand for D&O insurance is affected by family control. We conjecture that family control influences the effect of managerial overconfidence on the demand for D&O insurance for the following reasons: family wealth is closely connected to firm value (Anderson and Reeb, 2003), and family members care more about the firm's reputation (Miller, Le Breton-Miller, and Scholnick, 2008) and the long-term prospects of their business because they expect to pass on the firm's assets to future generations (Gomez-Mejia et al., 2007). Family owners' long-term horizons and their preference for long-term investments may mitigate managerial entrenchment for myopic investment decisions, thereby leading to less demand for D&O insurance.

To test our hypotheses, we use a sample of listed firms in Taiwan from 2008-2014. The Taiwan Stock Exchange has required publicly traded companies to reveal relevant information about their D&O insurance since 2008. In addition, in contrast to the environment in the U.S. and Canada, Taiwanese firms operate in an environment characterized by poor legal protection. This situation provides us with an opportunity

to investigate the effects of CEO managerial bias and family control on D&O insurance decisions. The panel regression results show a significantly negative relation between CEO overconfidence and the amount of D&O insurance purchased by non-family-controlled firms, suggesting that managerial overconfidence leads to a decrease in the demand for D&O insurance for Taiwan listed firms. Moreover, family control positively moderates the negative relation between CEO overconfidence and the demand for D&O insurance, consistent with our inference. Finally, we find that the moderating effects of family control are stronger for family CEOs than non-family CEOs.

The contribution of this paper is first to further advance our understanding of the impact of CEO overconfidence on a firm's decisions in an emerging market, which we examine through the CEO's D&O insurance purchasing decision. Second, we provide further evidence of a factor, managerial behavioral bias, that influences D&O insurance decisions. Third, we also contribute to the growing literature on the moderating effects of family control. Prior studies document that family control moderates the relation among business group performance, monitoring effectiveness, investment-cash-flow sensitivity and earnings management (Li and Hung, 2013; Kuo and Hung, 2011; Jaggi, Leung, and Gul, 2009; Bertrand et al., 2008). Our study makes the first attempt to fill a gap in the literature by examining whether family control moderates the effect of managerial overconfidence on D&O insurance decisions. Our study can be applied to many emerging markets that share unique characteristics regarding the legal environment, ownership concentration and family businesses. Finally, many studies suggest that the behavior of family CEOs differs from that of nonfamily CEOs because of competition in the labor market, compensation plans, pressure related to firm performance, family business characteristics, etc. (Anderson, Mani, and Reeb, 2003). We go a step further and investigate the differences between the moderating effects of family CEOs and nonfamily CEOs in the hope of explaining the cause of the moderating effects of family control as well as determining which type of CEO moderates the influence of overconfidence on D&O insurance decisions in family businesses. This work also provides insight to insurers regarding whether managerial characteristics and family or non-family control characteristics should be taken into consideration when pricing D&O insurance contracts.

The rest of the paper is organized as follows. Section 2 reviews the literature and develops our hypotheses. Section 3 explains the methodology and empirical design. Section 4 presents and discusses the empirical results. Finally, Section 5 contains our concluding remarks.

2. Literature Review and Hypotheses Development

2.1.Managerial Overconfidence and D&O Insurance

Because the directors and officers are personally responsible for the actions of their corporation due to their titles and roles, their personal assets are at risk in the event a lawsuit is filed against the corporation and/or its management (Boyer, 2008). D&O insurance aims to shield directors and the executives they serve from any liability that arises from decisions and actions made in conducting business. D&O insurance covers settlement amounts, legal fees and compensatory damages resulting from the conduct of directors and officers. There are several incentives for D&O insurance purchases: insurance contracts can shift the risk from firms' other claimholders to the insurance company, lower the transaction costs of bankruptcy, provide claim administration service efficiencies, help firms monitor and bond their managers' actions, guarantee real investment decisions and lower corporations' tax liability. The prior literature documents several factors associated with the corporate demand for D&O insurance. Summarizing these studies, the likelihood of D&O insurance purchases is a function of litigation risk (Core, 1997; O'Sullivan, 2002; Gillan and Panasian, 2015), financial distress (Core, 1997; Kalchev, 2004), and corporate governance (O'Sullivan, 1997; Core, 2000; Boyer and Stern, 2012; Gillan and Panasian, 2015).

Additionally, Chalmers, Dann, and Harford (2002) use a sample of initial public offering firms to test the managerial opportunism hypothesis and find that the amount of D&O insurance coverage at the time of the IPO is negatively associated with three-year stock performance. Chalmers, Dann, and Harford (2002) argue that the managers of IPO firms have superior private information in the insurance decision to pay in advance to prepare for future poor performance, which is consistent with the argument that entrenched managers are likely to buy more D&O insurance (Core, 1997, 2000). Further, prior works show that D&O insurance coverage is positively associated with firm risk. Lin, Officer and Zou (2011) examine the impact of D&O insurance on the outcomes for acquirers in mergers and acquisitions (M&As) and find that firms carrying a high level of D&O insurance receive poor synergies, resulting in lower abnormal stock returns around the M&A announcement period than those without protection from D&O insurance. The results support the argument that D&O insurance induces moral hazard for directors and officers by protecting them from the discipline of shareholder litigation. Lin et al. (2013) examine the effect of D&O insurance coverage on firms' cost of debt and find that a higher level of D&O insurance coverage is associated with a higher loan spread. The authors show that firms with higher D&O insurance coverage

increase their total risk and have lower financial reporting quality. Lenders perceive that the adverse effects of the moral hazard and information asymmetry caused by D&O insurance coverage might be harmful and therefore charge a higher loan spread to penalize the firm.

In summary, the prior work implies that firms with higher distress probability, greater corporate risks, weaker governance structures, greater growth opportunities and higher managerial entrenchment or opportunism are more likely to purchase more D&O insurance. Because the CEO is the top decision maker inside a firm, managerial characteristics have significant impacts on firm risks, the distress probability and corporate policy, including D&O insurance decisions. Accordingly, it is interesting to understand whether CEO overconfidence further influences the D&O insurance decision.

Managerial optimism and overconfidence have been shown theoretically and empirically to have a significant impact on important corporate decisions, including investments, financing, dividends, earnings management, and mergers (Malmendier and Tate, 2005a, 2005b, 2008; Goel and Thakor, 2008; Campbell et al., 2011; Gervais, Heaton, and Odean, 2011; Malmendier, Tate and Yan, 2011; Hirshleifer, Low and Toeh, 2012). Based on behavioral decision theory, optimistic or overconfident CEOs or managers tend to overestimate their own information and skills (Camerer and Lovallo, 1999) and underestimate the risk they face relative to others (March and Shapira, 1987; Kahneman and Lovallo, 1993); thus, they are generally too optimistic about the outcomes of their decisions (Malmendier and Tate, 2005a). As a result, studies document that the decisions of optimistic and overconfident managers could potentially harm shareholder value through a number of different risk-taking behavior, such as overinvestment (Malmendier and Tate, 2005a), overpayment for target firms, undertaking value-destroying mergers (Malmendier and Tate, 2008) and R&D expenditures (Hirshleifer, Low and Toeh, 2012). Extending this line of research, it is interesting to examine whether managerial overconfidence also affects D&O insurance decisions.

Based on the behavioral characteristics of managerial overconfidence, prior studies can help to describe two ways in which CEO overconfidence can play a role in D&O insurance decisions. First, an overconfident CEO tends to underestimate the uncertainties in the environment and the amount of risk that they face. Such misperceptions may lead the CEO to also underestimate the litigation risk that he or she will face, resulting in a lower demand for D&O insurance. Therefore,

Hypothesis 1a: A firm with an overconfident CEO will have less willingness to purchase and less coverage of D&O insurance relative to a firm with a CEO who is less overconfident.

Second, an overconfident CEO tends to overestimate his/her own information and problem-solving capabilities (Hayward, Shepherd, and Griffin, 2006). Such misperceptions may lead the CEO to overestimate the return and the net present value of implementing an action and thus undertake too many risk-taking activities and value-destroying projects (Malmendier and Tate, 2005a, 2005b, 2008). According to previous findings, firms with higher corporate risks, growth opportunities and managerial entrenchment or opportunism are more likely to purchase more D&O insurance, and we expect that firms with an overconfident CEO tend to purchase higher amounts of D&O insurance. Therefore,

Hypothesis 1b: A firm with a more overconfident CEO will have a greater willingness to purchase and greater coverage extent of D&O insurance relative to a firm with a CEO who is less overconfident.

2.2. Family Control and D&O Insurance

Family businesses have unique stewardship characteristics. Family members tend to focus on long-term organizational goals, and family wealth is closely connected to firm value (Anderson and Reeb, 2003); thus, the managers of family firms tend to act as good stewards by paying more attention to the firms' long-term performance and reputation. Additionally, family owners treat their firms as their own personal assets because they intend to pass on the business to future generations (Wang, 2006). As a result, even if family managers are overconfident about future firm performance, it will not increase their motivation to engage in excessive risk-taking activities because such opportunistic behavior would entail higher risk and threaten the firm's long-term performance (Eddleston, Kellermans, and Sarathy, 2008), the family's reputation (Miller, Le Breton-Miller, and Scholnick, 2008) and the family's ability to hand over the business to the next generation. Additionally, Mayers and Smith (1982) find a positive relationship between the ownership of the controlling shareholder and D&O insurance based on insiders' risk aversion. Under less risk taking and more risk aversion, we expect that family firms tend to purchase less D&O insurance than nonfamily firms.

Moreover, Zou et al. (2008) examine the effect of the ownership structure on the purchase of D&O insurance and find that firms with more controlling-minority

shareholder conflicts are more likely to purchase D&O insurance because D&O insurance can protect directors and managers from expropriation-related litigation risk. Extending the idea of Zou et al. (2008), the family members in family firms with concentrated ownership have absolute controlling rights, in contrast to outside minority shareholders, and thus tend to purchase less D&O insurance. Based on the argument of less risk taking and higher absolute controlling rights in family firms, hypothesis 2 is offered as follows:

Hypothesis 2: Family firms tend to purchase less D&O insurance than nonfamily firms.

Further, with less risk taking by family firms, we expect that family firms with an overconfident CEO will tend to purchase less D&O insurance than nonfamily firms with an overconfident CEO. Conversely, if the restraint on overconfident CEOs through family control is limited, and the family owners who have undiversified holdings in the firm are concerned about firm risk and firm survival, then family firms with an overconfident CEO, who might underestimate the corporate risk and the risk faced from litigation, tend to purchase more D&O insurance to protect their wealth and assets than nonfamily firms with an overconfident CEO. Therefore, it can be inferred that family control may moderate the effects of managerial overconfidence on D&O insurance decisions. Thus, hypothesis 3 is offered as follows:

Hypothesis 3: Family control moderates the impact of CEO overconfidence on D&O insurance decisions.

In addition to family ties, loyalty, insurance, and stability, which all motivate family CEOs to make decisions based on the interests of family members, the concentrated ownership structure of family businesses implies an increase in the family CEO's power of control. As a result, we expect that these combined effects may lead to a stronger moderating effect of family control on the relationship between overconfident family CEOs and D&O insurance.

On the contrary, Shen and Chih (2005) argue that nonfamily CEO salaries and tenure are highly sensitive and strongly related to earnings performance; thus, considering competition in the managerial labor market, nonfamily CEOs are more likely to engage in risk-taking activities when their job is threatened or their tenure with the firm is short (Detzler and Machuga, 2002; Ghosh and Moon, 2010). Anderson, Mani, and Reeb (2003) note that family businesses that are concerned about long-term

performance sometimes hire professional nonfamily CEOs who tend to be overconfident about their own expertise and experience and thus optimistic about the firm's future performance. Nonfamily CEOs thus may reinforce the effects of CEO overconfidence on the demand for D&O insurance. However, in a study of Taiwan family businesses, Solomon et al. (2003) disagree, finding that even though nonfamily CEOs are not family members, they are recruited by family directors, implying that their decisions are restricted by the family members. In other words, the effects of family control, such as conservatism and a perspective that emphasizes long-term prospects, may affect the attitudes of nonfamily CEOs and further restrict their D&O insurance decisions, even in the case of CEO overconfidence. Because family control and nonfamily CEO characteristics have opposing effects on corporate D&O insurance, it is an empirical issue whether nonfamily CEOs have significant moderating effects on the relation between CEO overconfidence and D&O insurance decisions, and whether overconfident nonfamily CEOs tend to be more or less likely to purchase D&O insurance than overconfident family CEOs. Hence, hypothesis 4 is offered as follows.

Hypothesis 4a: Family control provides a lighter moderating effect on the relationship between overconfident family CEOs and D&O insurance decisions than the relationship between overconfident nonfamily CEOs and D&O insurance decisions.

Hypothesis 4b: Family control provides a stronger moderating effect on the relationship between overconfident family CEOs and D&O insurance decisions than the relationship between overconfident nonfamily CEOs and D&O insurance decisions.

3. Data, Variables and Summary statistics

3.1. Sample Selection and Description

Empirical research on D&O insurance is often impeded by the lack of data on firm-level purchases of D&O insurance. In this paper, we focus on non-financial firms listed on the Taiwan Stock Exchange from 2008 to 2014 because the disclosure of details about D&O insurance purchases is mandatory in Taiwan.[1] All financial and accounting data are obtained from the Taiwan Economic Journal (TEJ) database. Financial

[1] Our sample period starts in 2008 because it was the first year that Taiwan mandated the disclosure of D&O insurance purchases in annual corporate filings.

institutions are dropped from the sample due to their unique characteristics, such as government regulations that may impact their risk management and/or investment decisions. After dropping observations with missing financial or corporate governance data, our final sample contains 7,525 firm-year observations in an unbalanced panel. The sample distribution by industry is presented in Table 2. Across industries in the sample, the top five industries for firms purchasing D&O insurance are electronic products distribution (76.09%), communications and internet (75.43%), semiconductors (74.48%), optoelectronics (73.58%), and computer and peripheral equipment (73.19%). For the coverage ratio of D&O insurance, the highest five industries are cultural and creative (14.8%), information services (13.8%), electronic products distribution (8.2%), communications and internet (7.7%), semiconductors (7.5%), and computer and peripheral equipment (7.5%). In summary, the industries that purchase D&O insurance are concentrated in the electronics and cultural and creative industries, which may be because the electronics and cultural and creative industries face higher litigation risks than other industries. Descriptions of the variables used in our analysis are contained in Table 1. Below, we describe the most important variables in detail.

3.2 **D&O Insurance**

To examine the relation between managerial overconfidence and the demand for D&O insurance, we follow the literature (e.g., Chalmers, Dann, and Harford, 2002; Lin, Officer, and Zou, 2011) and utilize two proxies to measure the demand for D&O insurance. First, a dummy variable for D&O insurance is equal to one if a firm purchased D&O insurance in a given year and zero otherwise.

Second, we follow the literature (Chalmers, Dann, and Harford, 2002; Lin, Officer, and Zou, 2011; Lin, Officer, Wang, and Zou, 2013) and use the continuous insurance coverage ratio as a measure of the extent of D&O insurance. This variable is defined as the coverage limit of the D&O insurance policy scaled by the book value of equity of the firm at the end of the concurrent fiscal year. Scaling D&O insurance coverage by the book value of equity is necessary because the market value of equity is in theory a proxy for the maximum liability exposure, and both D&O insurance coverage and demand awards are often positively correlated with the book value of equity (Baker and Griffith, 2007). To curtail the influence of nonlinearity, the logarithm of the D&O insurance coverage ratio is used for the regression analyses. Finally, the winsorized insurance coverage ratio at the first percentile in the right tail is used to mitigate the undue influence of outliers. Summary statistics of the D&O insurance information can be found in Table 3. As can be observed from the table, approximately 56.62% of our

sample comprises firms that purchase D&O insurance policies to protect their directors and officers. The coverage limit on average represents 6.00% of the issuing firm's book value of equity in the sample, which is similar to that found in Lin, Officer, Wang, and Zou (2013) (6.5%).

3.3.Measuring Managerial Overconfidence

Doukas and Petmezas (2007) propose that overconfident managers believe that their decisions will ultimately create firm value, and thus it is expected that managers increase their shareholdings when they make a decision about mergers and acquisitions. Unlike acquisition decisions that would be driven by all managers, the chief executive officer may decide whether to buy D&O insurance based on his or her own thinking without considering other managers' opinions. Thus, we construct the first proxy variable of CEO overconfidence, which is the managers' net purchase of shares ratio, represented by ownership purchases minus sales scaled by the sum of the averaged purchases and sales (*CEO OC ratio*), which is used as a continuous measure of CEO overconfidence.

Additionally, applying similar logic to Malmendier and Tate (2005) and Campbell et al. (2011), we classify a CEO as overconfident (*CEO OC*) if in a given year his net purchase ratio is positive and in the top quartile of the distribution of the positive net purchase ratio by all CEOs.[2]

It is worth noting that Doukas and Petmezas (2007) use the insider trading activity of top managers (including directors' trading) to measure managerial overconfidence in examining corporate acquisitions. Hence, an alternative measure based on the insider net purchase of shares ratio is also used to investigate D&O insurance decisions. To test our first prediction that firms with an overconfident CEO will affect the demand for D&O insurance relative to firms without an overconfident CEO, we construct two proxy variables to examine our first hypotheses (H1a and H1b). Table 2 shows that the percentage of firms with overconfident CEOs is approximately 11.60% of our sample. In addition, the industries with the top five highest proportions for the CEO OC dummy

[2] In addition to managers' net purchase of shares ratio, Malmendier and Tate (2008) suggest that the frequent disclosure of good information and holding in-the-money stock options are other methods that can be used to measure CEO overconfidence. To use these measures, detailed information on managers' disclosures and option holdings are required. However, Taiwan does not have an active stock options market, and it also lacks a media data bank, making this method difficult to apply. Further, Lin et al. (2005) classify a manager as overconfident if there are more upwardly biased earnings forecasts than downwardly biased forecasts during his tenure. However, Taiwan made disclosure voluntary in 2003, so much of the earnings forecast information from 2004-2009 is no longer available.

variable are cement (31%), computer and peripheral equipment (23.4%), communications and internet (21.9%), plastics (21.7%) and food (21.6%). Overall, the industrial distribution shows that the phenomenon of CEO overconfidence exists in every industry, i.e., not only in the electronics industries but also in traditional industries.

3.4.Definition of Family Control

Following Yeh, Lee, and Woidtke (2001), two criteria are used to distinguish family control from nonfamily control: First, the control rights of the controlling shareholders must exceed a threshold of 10%. Second, more than 50% of the directors are controlled by the controlling shareholders. If the observations conform to the above two criteria, the sample firms are classified as family controlled. Thus, we set *Family* equal to one if the sample firm is classified as family controlled and 0 otherwise.

3.5. Control Variables

To examine the impact of managerial overconfidence and family control on the demand for D&O insurance, we follow the literature and control for firm characteristics, corporate governance, CEO characteristics and contract-specific factors that might affect the likelihood of future litigation and the demand for D&O insurance (e.g., Core, 1997, 2000; Chalmers, Dann, and Harford, 2002; Boyer, 2003; Egger, Radulescu and Rees, 2011; Lin, Officer and Zou, 2011; Boyer and stern, 2012; Gupta and Prakash, 2012; Lin, Officer, Wang and Zou, 2013; Gillan and Panasian, 2014; Boyer and Tennyson, 2015). The firm characteristics, corporate governance, CEO characteristics and insurance contract-specific variables enter our regression with industry effects to attempt to capture the heterogeneity in the demand for D&O insurance that is unrelated to observable firm/contract characteristics.

In terms of firm characteristics, we include firm size, the probability of financial distress, return performance, return volatility, growth opportunity, overinvestment and industry factors. The effect of firm size on the D&O insurance coverage decision is ambiguous. On the one hand, larger firms can be targeted more often in shareholder lawsuits, leading to a greater demand for insurance (Chung and Wynn, 2008). On the other hand, Mayers and Smith (1982), Core (1997), and Boyer and Stern (2012) note that whereas large firms tend to be equipped with in-house legal staff in order to defend against litigation, small firms are more likely to demand insurance coverage due to the real service efficiencies brought by the insurance and because bankruptcy costs are proportionately higher. This additional effect due to the possibility of financial distress

is captured by financial leverage. As for financial leverage (measured by the ratio of total debt to total assets), firms with a greater probability of financial distress are more likely to purchase D&O insurance because they have greater litigation risk; further, being covered by the insurance also lowers their expected bankruptcy costs (Core, 1997; Zou et al., 2008). However, if external debtholders have an incentive to monitor the firm's management, such monitoring can act as a substitute for the monitoring services provided by D&O insurance. Studies find that firms face greater litigation risk when they exhibit lower return performance (measured using ROA) and higher return volatility (measured using the standard deviation of ROA over the past five years). In addition, regarding contract-specific characteristics, we control for coinsurance and the number of insurers on a D&O insurance policy. Coinsurance is a dummy variable that equals 1 if there are at least two insurers participating on a D&O insurance policy and 0 otherwise. The number of insurers shows how many insurers are participating on a D&O insurance policy. The impacts of coinsurance and the number of insurers covering a D&O insurance policy may be positively related.

To control for corporate governance, the board structure and the ownership structure are included in the regressions. If owner-managers use equity ownership in affiliated firms in order to strengthen their control rights, we expect that these firms face a greater likelihood of litigation due to the heightened agency problem. The board structure primarily emphasizes board size and leadership duality. $\ln(BS)$ is the natural logarithm of the total number of directors on the board. *CEO duality* is a dummy variable that equals 1 if the CEO is chairman of the board (COB) and 0 otherwise. Ownership structure includes the percentage of common stock owned by outside directors (*Outsider Shareholdings*), the percentage of common stock owned by block holders (*Block Holdings*), cash flow rights (*Cash Flow Rights*), which is the cash flow stakes held by the ultimate owner, and the deviation between control rights and cash flow rights (*Deviation Diff*, *Wedge Diff*), which is measured as the difference between the voting rights and the cash flow rights held by the ultimate owner. Firms with a smaller board size, CEO duality, a lower ratio of outside directors holding shares, a higher ratio of block holders holding shares, lower cash flow rights, and a higher deviation between cash flow rights and control rights may have a higher chance of the board making decisions at the expense of minority shareholders, which can lead to a greater demand for D&O insurance due to the increased likelihood of litigation (Boyer and Stern, 2012; Gupta and Prakash, 2012; Lin, Officer, Wang and Zou, 2013; Gillan and Panasian, 2014; Boyer and Tennyson, 2015). On the other hand, if outside directors require D&O insurance as part of their compensation package, then firms that have a greater proportion of outside board members may have a greater likelihood of carrying

D&O insurance (Core, 1997, 2000; Chalmers, Dann, and Harford, 2002; Zou et al., 2008). To control for CEO characteristics, the CEO's compensation (*ln(CEO Salary)*), the CEO's tenure (*ln(CEO Tenure)*), and the CEO's stock ownership (*CEO ownership%*) are included (Fier et al., 2012, Boyer, 2008; Boyer and Stern, 2013; Lin et al., 2011; Lin et al., 2013).

3.6. Empirical Model

To examine the impact of managerial overconfidence and family control on the demand for D&O insurance, the empirical model is formulated as follows in Eq. (1).

$$\begin{aligned} D\&O_{it} = {} & \beta_0 + \beta_1 CEO\ OC_{it} + \beta_2 Family_{it} + \beta_3 \left(CEO\ OC_{it} \times Family_{it}\right) \\ & + \beta_4 \ln\left(TA_{it}\right) + \beta_5 ROA_{it} + \beta_6 Leverage_{it} + \beta_7 Sales\ growth_{it} \\ & + \beta_8 \ln\left(ROA\ volatility_{it}\right) + \beta_9 \ln\left(BS_{it}\right) \\ & + \beta_{10} CEO\ dual_{it} + \beta_{11} Outsider\ shareholdings_{it} + \beta_{12} Block\ shareholdings \\ & + \beta_{13} Institutional\ ownership_{it} + \beta_{14} Cash\ \ flow\ rights_{it} + \beta_{15} Wedge\ diff_{it} \\ & + \beta_{16} CEO\ shareholdings_{it} + \beta_{17} \ln\left(CEO\ tenure_{it}\right) + \beta_{18} \ln\left(CEO\ salary_{it}\right) \\ & + \beta_{19} Coinsurance_{it} + \beta_{20} Number\ of\ insurers_{it} \\ & + Industry\ \ Effect + \varepsilon_{it} \end{aligned} \tag{1}$$

If overconfident CEOs underestimate the likelihood of litigation and decrease the amount of D&O coverage, the coefficient of *CEO OC* is expected to be significantly negative. If firms with overconfident CEOs conduct more risk-taking activities which induce higher distress risk or higher probability of litigate risk and increase the amount of D&O coverage, the coefficient of *CEO OC* is expected to be significantly positive. Due to less risk taking and more risk aversion of family firms, we expect that firms with family control will have a decreased demand for D&O insurance, i.e., $\beta_2 < 0$. Further, we expect that the coefficient of the interaction term of *CEO OC* and *Family* should be positive, i.e., $\beta_3 > 0$.

3.6. Univariate analysis

Before conducting the regression analysis in the following section, we first look at univariate statistics. Table 3 first reports summary statistics for the analyzing variables and all the other control variables in the study. More than half of the firms in our sample purchased D&O insurance (56%). Scaled by book value of equity, the means (medians) of the standardized D&O ratio and the natural logarithm of the ratio of D&O insurance coverage plus one are 0.06 and 1.106 (0.013 and 0.828), respectively. Approximately

16.9% of the CEOs in the sample are classified as overconfident. Meanwhile, the mean of the continuous measure of the *CEO OC ratio* is 1.292. Therefore, our sample is somewhat skewed toward CEOs that are not overconfident. Approximately 40% of the sample firms are controlled by families. The average CEO tenure is 11.07 years, suggesting that the sample consists of mostly older and more experienced CEOs. The average salary of the CEOs is 149 NTD thousand per month. The percentage of firms whose CEO is also the chairman of the board (COB) is 30.8%. The mean of the CEO shareholdings is 1.6%.

Table 4 shows the correlation matrix among the variables we use in the regression analysis. We find that the correlation coefficient is 0.80 between the binary measure of D&O insurance and the natural log of the ratio of D&O insurance coverage plus one. Additionally, the correlation coefficient between the binary measure of CEO overconfidence and the ratio of CEO overconfidence is 0.78. The correlation coefficient is 0.55 between the number of insurers and the natural log of the ratio of D&O insurance coverage plus one, which indicates that the number of insurers affect the coverage by D&O insurance for D&O policies with coinsurance. The correlation coefficient is 0.61 between the binary measure of coinsurance and the number of insurers, which indicates that many insurers participate in syndicated D&O insurance policies. Finally, the highest correlation coefficient is 0.41 among the other control variables. Therefore, including the other control variables in our empirical regression will not create a problem of collinearity.

[Insert Table 4 about here]

4. Empirical Results

4.1. Difference tests between CEO overconfidence and non CEO overconfidence

Before conducting regression analysis in the following section, we first look at univariate statistics to see whether the broad patterns of the data are consistent with our hypothesis 1 about the relation between CEO overconfidence and the demand of D&O insurance. We split the sample into two groups: a group with overconfident CEOs and a group with non-overconfident CEOs and compare the proportion of purchase of D&O insurance and ratio of D&O insurance coverage between the overconfident CEOs and non-overconfident CEOs groups. The results are presented in Table 5. As shown in column 1 and column 2 of Table 5, there is a significant difference between the

proportion of the purchase of D&O insurance and ratio of D&O coverage for these two subsamples. The proportion of the purchase of D&O insurance for firms with overconfident CEOs is 62.7% which is significantly higher at the 1% level than the proportion for firms with non-overconfident CEOs (55.4%). However, the average ratio of D&O coverage for firms with overconfident CEOs is 0.050 which is significantly lower at the 1% level than the average ratio for firms with non-overconfident CEOs. These results suggest that firms with overconfident CEOs purchase less D&O insurance coverage than firms with non-overconfident CEOs, which is consist with the hypothesis 1a: overconfident CEOs may underestimate investment risk to forecast lower probability of litigation risk, thus firms with overconfident CEOs purchase less D&O insurance coverage than firms with non-overconfident CEOs. These univariate comparisons provide initial evidence confirming a relation between CEO overconfidence and D&O insurance coverage. Additionally, we find that firms with overconfident CEOs have higher shares of CEO holding, longer CEO tenure, higher CEOs' salary, large size, higher ROA, lower ROA volatility, large board size, lower ratios of block shareholders and outsider directors holding shares, and less cash flow rights. These significant characteristics are similar with previous findings.

Moreover, we divide our sample into family firms and nonfamily firms, and divide these two groups into firms with overconfident CEOs and firms with non-overconfident CEOs respectively. With regard to the sample set of family firms (column 3 and 4 in Table 5), the proportion of purchase of D&O insurance is significantly higher for firms with overconfident CEOs than for those with non-overconfident CEOs, maybe supporting hypothesis 4b. While ratio of D&O insurance coverage is significant lower for firms with overconfident CEOs than firms with non-overconfident CEOs, maybe consisting with the hypothesis 4a. With regard to the sample set of nonfamily firms (column 5 and 6 in Table 5), the proportion of D&O insurance is not significantly different between firms with overconfident CEOs and firms with non-overconfident CEOs, but the ratio of D&O insurance coverage is still significantly lower for firms with overconfident CEOs than firms with non-overconfident CEOs. Finally, most of means of the other independent variables for these subsamples are significantly different from each other.

[Insert Table 5 about here]

4.2. The Effect of CEO Overconfidence on D&O Insurance

In this section, we use panel regression analysis to examine the effects of CEO overconfidence on the likelihood of a firm having D&O insurance and D&O insurance coverage ratio. The key independent variables of interest are the CEOs overconfidence,

family control and the interaction term of family and CEOs overconfidence. The empirical results are presented in Table 6, which contains four regressions. The model (1) specification examines the effect of dummy variable of CEOs overconfidence, while the regression of model (3) examines the effect of CEOs overconfidence ratio. The model (2) and (4) examines the effect of CEOs overconfidence dummy and ratio under consideration for family control and the interaction term of family control and CEOs overconfidence.

As can be seen from the Logit regressions of model (1)-(4) in Panel A of Table 6, dummy variables of CEOs overconfidence (CEO OC) and the ratios of CEOs overconfidence (CEO OC ratio) do not have significantly impact on the likelihood of a firm having D&O insurance. This implies that CEO overconfidence on average do not affect incentive of purchasing D&O insurance under the mandatory regulation in Taiwan. Moreover, from the Tobit regressions for the ratio of D&O insurance coverage in Panel B of Table 6, the coefficients of CEO OC is -0.099 and significant at the 5% level in model (2), while the coefficients of CEO OC ratio is -0.022 and significant at the 5% level in model (4). The result supports our prediction that a firm with a more overconfident CEO will have a lower demand for D&O insurance relative to a firm with a non-overconfident CEO. These suggest that the demand for D&O insurance is decreasing in the level of CEO overconfidence, supporting the hypothesis 1a.

Family members tend to focus on long-term organizational goals and family wealth is closely connected to firm value (Anderson and Reeb, 2003; Miller, Le Breton-Miller, and Scholnick, 2008), thus managers of family firms tend to act as good stewards, paying more attention to the firms' long-term performance and reputation. Therefore, family businesses have lower risk-taking than nonfamily businesses, and restrict overconfident managers' risk-taking activities. As can be seen from the model (2) and model (4) in Panel A and Panel B, the coefficients of family control are significant negative at 1% level, supporting with our hypothesis 2: family businesses have less incentive to purchase D&O insurance than non-family firms.

Further, the signs of the interaction term (*CEO OC*Family*, *CEO OC ratio*Family*) are positive and significant at 1% level in the model (2) and model (4) of Panel A. With regards to model (2) and (4) of Panel B, the coefficients of the interaction variable are 0.294 and 0.059, and both significant at 1% level. These results support our Hypothesis 3, indicating that family control positively moderates the negative relation between CEO overconfidence and D&O insurance demand.

Based on model (2) in Panel B of Table 6, the effect of CEO overconfidence in family businesses on D&O insurance coverage is 0.195 (-0.099+0.294) but the effect is -0.099 in nonfamily businesses. Additionally, based on model (4) in Panel B, the effect of overconfident CEOs in family businesses is equal to 0.0004 (-0.022*0.01+0.059*0.01) which is significantly higher than that in nonfamily businesses (-0.022*0.01) as CEOs OC ratio increases 1%. Compared with overconfident CEOs in family businesses, overconfident CEOs in nonfamily businesses have stronger incentives to decreases D&O insurance coverage. The results suggest that if CEOs in nonfamily businesses are overly optimistic about future risk, they may be more likely to decrease the demand of D&O insurance. Taken together, overconfident CEOs in family businesses are more likely to increase D&O insurance coverage than overconfident CEOs in nonfamily businesses, implying that the positive influence of family control on D&O insurance coverage dominates the negative effect of CEOs overconfidence.

[Insert Table 6 about here]

Anderson et al. (2003) suggest that the difference in the behavior of family and nonfamily CEOs may be due to the effects of family control. We thus go a step further to investigate whether there is a difference in how family and nonfamily CEOs moderate the effects of CEOs overconfidence on D&O insurance. Table 7 presents the results. With regards to the Logit regressions of model (1) and (2), the signs of interaction terms of *FCEO*CEO OC* and *FCEO*CEO ratio* are significantly positive at the 5% level while the signs of interaction terms of *FNFCEO*CEO OC* and *FNFCEO*CEO ratio* are also significantly positive at the 5% level. With regards to Tobit regressions of model (3) and (4), the coefficients of interact terms of *FCEO*CEO OC* (*FCEO*CEO ratio*) is 0.355 (0.067) and significant at the 1% level but the coefficients of interactive terms of *FNFCEO*CEO OC* (*FNFCEO*CEO ratio*) is 0.144 (0.034) and insignificant. In model (3), the coefficient of overconfident family CEOs in family businesses is equal to 0.259 (-0.096+0.355), is significantly larger than that in nonfamily business (-0.096). These results support the Hypothesis 4b that family control provides stronger moderating effect on the relationship between overconfident *family* CEOs and D&O insurance than the relationship between overconfident *nonfamily* CEOs and D&O insurance.

[Insert Table 7 about here]

4.3. Economic Mechanism: The Effects of Overinvestment on the Relation between CEO Overconfidence and D&O Insurance

Our evidence suggests that firms with overconfident CEO tend to have smaller D&O insurance coverage in non-family firms while the family firms with overconfident CEO tend to purchase more D&O insurance. In this section, we seek to understand the economic mechanisms through which D&O insurance coverage might affected by overconfident CEO. Evidence has shown that overconfident CEOs conduct more risk taking activities, such as overinvestment, higher R&D spending, more merger and acquisitions. Excessive risk taking is an important concern of a firm's insurance decision. Because excessive risk taking increase litigation risk of a firm, thus the firm has incentive to purchase D&O insurance to avoid litigation risk and losses. Hence, we suggest that firm with overinvestment may tent to purchase more D&O insurance. If overconfident CEO underestimates excessive risk from overinvestment, then he/she is possible to under-estimate litigation risk. Therefore, compare to firms, which conduct the same level overinvestment, with non-overconfident CEO, firms with overconfident CEO tend to purchase less D&O insurance. Therefore, we utilize Eq. (2) to investigate this impact of interaction term of dummy overconfident CEO and overinvestment on the incentive of purchasing D&O insurance and D&O insurance coverage.

$$
\begin{aligned}
D\&O_{it} = {} & \theta_0 + \theta_1 CEO\ OC_{it} + \theta_2 \left(CEO\ OC_{it} \times Overinvestment_{it}\right) + \theta_3 \ln\left(TA_{it}\right) + \beta_3 ROA_{it} \\
& + \theta_4 Leverage_{it} + \theta_5 Sales\ Growth_{it} + \theta_6 \ln\left(ROA\ Volatility_{it}\right) + \theta_7 Overinvestment_{it} \\
& + \theta_8 \ln\left(BS_{it}\right) + \theta_9 CEO\ dual_{it} + \theta_{10} Outsider\ shareholdings_{it} + \theta_{11} Block\ shareholdings \\
& + \theta_{12} Institutional\ ownership_{it} + \theta_{13} Cash\ \ flow\ rights_{it} + \theta_{14} Wedge\ diff_{it} \\
& + \theta_{15} CEO\ shareholdings_{it} + \theta_{16} \ln\left(CEO\ tenure_{it}\right) + \theta_{17} \ln\left(CEO\ salary_{it}\right) \\
& + \theta_{18} Syndicate_{it} + \theta_{19} Number\ of\ insurers_{it} + Industry\ Effect + \varepsilon_{it}
\end{aligned}
\tag{2}
$$

We conduct regression analyses with overinvestment, and the interaction term of *CEO OC* (*CEO OC ratio*) and overinvestment is the main variable we are interested. The regression results are shown in Table 8. The regressions in model (1), (2), (5) and (6) use the dummy variable of D&O insurance as the dependent variable, while the empirical results based on D&O insurance coverage are presented in model (3), (4), (7) and (8). Either samples of family control or samples of non-family control, except in model (7) and (8), the impacts of overinvestment on the incentive of purchasing D&O insurance and D&O insurance coverage are significantly positive at 5% level, indicating that firms with higher risk-taking activities tend to increase D&O insurance to mitigate litigation risk. With regards to sample set of family control, interaction term of overconfident CEO and overinvestment do not affect the incentive of purchasing D&O insurance and D&O coverage. However, in sample set of nonfamily control, the interaction term of *CEO OC* and overinvestment significantly and negatively affect the purchase of D&O insurance and D&O insurance coverage ratio. These results reveal

that the negative relationship between CEO OC and D&O insurance coverage mainly results from the risk underestimate by overconfident CEOs.

[Insert Table 8 about here.]

4.4. Robustness Checks

We now look at the robustness of our primary findings. The test results indicate that the moderating effects of family control on the relation between CEOs overconfidence and demand of D&O insurance are constant over time and robust in relation to (1) endogeneity, the results are shown in Table 9. (2) alternative measures of CEO overconfidence, the results are shown in Table 10. (3) alternative measures of D&O insurance coverage ratio, the results are presented in Table 11. (4) alternative measures of family control, the results are presented in Table 12. (5) the effect of manager overconfidence, the results are shown in Table 13.

4.4.1. Endogeneity

Our empirical framework for testing the effect of CEO overconfidence on D&O insurance decision may suffer from potential endogeneity issues: simultaneity, omitted variables, or measurement errors. To mitigate these issues, we have taken step to alleviate concerns arising from reverse-causality and omitted variables by two-stage least squares (2SLS) procedure (see, e.g., Griliches and Hausman, 1986; Berger and Hannan, 1998; Biorn, 2000) by using CEO education (*CEO education*) as an instrument that is an exogenous variable economically related to CEO overconfidence but is uncorrelated with the error term of the regression relating the D&O insurance decision. This instrument that we choose is consistent with Bhandari and Deaves (2006), which suggest that highly-educated males are more subject to overconfidence.

In the 2SLS mode, we treat dummy *CEO OC* and *CEO OC ratio* as an endogenous variable that we instrument with CEO education in the first stage with other exogenous variables. In the second stage, we replace the fitted value of CEO OC and CEO OC ratio from the first stage in the main regressions. The results from the 2SLS regression shown in Table 9 are consistent with the baseline results in Table 6. The predicted values of dummy *CEO OC* and *CEO OC ratio* from the first stage have significant negative impacts on the likelihood of firm having D&O insurance and the D&O insurance coverage ratio in almost all models of the second stage at 1% level. The coefficients of binary measures of family control are still significantly negative at 1% level. The coefficients of interaction terms of predicted value of CEO OC and family control, of predicted value of CEO OC ratio and family control are still significantly positive in all

models of the second stage at 1% level. Therefore, our supportive results in Table 6 are robust to the possibility of the endogenous problem.

[Insert Table 9 about here]

4.4.2. Alternative Definition of CEO Overconfidence

In the above tests and discussion, the firms with the highest 25% of the CEO net purchase ratio in the sample are classified as the firms with overconfident CEO. To assure that our results are not dependent upon the particular choice of the order of the CEO net purchase ratio, we examine equation (1) using different thresholds of CEO positive net purchase ratio which has been tested in prior studies (see, for example, Campbell et al., 2011). The binary measure of CEOs overconfidence (*CEO OC*) equals unity if the order of CEO positive net purchase ratio is within the top 20th percentile, the top 10th percentile respectively; otherwise *CEO OC* is zero. Additionally, we rank firms with overconfident CEO according to CEO net purchase (NT dollars). The binary measure of CEOs overconfidence (CEO OC) equals unity if the CEO net purchase is within the top 25th ranking; otherwise CEO OC is zero. Finally, we use the highest 25% of CEO positive net purchase ratio in lag one period to define the firm with CEOs overconfidence. The results for using different thresholds in models are reported in Table 10. All coefficients of CEO OC are negative, but only the binary measures of CEO OC from top 25th percentile and top 25th ranking of CEO net purchase ratio significantly and negatively affect the incentive and extents of D&O insurance at 5% level, which is similar as the main results of Table 6. Further, the interaction terms of *CEO OC dummy* and *family control* are all positive and statistically significant in all Logit and Tobit regressions. Therefore, the Hypothesis 1a, Hypothesis 2 and Hypothesis 3 are still validly supported when adopting different thresholds of CEO OC.

[Insert Table 10 about here]

4.4.3. Alternative Measures of D&O Insurance Coverage Ratio

Two new D&O insurance coverage ratio are adopted to rerun the effect of CEO overconfidence on D&O insurance. The first is measured by natural log of the D&O insurance amount divided by market value of equity and the second is measured by the D&O insurance amount divided by book value of equity (see, for example, Lin et al., 2013). Table 11 shows that the direction and significance of the estimating coefficients are all similar to those in Panel B of Table 6. Therefore, the empirical results presented in the present study are not driven by the measures of the D&O insurance coverage

ratio.

[Insert Table 11 about here]

4.4.4. Alternative Definitions of Family Control

Although in our study 10% control rights is chosen as the threshold for distinguishing between family and nonfamily business, we also test levels of 5% and 15% in the robustness tests. All the results in Table 12 are qualitatively as similar as in Table 6 and significant at conventional levels. The coefficients of CEO OC, CEO OC ratio and family control are negative and significant at 10% level. The coefficients of interaction terms of *CEO OC*Family* and *CEO OC ratio*Family* are significantly positive at 5% level. Taken together, our empirical results still support that Hypothesis 1a, Hypothesis 2 and Hypothesis 3. Therefore, our empirical results are robustness.

[Insert Table 12 about here]

4.4.5 The Effect of Managerial Overconfidence

Most D&O insurance contracts involve provisions for other top executives besides the CEO. Therefore it can be argued that the joint decision by the top executives may affect the demand for D&O insurance more than the decision by the CEO. In order to test the overall board or top executive demand for D&O insurance we construct an aggregate measure of managerial level overconfidence. We construct the aggregate overconfidence measure for the all managers in the following way: the first stage is to calculate net purchase ratio of all managers by sum of all managers' ownership of purchases minus sales scaled by the sum of averaged purchase and sales of all managers for each firm-year (managers OC ratio). The second stage is defined the binary measure of managerial overconfidence (Managers OC) equals unity if the order of aggregated managers net purchase ratio is within the top 25^{th} percentile; otherwise Managers OC is zero. The results show that the direction and significance of the estimating coefficients in Table 13 are similar to those in Panel A and Panel B of Table 6. Therefore, the empirical results presented in the present study are not driven by the measures of managerial overconfidence.

[Insert Table 13 about here]

5. Conclusions

This dynamic is the moral hazard problem in D&O insurance which has been supported

somewhat in the literature as firms with higher litigation risk tend to purchase more D&O liability insurance (Gillan and Panasian, 2014). In this paper, we use a sample of listed firms in Taiwan from 2008-2014 to investigate how CEO overconfidence impacts the demand for D&O insurance. We have an important and main reason for using sample of listed firms in Taiwan because Taiwan Stock Exchange requires publicly traded companies to mandatorily reveal relevant information about D&O insurance since 2008. In addition, different from the environment in the U.S. and Canada, firms operate in environment characterized by poor corporate governance, poor legal protection and family control in Asian-Pacific emerging market. Therefore, the D&O insurance is more important for shareholders in Asian-Pacific emerging market than for shareholder in U.S. and Canada. This situation provides us an opportunity to investigate the effects of CEO managerial bias and family control on D&O insurance decisions. The panel regression results show a significantly negative relation between CEO overconfidence and the amount of D&O insurance purchase of non-family-controlled firms, suggesting that managerial overconfidence leads to a decrease in the demand of D&O insurance. Moreover, family control positively moderates the negative relation between CEO overconfidence and the demand of D&O insurance. Finally, we find that the moderating effects of family control are stronger in family CEOs than non-family CEOs.

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Table 1 The Variable definitions

Variables	Definition
D&O insurance information	
$D\&O(1/0)$	Indicator variable equal to one if the firm purchases D&O insurance in the fiscal year; zero otherwise.
$D\&O\ \ coverage\ \ ratio$	The ratio of the coverage of the D&O insurance to book value of equity at the fiscal year end (winsorized at the 99th percentile).
$\ln(D\&O\ \ coverage\ \ ratio + 1)$	The natural logarithm of ratio of coverage of D&O insurance plus one
CEO Overconfidence	
CEO OC ratio	The ratio is the net ownership of purchases minus sales scaled by the sum of averaged purchase and sales at the fiscal year end (winsorized at the 99th percentile)
CEO OC(1/0)	This variable is the dummy variable and is equal to one if managers' net purchase ratio are in the top quartile of the distribution of positive net purchases ratio (winsorized at the 99th percentile) by all CEOs.
Family Control	
Family (1/0)	The variable is a dummy variable equal to 1 if the control rights of controlling shareholders must exceed a threshold of 10% and more than 50% of the directors are controlled by controlling shareholders and 0 otherwise.
FCEO (1/0)	Dummy variable equals one if the managers of family businesses are family members, and zero otherwise.
FNFCEO (1/0)	Dummy variable equals one if the managers of family businesses are professional managers, and zero otherwise.
Contract-specific factor of D&O insurance	
Coinsurance	Indicator variable equal to one if there is at least two insurers to underwrite a D&O insurance policy for a firm.
Number of Insurers	The variable counts the number of insurers which how many insurers joint a D&O insurance policy to provide the demand of D&O insurance for a firm.
Firm Characteristics	
$\ln(Total\ \ Assets)$	The natural logarithm of book value of firm's total assets in fiscal year end
ROA	The ratio is return on assets which net income is divided by total assets in fiscal year end.
$Sales\ \ Growth$	The ratio measures as the amount of current net sales minus previouse net sales is dividend by net sales in last year.
$Leverage$	The total liabilities to total assets, measured at the end of the current year
$\ln(ROA\ \ Volatility)$	The natural logarithm of standard deviation of ROA. The standard deviation of ROA is standard deviation of return on assets over the past five years
Over-investment	Over-investment is defined as positive residues from the investment efficiency estimation model. We define the residuals from estimating the following model based on Biddle et al. (2009) as investment inefficiency. The model is shown as follows: $Invest_{it} = \alpha_0 + \alpha_1 NEG_{it-1} + \alpha_2 Growth_{it-1} + \varepsilon_{it}$, where INVEST is measured as the sum of new purchase of property, plant, and equipment (PPE) and the research and development expenditure less the sale of property, plant, and equipment (PPE) in the following year, scaled by average total assets. NEG is a dummy variable that is equal to 1 if the revenue growth ratio is negative in the last year and 0 otherwise. Growth is the growth rate of net sales over the previous year.
Governance Characteristics	
$\ln(BS)$	The natural logarithm of number of directors and supervisors on the board
Cash flow rights	The cash flow stakes held by the ultimate owner
Deviation diff (wedge diff)	The difference between the voting rights and the cash flow rights held by this shareholder
Outsider Shareholdings	The percentage of the common stock owned by outside directors
Block Holdings	The percentage of the common stock owned by block shareholders
Institutional Ownership	The percentage of the common stock owned by institutional investors
Managerial Characteristics	
CEO Dual	The dummy variable is equal to 1 if the CEO is also the chairperson of the board and 0 otherwise.
CEO shareholdings	The percentage of the common stock owned by CEO
$\ln(CEO\ \ Tenure)$	The natural logarithm of average tenure of managers
$\ln(CEO\ \ salary)$	The natural logarithm of CEO salary

Table 2 Sample distribution by industry

TSE Industry Code	number of firm-year	% of obs.	Purchase of D&O (%)	D&O Coverage (by Equity BV) (%)	% of CEO OC
Cement (01)	42	0.56	35.71	0.005	0.310
Food (02)	139	1.85	39.57	0.024	0.216
Plastic (03)	157	2.09	35.03	0.020	0.217
Textile (04)	276	3.67	13.04	0.033	0.123
Electric Machinery (05)	357	4.74	37.82	0.043	0.143
Electrical and Cable (06)	83	1.10	37.35	0.011	0.096
Glass and Ceramic (08)	26	0.35	23.08	0.013	0.154
Paper and Pulp (09)	39	0.52	28.21	0.016	0.154
Iron and Steel (10)	215	2.86	41.86	0.051	0.191
Rubber (11)	57	0.76	24.56	0.007	0.123
Automobile (12)	32	0.43	18.75	0.008	0.063
Building Material and Construction (14)	404	5.37	36.39	0.037	0.139
Shipping and Transportation (15)	124	1.65	45.16	0.009	0.097
Tourism (16)	96	1.28	32.29	0.026	0.042
Trading and Consumers Goods Industry (18)	134	1.78	37.31	0.038	0.164
Chemical Industry (21)	207	2.75	34.78	0.032	0.145
Biotechnology and Medical Care (22)	309	4.11	61.49	0.066	0.172
Oil, Gas and Electricity Industry (23)	69	0.92	20.29	0.009	0.101
Semiconductor Industry (24)	674	8.96	74.78	0.075	0.175
Computer and Peripheral Equipment Industry (25)	593	7.88	73.19	0.075	0.234
Optoelectronic Industry (26)	636	8.45	73.58	0.068	0.140
Communications and Internet Industry (27)	411	5.46	75.43	0.077	0.219
Electronic Parts/Components Industry (28)	1073	14.26	59.65	0.056	0.184
Electronic Products Distribution Industry (29)	230	3.06	76.09	0.082	0.187
Information Service Industry (30)	192	2.55	72.92	0.138	0.167
Other Electronic Industry (31)	389	5.17	68.64	0.057	0.159
Cultural ad Creative Industry (32)	96	1.28	63.54	0.148	0.208
Others (20)	446	5.93	54.48	0.100	0.146
Managed Stock (80)	19	0.25	26.32	0.034	0.053
Total	7525	100.00	56.62	0.060	0.116

Table 3 Descriptive statistics

All variables are as defined in Table 1.

Variable	Mean	Std. dev.	1st Perc.	10th Perc.	Q1	Median	Q3	90th Perc.	99th Perc.
The Demand of D&O Insurance									
$D\&O(1/0)$	0.566	0.496	0	0	0	1	1	1	1
$\ln(D\&O\ \ coverage\ \ ratio + 1)$	1.106	1.204	0	0.000	0.000	0.828	2.039	2.794	4.467
$D\&O\ \ coverage\ \ ratio$	0.060	0.126	0	0.000	0.000	0.013	0.067	0.154	0.861
CEO Characteristics									
CEO OC	0.169	0.375	0	0	0	0	0	1	1
CEO OC Ratio	1.292	2.191	0.000	0.000	0.000	0.000	2.000	4.000	11.136
Family	0.400	0.490	0	0	0	0	1	1	1
Ln (Avg. Manager Tenure)	2.405	0.876	-0.592	1.253	2.040	2.565	2.992	3.335	3.745
Ln (CEO Salary)	5.006	4.128	0.000	0.000	0.000	6.140	8.519	9.895	12.401
CEO Dual	0.308	0.461	0	0	0	0	1	1	1
CEO Shareholdings	0.016	0.026	0.000	0.000	0.001	0.006	0.021	0.044	0.118
Firm Characteristics									
Co-insurance	0.044	0.205	0	0	0	0	0	0	1
Number of Insurers	0.680	0.834	0	0	0	1	1	1	4
Ln (Board Size)	2.221	0.215	1.792	1.946	2.079	2.197	2.303	2.485	2.890
Block Holdings	0.204	0.118	0.020	0.078	0.122	0.182	0.262	0.355	0.598
Outsider Shareholdings	0.139	0.103	0.000	0.029	0.064	0.117	0.191	0.278	0.483
Cash Flow Rights	0.238	0.177	0.005	0.045	0.096	0.195	0.344	0.493	0.731
Deviation	6.402	11.275	0.000	0.030	0.310	1.730	6.480	20.510	52.980
Institutional Ownership	0.364	0.227	0.009	0.091	0.178	0.327	0.527	0.692	0.937
Ln (Total Assets)	15.178	1.396	12.316	13.629	14.238	14.984	15.953	16.991	19.437
ROA	0.027	0.176	-0.435	-0.079	0.003	0.043	0.087	0.133	0.242
Sales Growth	-0.009	0.495	-1.303	-0.358	-0.153	-0.001	0.136	0.318	1.328
Leverage	0.355	0.176	0.045	0.143	0.221	0.340	0.465	0.585	0.839
Ln (ROA Volatility)	-3.185	0.846	-5.174	-4.215	-3.709	-3.208	-2.668	-2.137	-0.924
Overinvestment	0.019	0.046	0.000	0.000	0.000	0.000	0.018	0.059	0.210

Table 4 Correlated matrix

All variables are as defined in Table 1. *** indicates significance at the 1% level. ** indicates significance at the 5% level. * indicates significance at the 10% level.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1 D&O	1																					
2 Ln (D&O Coverage)	**0.80** ***	1																				
3 CEO OC Ratio	0.08 ***	0.00	1																			
4 CEO OC	0.06 ***	0.00	**0.78** ***	1																		
5 Family	-0.22 ***	-0.23 ***	-0.01	-0.01	1																	
6 Ln (Avg. Manager Tenure)	-0.12 ***	-0.17 ***	0.02	0.02 **	0.04 ***	1																
7 Ln (CEO Salary)	0.09 ***	-0.06 ***	0.19 ***	0.14 ***	-0.07 ***	0.28 ***	1															
8 Co-insurance	0.19 ***	0.11 ***	0.05 ***	0.03 **	0.01	0.00	0.05 ***	1														
9 Number of Insurers	**0.71** ***	**0.55** ***	0.08 ***	0.06 ***	-0.12 ***	-0.07 ***	0.09 ***	**0.61** ***	1													
10 Ln (Board Size)	0.04 ***	-0.03 ***	0.06 ***	0.05 ***	-0.05 ***	0.02 **	0.07 ***	0.05 ***	0.07 ***	1												
11 Block Holdings	-0.14 ***	-0.09 ***	-0.09 ***	-0.07 ***	0.07 ***	-0.06 ***	-0.09 ***	-0.03 *	-0.09 ***	-0.18 ***	1											
12 Outsider Shareholdings	0.06 **	0.11 ***	-0.06 ***	-0.05 ***	-0.28 ***	-0.12 ***	-0.08 ***	-0.01	0.05 ***	0.05 ***	0.27 ***	1										
13 Cash Flow Rights	-0.24 ***	-0.20 ***	-0.08 ***	-0.05 ***	0.25 ***	0.01	-0.02 *	-0.14 ***	-0.22 ***	-0.18 ***	**0.41** ***	-0.31 ***	1									
14 Deviation	0.08 ***	0.15 ***	-0.01	0.00	0.12 ***	-0.12 ***	-0.03 **	0.15 ***	0.14 ***	0.11 ***	-0.08 ***	-0.12 ***	-0.24 ***	1								
15 Institutional Ownership	0.06 ***	-0.05 ***	0.01	0.00	0.23 ***	-0.11 ***	0.12 ***	0.17 ***	0.18 ***	0.16 ***	0.25 ***	0.11 ***	0.19	**0.40** ***	1							
16 CEO Dual	0.01	0.05 ***	0.01 ***	0.01	-0.07 ***	0.22 ***	0.05 ***	-0.03 **	-0.02	-0.14 ***	0.03 **	0.04 ***	0.02 ***	-0.15 ***	-0.18 ***	1						
17 CEO Shareholdings	0.09 ***	0.13 ***	0.08	0.07 ***	-0.08 ***	0.02 *	0.11 ***	-0.01	0.02 *	0.02 *	-0.08 ***	0.03 ***	-0.19 ***	0.18 ***	-0.18 ***	-0.03 **	1					
18 Ln(Total Assets)	0.09 ***	-0.24 ***	0.16 ***	0.12 ***	0.22 ***	0.14 ***	0.29 ***	0.27 ***	0.27 ***	0.26 ***	-0.09 ***	-0.20 ***	-0.13 ***	0.08 ***	**0.41** ***	-0.15 ***	-0.16 ***	1				
19 ROA	-0.01	-0.13 ***	0.05 ***	0.04 ***	0.00	0.10 ***	0.30 ***	-0.01	-0.01	0.06 ***	-0.02 *	-0.03 ***	0.03 ***	0.03 **	0.12 ***	-0.07 ***	0.05 ***	0.18 ***	1			
20 Sales Growth	-0.01	-0.04 ***	0.03 **	0.01	0.01	-0.02 **	0.03 **	-0.02	-0.02	0.02 **	0.03 **	0.03 ***	0.03 ***	0.02	0.06 ***	-0.03 **	0.03 ***	0.04 ***	0.21 ***	1		
21 Leverage	-0.03 ***	0.01	0.03 **	0.01	0.05 ***	-0.04 ***	-0.17 ***	0.04 ***	0.00	-0.03 ***	0.08 ***	0.01	0.03 ***	-0.02 *	0.03 **	-0.01	-0.05 ***	0.18 ***	-0.19 ***	0.02	1	
22 Ln (ROA Volatility)	0.08 ***	0.19 ***	-0.07 ***	-0.07 ***	-0.12 ***	-0.25 ***	-0.33 ***	0.01	0.04 ***	-0.14 ***	0.06 ***	0.13 ***	-0.04 ***	0.03 ***	-0.07 ***	0.06 ***	0.01	-0.27 ***	-0.21 ***	-0.02	0.00	1
23 Overinvestment	0.07 ***	0.14 ***	0.00	0.01	-0.08 ***	-0.08 ***	0.00	0.00	0.05 ***	-0.01	0.01	0.10 ***	-0.05 ***	0.05 ***	0.02 **	0.00	0.03 ***	-0.12 ***	-0.05 ***	0.03 ***	0.01	0.14 ***

Table 5 Demand of D&O insurance for subsamples

All variables are as defined in Table 1. *** indicates significance at the 1% level. ** indicates significance at the 5% level. * indicates significance at the 10% level.

	Full Sample					Family Firms				Non-Family Firms					
	CEO OC Firms		Non-CEO OC Firms		Difference tests	CEO OC Firms		Non-CEO OC Firms		CEO OC Firms		Non-CEO OC Firms		Difference tests	Difference tests
	(1)		(2)		(1)-(2)	(3)		(4)		(5)		(6)		(3)-(4)	(5)-(6)
Variable	N	Mean	N	Mean	t-value	N	Mean	N	Mean	N	Mean	N	Mean	t-value	t-value
D&O	1270	0.627	6255	0.554	4.78 ***	490	0.547	2517	0.409	780	0.677	3738	0.651	5.66 ***	1.36
Ln (D&O Coverage)	1270	1.104	6255	1.106	-0.04	490	0.818	2517	0.759	780	1.285	3738	1.339	1.18	-1.20
D&O Coverage	1270	0.050	6255	0.062	-4.00 ***	490	0.031	2517	0.045	780	0.061	3738	0.074	-3.60 ***	-2.82 ***
CEO OC Ratio	1270	5.092	6255	0.520	63.66 ***	490	5.390	2517	0.460	780	4.906	3738	0.561	41.12 ***	48.88 ***
CEO Shareholdings	1270	0.020	6255	0.015	6.02 ***	490	0.017	2517	0.013	780	0.022	3738	0.017	3.65 ***	4.55 ***
Ln (Board Size)	1270	2.246	6255	2.216	4.51 ***	490	2.229	2517	2.205	780	2.256	3738	2.224	1.99 **	4.66 ***
Block Holdings	1270	0.186	6255	0.207	-6.57 ***	490	0.186	2517	0.219	780	0.186	3738	0.200	-6.10 ***	-3.32 ***
Cash Flow Rights	1270	0.216	6255	0.242	-4.94 ***	490	0.266	2517	0.298	780	0.185	3738	0.204	-3.64 ***	-3.13 ***
Deviation	1270	6.322	6255	6.418	-0.29	490	8.464	2517	8.040	780	4.977	3738	5.326	0.66	-1.03
Institutional Ownership	1270	0.362	6255	0.365	-0.43	490	0.433	2517	0.427	780	0.317	3738	0.323	0.51	-0.70
Outsider Shareholdings	1270	0.128	6255	0.141	-4.59 ***	490	0.090	2517	0.106	780	0.152	3738	0.165	-4.37 ***	-3.46 ***
CEO Dual	1270	0.318	6255	0.305	0.90	490	0.276	2517	0.265	780	0.345	3738	0.333	0.48	0.66
Ln (Avg. Manager Tenure)	1270	2.451	6255	2.395	2.20 **	490	2.545	2517	2.430	780	2.392	3738	2.372	2.79 ***	0.62
Ln (CEO Salary)	1270	6.295	6255	4.744	12.84 ***	490	6.424	2517	4.285	780	6.215	3738	5.054	10.45 ***	7.67 ***
Co-insurance	1270	0.057	6255	0.041	2.22 **	490	0.063	2517	0.043	780	0.053	3738	0.040	1.77 *	1.41
Number of Insurers	1270	0.784	6255	0.659	4.26 ***	490	0.691	2517	0.527	780	0.842	3738	0.748	4.10 ***	2.34 **
Leverage	1270	0.359	6255	0.355	0.90	490	0.373	2517	0.366	780	0.350	3738	0.347	0.94	0.48
Ln (ROA Volatility)	1270	-3.308	6255	-3.160	-6.25 ***	490	-3.459	2517	-3.279	780	-3.213	3738	-3.080	-4.70 ***	-4.52 ***
Ln (Total Assets)	1270	15.536	6255	15.106	9.41 ***	490	16.037	2517	15.457	780	15.222	3738	14.869	7.50 ***	6.63 ***
Sales Growth	1270	0.003	6255	-0.011	1.02	490	0.012	2517	-0.005	780	-0.002	3738	-0.016	0.69	0.77
ROA	1270	0.044	6255	0.024	5.81 ***	490	0.048	2517	0.023	780	0.041	3738	0.024	4.29 ***	4.04 ***
Overinvestment	1270	0.020	6255	0.019	-0.53	490	0.016	2517	0.014	780	0.022	3738	0.022	-1.28	0.22
Family	1270	0.386	6255	0.402	-1.10										

Table 6 The impact of CEO overconfidence on D&O insurance

The table reports the results of the association between CEO overconfidence and D&O insurance. The dependent variable in Panel A is the dummy for the purchase of D&O insurance. The dependent variable in Panel B is the D&O insurance coverage ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

Panel A. The Logit regressions for the purchase of D&O insurance

Parameter	(1)	(2)	(3)	(4)
Intercept	-3.247 ***	-3.399 ***	-3.234 ***	-3.351 ***
	(-4.48)	(-4.61)	(-4.46)	(-4.54)
CEO OC	0.093	-0.083		
	(1.29)	(-0.90)		
CEO OC Ratio			0.020	-0.021
			(1.52)	(-1.23)
Family		-0.872 ***		-0.924 ***
		(-13.05)		(-13.15)
Family*CEO OC		0.416 ***		
		(2.88)		
Family*CEO OC Ratio				0.095 ***
				(3.70)
Ln (Board Size)	0.158	-0.044	0.158	-0.046
	(1.16)	(-0.32)	(1.15)	(-0.33)
Block Holdings	-0.774 ***	-0.776 ***	-0.768 ***	-0.767 ***
	(-2.75)	(-2.73)	(-2.72)	(-2.69)
Outsider Shareholdings	-0.315	-1.099 ***	-0.307	-1.103 ***
	(-0.86)	(-2.93)	(-0.84)	(-2.93)
Cash Flow Rights	-1.936 ***	-1.783 ***	-1.932 ***	-1.785 ***
	(-8.04)	(-7.28)	(-8.02)	(-7.28)
Deviation	-0.008 **	-0.006 *	-0.008 **	-0.006 *
	(-2.41)	(-1.83)	(-2.39)	(-1.78)
Institutional Ownership	1.186 ***	1.518 ***	1.185 ***	1.522 ***
	(6.34)	(7.92)	(6.34)	(7.94)
CEO Dual	0.223 ***	0.227 ***	0.221 ***	0.225 ***
	(3.69)	(3.71)	(3.66)	(3.68)
CEO Shareholdings	4.486 ***	5.477 ***	4.452 ***	5.474 ***
	(3.84)	(4.60)	(3.81)	(4.59)
Ln (Avg. Manager Tenure)	-0.319 ***	-0.316 ***	-0.318 ***	-0.316 ***
	(-9.42)	(-9.20)	(-9.36)	(-9.17)
Ln(CEO Salary)	0.037 ***	0.022 ***	0.036 ***	0.021 **
	(4.68)	(2.69)	(4.58)	(2.57)
Ln (Total Assets)	0.213 ***	0.266 ***	0.212 ***	0.263 ***
	(7.11)	(8.69)	(7.08)	(8.60)
ROA	-0.679 ***	-0.887 ***	-0.677 ***	-0.888 ***
	(-2.69)	(-3.39)	(-2.68)	(-3.39)
Sales Growth	-0.033	-0.025	-0.034	-0.028
	(-0.59)	(-0.45)	(-0.62)	(-0.49)
Leverage	-0.145	-0.228	-0.151	-0.240
	(-0.84)	(-1.29)	(-0.87)	(-1.36)
Ln (ROA Volatility)	0.177 ***	0.158 ***	0.177 ***	0.157 ***
	(4.80)	(4.23)	(4.80)	(4.21)
Industry Fixed Effect	Yes	Yes	Yes	Yes
# of observations	7525	7525	7525	7525
pesudo R^2	0.1522	0.1693	0.1522	0.1699

Table 6 The Impact of CEO overconfidence on D&O insurance (continued)

Panel B. The Tobit regressions for the D&O insurance coverage ratio

Parameter	(1)	(2)	(3)	(4)
Intercept	5.248 ***	5.283 ***	5.248 ***	5.313 ***
	(11.52)	(11.61)	(11.51)	(11.67)
CEO OC	0.001	-0.099 **		
	(0.03)	(-1.98)		
CEO OC Ratio			-0.00002	-0.022 ***
			(-0.003)	(-2.55)
Family		-0.272 ***		-0.303 ***
		(-6.87)		(-7.32)
Family*CEO OC		0.294 ***		
		(3.51)		
Family*CEO OC Ratio				0.059 ***
				(4.35)
Co-insurance	-2.809 ***	-2.781 ***	-2.809 ***	-2.788 ***
	(-32.18)	(-31.93)	(-32.18)	(-32.02)
Number of Insurers	1.809 ***	1.792 ***	1.809 ***	1.791 ***
	(69.58)	(68.87)	(69.58)	(68.89)
Ln (Board Size)	0.124	0.073	0.124	0.073
	(1.52)	(0.89)	(1.52)	(0.89)
Block Holdings	-0.369 **	-0.369 **	-0.370 **	-0.362 **
	(-2.17)	(-2.17)	(-2.17)	(-2.13)
Outsider Shareholdings	-0.759 ***	-0.985 ***	-0.759 ***	-1.002 ***
	(-3.45)	(-4.42)	(-3.44)	(-4.49)
Cash Flow Rights	-1.073 ***	-1.020 ***	-1.073 ***	-1.028 ***
	(-7.42)	(-7.05)	(-7.42)	(-7.11)
Deviation	0.005 ***	0.006 ***	0.005 ***	0.006 ***
	(2.78)	(3.07)	(2.77)	(3.08)
Institutional Ownership	0.163	0.249 **	0.163	0.256 **
	(1.46)	(2.21)	(1.46)	(2.28)
CEO Dual	0.052	0.054	0.053	0.054
	(1.49)	(1.55)	(1.49)	(1.53)
CEO Shareholdings	1.103 *	1.326 **	1.104 *	1.353 **
	(1.72)	(2.07)	(1.72)	(2.11)
Ln (Avg. Manager Tenure)	-0.118 ***	-0.117 ***	-0.118 ***	-0.118 ***
	(-6.04)	(-6.04)	(-6.04)	(-6.09)
Ln (CEO Salary)	0.016 ***	0.011 **	0.016 ***	0.011 **
	(3.43)	(2.49)	(3.42)	(2.45)
Ln (Total Assets)	-0.460 ***	-0.448 ***	-0.460 ***	-0.450 ***
	(-26.29)	(-25.43)	(-26.25)	(-25.48)
ROA	-0.187 **	-0.212 **	-0.187 **	-0.212 **
	(-2.11)	(-2.39)	(-2.11)	(-2.39)
Sales Growth	-0.036	-0.036	-0.036	-0.036
	(-1.11)	(-1.10)	(-1.11)	(-1.09)
Leverage	1.054 ***	1.027 ***	1.054 ***	1.026 ***
	(10.63)	(10.37)	(10.63)	(10.35)
Ln (ROA Volatility)	0.096 ***	0.091 ***	0.096 ***	0.091 ***
	(4.49)	(4.26)	(4.49)	(4.24)
Industry Fixed Effect	Yes	Yes	Yes	Yes
# of observations	7521	7521	7521	7521
pesudo R^2	0.2841	0.2863	0.2841	0.2865

Table 7 The effect of family controlled on the relation between CEO overconfidence on D&O insurance

For the regression, the dependent variables are the dummy for the purchase of D&O insurance and the D&O insurance coverage ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

	D&O Logit Regression		D&O Coverage Tobit Regression	
Parameter	(1)	(2)	(3)	(4)
Intercept	-3.301 ***	-3.275 ***	5.332 ***	5.354 ***
	(-4.46)	(-4.42)	(11.77)	(11.81)
CEO OC	-0.071		-0.096 **	
	(-0.78)		(-1.96)	
CEO OC Ratio		-0.016		-0.020 **
		(-0.97)		(-2.35)
FCEO	-1.048 ***	-1.094 ***	-0.425 ***	-0.454 ***
	(-14.78)	(-14.65)	(-9.88)	(-10.09)
FCEO*CEO OC	0.391 **		0.355 ***	
	(2.57)		(3.92)	
FCEO*CEO OC Ratio		0.087 ***		0.067 ***
		(3.20)		(4.43)
FNFCEO	-0.437 ***	-0.481 ***	0.078	0.055
	(-3.24)	(-3.38)	(1.08)	(0.73)
FNFCEO*CEO OC	0.769 **		0.144	
	(1.97)		(0.89)	
FNFCEO*CEO OC Ratio		0.130 **		0.034
		(2.06)		(1.44)
Co-insurance			-2.765 ***	-2.775 ***
			(-31.89)	(-32.00)
Number of Insurers			1.780 ***	1.780 ***
			(68.69)	(68.71)
Ln (Board Size)	-0.099	-0.098	0.047	0.049
	(-0.70)	(-0.69)	(0.57)	(0.60)
Block Holdings	-0.584 **	-0.576 **	-0.260	-0.256
	(-2.04)	(-2.01)	(-1.54)	(-1.51)
Outsider Shareholdings	-1.278 ***	-1.281 ***	-1.076 ***	-1.091 ***
	(-3.39)	(-3.39)	(-4.84)	(-4.90)
Cash Flow Rights	-1.789 ***	-1.787 ***	-1.003 ***	-1.008 ***
	(-7.29)	(-7.28)	(-6.97)	(-7.01)
Deviation	-0.006 *	-0.005	0.006 ***	0.006 ***
	(-1.67)	(-1.61)	(3.30)	(3.32)
Institutional Ownership	1.457 ***	1.460 ***	0.206 *	0.211 *
	(7.56)	(7.58)	(1.84)	(1.88)
CEO Dual	0.214 ***	0.212 ***	0.042	0.042
	(3.47)	(3.45)	(1.20)	(1.19)
CEO Shareholdings	4.841 ***	4.838 ***	0.813	0.830
	(4.02)	(4.01)	(1.26)	(1.29)
Ln (Avg. Manager Tenure)	-0.311 ***	-0.311 ***	-0.114 ***	-0.115 ***
	(-9.02)	(-9.00)	(-5.90)	(-5.96)
Ln (CEO Salary)	0.021 **	0.020 **	0.010 **	0.010 **
	(2.56)	(2.44)	(2.23)	(2.18)
Ln (Total Assets)	0.271 ***	0.270 ***	-0.443 ***	-0.445 ***
	(8.80)	(8.74)	(-25.31)	(-25.35)
ROA	-0.893 ***	-0.896 ***	-0.187 **	-0.187 **
	(-3.40)	(-3.41)	(-2.12)	(-2.13)
Sales Growth	-0.026	-0.028	-0.036	-0.037
	(-0.45)	(-0.49)	(-1.11)	(-1.12)
Leverage	-0.262	-0.271	1.013 ***	1.013 ***
	(-1.48)	(-1.53)	(10.27)	(10.26)
Ln (ROA Volatility)	0.159 ***	0.158 ***	0.091 ***	0.091 ***
	(4.24)	(4.22)	(4.29)	(4.25)
Industry Fixed Effect	Yes	Yes	Yes	Yes
# of observations	7525	7525	7521	7521
pesudo R^2	0.1750	0.1754	0.2889	0.2890

Table 8 The effect of risk taking on the relation between CEO overconfidence on D&O insurance

For the regression, the dependent variables are the dummy for the purchase of D&O insurance and the D&O insurance coverage ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

	Family Set				Non-Family Set			
	D&O Logit Regression		D&O Coverage Tobit Regression		D&O Logit Regression		D&O Coverage Tobit Regression	
Parameter	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	-3.501 **	-3.535 ***	3.983 ***	4.234 ***	-4.606 ***	-4.626 ***	5.743 ***	6.028 ***
	(-2.47)	(-2.46)	(5.17)	(5.03)	(-4.74)	(-4.76)	(11.00)	(15.96)
CEO OC	0.308 **		0.090		-0.030		-0.019	
	(2.37)		(1.30)		(-0.30)		(-0.38)	
CEO OC Ratio		0.063 ***		0.009		-0.005		0.0001
		(2.78)		(0.79)		(-0.29)		(0.01)
Overinvestment	2.937 **	2.738 **	1.023 *	1.478 **	2.240 ***	2.605 ***	0.514	-0.489
	(2.31)	(2.03)	(1.69)	(2.19)	(2.61)	(2.71)	(1.31)	(-1.08)
CEOOC*Overinvestment	-0.985		0.752		-0.848		-1.967 **	
	(-0.29)		(0.45)		(-0.42)		(-2.26)	
CEO OC Ratio*Overinvestment		0.043		0.237		-0.399		-0.081
		(0.07)		(0.78)		(-0.96)		(-0.414)
Co-insurance			-2.373 ***	-2.465 ***			-2.953 ***	-2.833 ***
			(-19.90)	(-19.15)			(-26.76)	(-24.57)
Number of Insurers			1.903 ***	2.022 ***			1.638 ***	1.621 ***
			(44.38)	(43.62)			(53.42)	(50.55)
Ln (Board Size)	0.017	0.012	-0.162	-0.119	0.039	0.037	0.092	0.007
	(0.08)	(0.06)	(_1.36)	(-0.92)	(0.19)	(0.18)	(0.91)	(0.07)
Block Holdings	-1.183 ***	-1.168 ***	-0.295	-0.320	-0.373	-0.372	-0.407 *	-0.270
	(-2.82)	(-2.79)	(-1.27)	(-1.28)	(-0.90)	(-0.90)	(-1.85)	(-1.19)
Outsider Shareholdings	-0.987	-0.937	-0.377	-0.237	-1.512 ***	-1.517 ***	-1.594 ***	-1.659 ***
	(-1.56)	(-1.48)	(-1.03)	(-0.60)	(-3.03)	(-3.04)	(-6.10)	(-6.21)
Cash Flow Rights	-1.346 ***	-1.328 ***	-0.228	-0.273	-2.072 ***	-2.074 ***	-1.323 ***	-1.278 ***
	(-3.41)	(-3.36)	(-1.05)	(-1.16)	(-6.19)	(-6.20)	(-7.51)	(-7.23)
Deviation	0.006	0.006	0.010 ***	0.011 ***	-0.016 ***	-0.016 ***	-0.001	0.004
	(1.11)	(1.18)	(3.71)	(3.82)	(-3.17)	(-3.17)	(-0.35)	(1.63)
Institutional Ownership	0.985 ***	0.986 ***	-0.171	-0.066	1.793 ***	1.792 ***	0.432 ***	0.102
	(3.26)	(3.26)	(-1.01)	(-0.36)	(6.76)	(6.75)	(3.14)	(0.71)
CEO Dual	0.189 *	0.185 *	0.076	0.099	0.249 ***	0.249 ***	0.010	0.063
	(1.79)	(1.75)	(1.30)	(1.58)	(3.19)	(3.19)	(0.24)	(1.51)
CEO Shareholdings	4.206 **	4.146 **	1.414	1.392	6.234 ***	6.305 ***	1.633 **	2.306 ***
	(2.21)	(2.17)	(1.40)	(1.27)	(3.95)	(3.99)	(2.21)	(2.99)
Ln (Avg. Manager Tenure)	-0.423 ***	-0.418 ***	-0.138 ***	-0.146 ***	-0.220 ***	-0.221 ***	-0.079 ***	-0.073 ***
	(-7.50)	(-7.43)	(-4.62)	(-4.53)	(-4.90)	(-4.92)	(-3.45)	(-3.08)
Ln (CEO Salary)	0.045 ***	0.043 ***	0.020 ***	0.019 **	-0.005	-0.005	0.000	-0.008
	(3.57)	(3.36)	(2.81)	(2.54)	(-0.46)	(-0.44)	(0.06)	(-1.42)
Ln (Total Assets)	0.283 ***	0.279 ***	-0.312 ***	-0.362 ***	0.310 ***	0.311 ***	-0.463 ***	-0.395 ***
	(6.09)	(5.98)	(-12.29)	(-13.15)	(6.85)	(6.86)	(-20.81)	(-17.42)
ROA	-0.905 **	-0.920 **	-0.110	-0.220 **	-0.688 *	-0.686 *	0.205	-0.813 ***
	(-2.17)	(-2.20)	(-1.20)	(-2.21)	(-1.92)	(-1.92)	(1.24)	(-4.77)
Sales Growth	0.043	0.039	0.062	0.050	-0.135	-0.134	-0.118 ***	-0.202 ***
	(0.53)	(0.47)	(1.38)	(1.03)	(-1.56)	(-1.54)	(-2.74)	(-4.48)
Leverage	-0.382	-0.414	0.536 ***	0.675 ***	-0.234	-0.231	0.998 ***	0.987 ***
	(-1.33)	(-1.44)	(3.52)	(4.10)	(-0.98)	(-0.97)	(8.33)	(8.30)
Ln (ROA Volatility)	0.148 **	0.146 **	0.058 *	0.061 *	0.203 ***	0.202 ***	0.094 ***	0.026
	(2.53)	(2.49)	(1.82)	(1.79)	(3.92)	(3.91)	(3.57)	(0.99)
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
# of observations	3007	3007	3005	3005	4518	4518	4516	4516
pesudo R^2	0.2176	0.2184	0.3972	0.3741	0.1185	0.1186	0.2554	0.2395

Table 9 2SLS regressions for endogenity issue

For the regression, the dependent variables are the dummy for the purchase of D&O insurance and the D&O insurance ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

	1st Stage Reg.	2nd Stage Regressions			
	CEO OC Ratio Tobit Reg.	D&O Logit Regressions		D&O Coverage Ratio Tobit Regressions	
Parameter	(1)	(2)	(3)	(4)	(5)
Intercept	-8.052 ***	-3.325 ***	-2.311 ***	5.266 ***	5.013 ***
	(-5.21)	(-4.50)	(-2.89)	(11.55)	(10.32)
CEO Education	0.232 ***				
	(3.32)				
CEO Financial Expert	0.976				
	(1.02)				
CEO Education*CEO Financial Expert	-0.393				
	(-1.07)				
CEO OC		-0.186		-0.175 ***	
		(-1.56)		(-2.83)	
CEO OC Ratio			0.209		-0.565 ***
			(1.18)		(-6.03)
Family		-0.898 ***	-1.626 ***	-0.281 ***	-1.048 ***
		(-13.71)	(-9.69)	(-7.17)	(-11.14)
Family*CEO OC		0.870 ***		0.435 ***	
		(4.79)		(4.60)	
Family*CEO OC Ratio			0.620 ***		0.603 ***
			(5.26)		(9.65)
Co-insurance				-2.773 ***	-2.759 ***
				(-31.87)	(-31.91)
Number of Insurers				1.789 ***	1.792 ***
				(68.81)	(69.28)
Ln (Board Size)		-0.030	-0.047	0.071	0.053
		(-0.22)	(-0.33)	(0.87)	(0.65)
Block Holdings		-0.780 ***	-0.761 ***	-0.381 **	-0.384 **
		(-2.74)	(-2.65)	(-2.25)	(-2.27)
Outsider Shareholdings		-1.139 ***	-1.276 ***	-0.990 ***	-1.109 ***
		(-3.03)	(-3.37)	(-4.44)	(-4.99)
Cash Flow Rights		-1.778 ***	-1.828 ***	-1.018 ***	-1.083 ***
		(-7.25)	(-7.43)	(-7.04)	(-7.53)
Deviation		-0.006 *	-0.007 **	0.006 ***	0.005 **
		(-1.83)	(-2.10)	(2.99)	(2.47)
Institutional Ownership		1.525 ***	1.612 ***	0.257 **	0.316 ***
		(7.94)	(8.35)	(2.29)	(2.80)
CEO Dual	0.276 **	0.224 ***	0.166 ***	0.059 *	0.091 **
	(2.44)	(3.65)	(2.56)	(1.68)	(2.46)
CEO Shareholdings		5.513 ***	5.641 ***	1.311 **	1.354 **
		(4.61)	(4.72)	(2.05)	(2.13)
Ln (Avg. Manager Tenure)	-0.355 ***	-0.312 ***	-0.243 ***	-0.120 ***	-0.172 ***
	(-5.59)	(-8.97)	(-5.53)	(-6.11)	(-7.04)
Ln (CEO Salary)	0.184 ***	0.018 **	-0.016	0.012 **	0.040 ***
	(12.62)	(2.14)	(-0.97)	(2.46)	(4.54)
Ln (Total Assets)	0.287 ***	0.258 ***	0.189 ***	-0.447 ***	-0.403 ***
	(7.02)	(8.29)	(4.71)	(-24.98)	(-17.62)
ROA	0.510	-0.843 ***	-0.788 ***	-0.208 **	-0.208 **
	(1.11)	(-3.23)	(-3.04)	(-2.35)	(-2.36)
Sales Growth		-0.025	-0.027	-0.034	-0.031
		(-0.43)	(-0.46)	(-1.03)	(-0.95)
Leverage		-0.201	-0.226	1.039 ***	1.062 ***
		(-1.14)	(-1.27)	(10.49)	(10.77)
Ln (ROA Volatility)		0.156 ***	0.172 ***	0.091 ***	0.091 ***
		(4.19)	(4.58)	(4.25)	(4.27)
Tobin's Q	-0.312 ***				
	(-5.05)				
NET PPE/TA	2.927 ***				
	(3.91)				
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes
# of observations	7525	7525	7525	7521	7521
pesudo R^2	0.0209	0.1709	0.1717	0.2866	0.2906

Table 10 Robustness check: Alternative definition of CEO overconfidence

For the regression, the dependent variables are the dummy for the purchase of D&O insurance and the D&O insurance ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

	D&O Logit Regressions					D&O Coverage Tobit Regressions				
	Net Purchase Ratio 75% Threshold	Net Purchase Ratio 80% Threshold	Net Purchase Ratio 90% Threshold	Net Purchase rank 75% Threshold	Lag One Period Purchase Ratio 75% Threshold	Net Purchase Ratio 75% Threshold	Net Purchase Ratio 80% Threshold	Net Purchase Ratio 90% Threshold	Net Purchase rank 75% Threshold	Lag One Period Purchase Ratio 75% Threshold
Parameter	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CEO OC	-0.083	-0.061	-0.085	-0.244 **	-0.041	-0.099 **	-0.007	-0.116	-0.231 ***	-0.074
	(-0.90)	(-0.61)	(-0.59)	(-2.23)	(-0.40)	(-1.98)	(-1.15)	(-1.52)	(-3.84)	(-1.33)
Family	-0.872 ***	-0.862 ***	-0.842 ***	-0.872 ***	-0.853 ***	-0.272 ***	-0.014 ***	-0.243 ***	-0.285 ***	-0.263 ***
	(-13.05)	(-13.07)	(-13.13)	(-13.25)	(-12.98)	(-6.87)	(-2.96)	(-6.38)	(-7.34)	(-6.76)
Family*CEO OC	0.416 ***	0.434 ***	0.523 **	0.559 ***	0.386 **	0.294 ***	0.027 **	0.275 **	0.508 ***	0.309 ***
	(2.88)	(2.74)	(2.42)	(3.27)	(2.38)	(3.51)	(2.54)	(2.32)	(5.21)	(3.32)
Controls, Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11 Robustness check: Alternative measures of D&O coverage ratio

For the regression, the dependent variables are the dummy for the purchase of D&O insurance and the D&O insurance ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

	Ln(DO Amount/Equity BV+1)		Ln(DO Amount/Equity MV+1)		DO Amount/Equity BV	
Parameter	(1)	(2)	(3)	(4)	(5)	(6)
CEO OC	-0.099 **		-0.090 *		-0.008	
	(-1.98)		(-1.84)		(-1.37)	
CEO OC Ratio		-0.022 ***		-0.009		-0.002 *
		(-2.55)		(-1.04)		(-1.79)
Family	-0.272 ***	-0.303 ***	-0.244 ***	-0.264 ***	-0.014 ***	-0.018 ***
	(-6.87)	(-7.32)	(-6.24)	(-6.44)	(-2.99)	(-3.64)
Family*CEO OC	0.294 ***		0.269 ***		0.025 **	
	(3.51)		(3.26)		(2.47)	
Family*CEO OC Ratio		0.059 ***		0.047 ***		0.006 ***
		(4.35)		(3.50)		(3.60)
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 12 Robustness check: Alternative definitions of family control

For the regression, the dependent variables are the dummy for the purchase of D&O insurance and the D&O insurance ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

Panel A. The Logit regressions for the purchase of D&O insurance

	5% Threshold		10% Threshold		15% Threshold	
Parameter	(1)	(2)	(3)	(4)	(5)	(6)
CEO OC	-0.117		-0.083		-0.037	
	(-1.26)		(-0.90)		(-0.41)	
CEO OC Ratio		-0.024		-0.021		-0.011
		(-1.41)		(-1.23)		(-0.67)
Family	-0.818 ***	-0.861 ***	-0.872 ***	-0.924 ***	-0.867 ***	-0.912 ***
	(-12.38)	(-12.41)	(-13.05)	(-13.15)	(-12.59)	(-12.64)
Family*CEO OC	0.474 ***		0.416 ***		0.332 **	
	(3.31)		(2.88)		(2.25)	
Family*CEO OC Ratio		0.096 ***		0.095 ***		0.080 ***
		(3.77)		(3.70)		(3.06)
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. The Tobit regressions for the demand of D&O insurance

	5% Threshold		10% Threshold		15% Threshold	
Parameter	(1)	(2)	(3)	(4)	(5)	(6)
CEO OC	-0.088 *		-0.099 **		-0.084 *	
	(-1.73)		(-1.98)		(-1.73)	
CEO OC Ratio		-0.018 **		-0.022 ***		-0.017 **
		(-1.99)		(-2.55)		(-2.10)
Family	-0.264 ***	-0.281 ***	-0.272 ***	-0.303 ***	-0.283 ***	-0.309 ***
	(-6.80)	(-6.94)	(-6.87)	(-7.32)	(-6.84)	(-7.17)
Family*CEO OC	0.240 ***		0.294 ***		0.281 ***	
	(2.92)		(3.51)		(3.24)	
Family*CEO OC Ratio		0.043 ***		0.059 ***		0.055 ***
		(3.21)		(4.35)		(3.88)
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 13 Robustness check: The effect of managerial overconfidence

For the regression, the dependent variables are the dummy for the purchase of D&O insurance and the D&O insurance ratio. All variables are as defined in Table 1. *, **, or *** indicates that the coefficient (or statistic) is statistically significantly different from zero at the 0.10, 0.05, or 0.01 level, respectively.

	D&O Logit Regressions		D&O Coverage Tobit Regressions	
Parameter	(1)	(2)	(3)	(4)
Managers OC	-0.201 **		-0.081	
	(-2.01)		(-1.52)	
Managers OC Ratio		-0.016 ***		-0.007 **
		(-2.74)		(-2.33)
Family	-0.791 ***	-0.836 ***	-0.217 ***	-0.243 ***
	(-11.73)	(-11.34)	(-5.53)	(-5.71)
Family*Managers OC	0.279 *		0.189 **	
	(1.91)		(2.22)	
Family*Managers OC Ratio		0.020 **		0.012 ***
		(2.39)		(2.66)
Controls	Yes	Yes	Yes	Yes