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家族控制公司、董監事暨重要職員責任保險與衍生性金融商品使用程度#

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摘要

家族企業之家族財富與公司資產緊密聯繫，亦有企圖將公司傳承給其後代。故家族企業制定決策時，會著重於永續經營與家族控制，導致其有規避風險之傾向。爰此，本文旨在檢視家族控制公司是否有較高(低)的避險(交易)目的衍生性金融商品使用程度。此外，董監事暨重要職員責任保險在某種程度可限制公司管理者的預期法律責任，使管理者較願意從事具風險性的活動，故本文進一步檢測此責任保險在家族控制公司的衍生性金融商品使用決策上所扮演的角色。實證結果顯示：相較於非家族控制公司，家族控制公司使用較多(少)的避險(交易)目的之衍生性金融商品，且此現象在未投保董監事暨重要職員責任保險之情況下更為明顯。就衍生性金融商品使用決策而言，前述實證結果隱含投保責任保險可減緩家族企業較多規避風險之行為。本文進行若干額外測試，發現上述實證結果具相當穩固性。

關鍵詞：家族控制公司、衍生性金融商品使用程度、董監事暨重要職員責任保險、規避風險

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Family-Controlled Firms, Directors' & Officers' Insurance Coverage, and the Use of Derivatives[#]

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Abstract

Decision making in family-controlled firms typically entails a long time horizon because of the close ties between family wealth and the business, and because of the intention to pass the firm on to the next generation. Family owners may focus more on family control in addition to the survival of the family business, thereby becoming even more risk-averse. This study examines whether the risk management practices of family-controlled firms are associated with higher (lower) levels of hedging (trading) derivatives usage. Note that directors' & officers' insurance limits expected legal liabilities, which in turn encourages managers to take more risks. This study further examines the moderating role of directors' & officers' insurance on family-controlled firms' derivatives usage. The empirical results document that family-controlled firms are associated with higher (lower) levels of hedging (trading) derivatives usage than firms that are not controlled by a specific family. Further evidence reveals that these results are particularly pronounced for family-controlled firms without directors' & officers' insurance coverage, suggesting that directors' & officers' insurance coverage mitigates family-controlled firms' being even more risk-averse through the use of derivatives. This study performs several diagnostic tests and reveals the results are robust in various specifications.

Keywords: Family-controlled firms; Derivatives usage; Directors' & officers' insurance (D&O); Risk-averseness

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1. Introduction

Family owners are active managers in their firms (Anderson and Reeb 2003), and hence may enjoy greater latitude in altering financial and/or investing decisions. A growing stream of research explains organizational decisions that distinguish family-controlled firms from those that are not controlled by a specific family (hereafter, nonfamily-controlled firms). For example, Zellweger (2007) argues that family firms have a strong incentive for effective monitoring and a long time horizon in their decision making because of the close ties between the family's wealth and the business, and because of the intention to pass the firm onto the next generation. Achleitner et al. (2014) also found that family-controlled firms engage less in real earnings management as compared with nonfamily-controlled firms out of concern for transgenerational sustainability and the desire to maintain control within the family over time. This suggests that family-controlled firms may align their interests with their stakeholders, creating incentives for strategic financing/investing decisions that ensure the firm's long-term viability and health (Anderson and Reeb 2003; Chen et al. 2008). Nevertheless, Wiseman and Gomez-Mejia (1998) and Anderson et al. (2012) argue that family owners focus more on family control, the maintenance of the current status quo as well as the survival of family business, making them more risk averse. Kim et al. (2014) also show that founding families' need to hedge the risk of their undiversified personal wealth portfolio leads to suboptimal derivatives usage decisions.

Financial instruments (an important tool for risk management) provide a role for the use of derivatives to manage managerial incentives,[1] and to reduce investment distortion and agency costs. A plenty of research is dedicated to understanding how risk preferences affect family firms' investment decisions (e.g., Czarnitzki and Kraft 2009; Lin et al. 2016). However, less attention has focused on how risk management strategy influences the determinants of derivatives usage from the perspective of family-controlled firms. Note that firm characteristics correlated with derivatives usage are described as capturing the costs and benefits of hedging. Nevertheless, firms use derivatives not only for hedging but also for trading. It is intuitive to incorporate the distinct motives for the use of derivatives into firms' risk management activities (Bartram 2019). As derivatives usage may decrease (in the

[1] Derivatives hedging (trading) decisions are defined as a policy and/or a strategy that reduces (increases) firm value exposure to market risk factors (Bartram 2019).

臺灣大學學術期刊資料庫

case of hedging) or increase (in the case of trading) the risk characteristics of a firm's stock and consequently affect its value,[2] it is important to understand the motives for which firms employ derivatives. Annual hedging and trading derivatives positions for listed firms in Taiwan are captured by the Market Observation Post System (MOPS) of the Taiwan Securities Exchange (TWSE),[3] allowing this study to identify the distinct motives of derivatives usage samples and to examine whether family-controlled firms are associated with more or less hedge/trading activities than nonfamily-controlled firms. The findings can provide academics, practitioners, and regulatory agencies with insights on the factors that affect the propensity and the extent of derivatives usage in family-controlled firms, which tend to be even more risk-averse.

In addition, derivatives transactions sometime bring the firms huge losses and even trigger off lawsuits (e.g., Archegos and Chyang-Sheng cases).[4,5] As lawsuits occur, firm directors and officers (D&O) are often primary targets.[6] D&O insurance covers lawsuits for improper management of the firm's finances (including losses on

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[2] For example, average loss on trading derivatives in the third quarter of 2022 is up to 6 percent of net sales in semiconductor firms trading on the counter and while on average, net profit margin in these firms was 18 percent. Compared to the third quarter of 2021, their average market value dropped about 42 percent.

[3] *The Securities and Exchange Act* in Taiwan required listed firms to file their derivatives activities every month to MOPS. The disclosures include: the purpose of derivatives usage (hedging or trading), accumulated notional amount of offsetting and non-offsetting derivatives positions, and whether hedge accounting is applicable for the hedging purpose derivatives usage. To illustrate the required disclosure of derivatives usage on MOPS, see Appendix that uses Taiwan Semiconductor Manufacturing Company Limited (TSMC) as an example.

[4] Archegos Capital Management Co. leveraged on equities by entering into total return swaps with transnational banks. It failed to meet margin calls as the price of the underlying stocks dramatically plunged (ESMA 2022). Its counterparties thus faced huge losses and accused its founder and CFO of deception. In addition, some counterparties (e.g., Credit Suisse and Nomura) fired their CEOs or managers (Griffin, and Nakamichi. 2022). CEO in Credit Suisse were even sued for improperly dealings with customers. Some counterparties (e.g., Goldman Sachs and Morgan Stanley) are also accused of insider trading, which involved in selling the stocks Archegos invested in to unwitting investors (Stempel 2022).

[5] For the Chyang Sheng case, its chairman acted for the subsidiaries in buying more than 80 million dollars of futures through Fubon Securities Ltd. from 2004 to 2007. As a result, these futures cause its subsidiaries to suffer from great losses. Chyang-Sheng Company sued the sales manager in Fubon Securities Company for deception (TEJ database).

[6] Article 21 of *Regulations Governing the Acquisition and Disposal of Assets by Public Companies* stipulates that when a public company engaging in derivatives trading, its board of directors shall faithfully supervise and manage such trading. Authorized officers shall manage derivatives trading. Thus, as D&O insurance covers losses suffered as a result of the D&O actions (Business Benefit Group 2016), it will reimburse D&O for the costs of derivatives lawsuits resulting from their derivatives decisions.

assets sold for a low price) (Business Benefits group 2016).[7] Hence D&O can mitigate their personal legal liability through D&O insurance and indemnification, and firms also can recoup their indemnification costs through D&O insurance (Wynn 2008). By effectively shielding D&O from bearing personal and/or firms' legal liabilities, D&O insurance reduces the expected legal liabilities associated with bad outcomes of D&O decisions, and thus it encourages more risk-taking (Chen et al. 2016; Core 1997; Chalmers et al. 2002). Without D&O insurance, D&O can become overly averse to taking risks due to fears of litigation. Accordingly, D&O insurance coverage to some extent can mitigate the problem of more risk-averseness in corporate risk management. Prior studies have examined the effect of D&O insurance on accounting restatements (e.g., Lin et al. 2013), reporting conservatism (e.g., Chung and Wynn 2008), management forecasts (e.g., Cao and Narayanamoorthy 2011; Wynn 2008), investment decisions (e.g., Lin et al. 2011), loan financing (e.g., Lin et al. 2013), cost of equity (e.g., Chen et al. 2016), and investment-uncertainty relation (Chen and Chang 2022). This study extends this stream of research by examining the association between D&O insurance and family-controlled firms' propensity to be more risk-averse in their derivatives usage decisions when this insurance covers derivatives litigation as well.

Based on unbalanced-panel data analysis, empirical results indicate that family-controlled firms in Taiwan are associated with higher (lower) levels of hedging (trading) derivatives usage than their counterparts, i.e., nonfamily-controlled firms. These results support the argument of Wiseman and Gomez-Mejia (1998) and Anderson et al. (2012) that family owners focus more on control as well as the survival of the family business, making them even more risk-averse. The results also support the finding of Kim et al. (2014) that family owners tend to have large parts of their private wealth invested in the family firm, which further increase their aversion to risky derivatives usage in the firms. Further evidence reveals that these phenomena are particularly pronounced for family-controlled firms without D&O insurance coverage, suggesting that D&O insurance coverage mitigates family-controlled firms' being even more risk-averse through the use of derivatives.

This study enriches the existing literature in several ways. First, non-financial

[7] D&O insurance reimburses D&O for the costs of lawsuits which occur because their business decisions make errors, omission, negligence, breach of duty or trust, misleading statements, and so on (Chan et al. 2014).

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firms only provide information about the non-offsetting derivatives position in their balance sheets (Bartram 2019; Chang, Donohoe, and Sougiannis 2016). However, firms may trade derivatives within a short period and rarely have positions left on the balance sheet at the end of the fiscal year (i.e., the non-offsetting derivatives position). Thus, using non-offsetting derivatives positions could not capture a firm's full picture of derivatives usage transactions. The MOPS-required disclosure of yearly notional value of hedging and trading derivatives (include offsetting and non-offsetting positions) for listed firms in Taiwan can potentially alleviate the above concern and provide a setting to conduct an empirical test of family-controlled firms' distinctive motives for derivatives usage. Moreover, limited research has examined the potential effect of family-control on a firm's distinct motives (i.e., hedging and trading) of derivatives usage. This study attempts to fill this gap in the literature by explicitly examining the impact of risk management policies on the derivatives usage of family-controlled firms in an emerging market (i.e., Taiwan).

Second, family owners represent an important type of large shareholder maintaining an undiversified or concentrated ownership stake in family-controlled firms (Anderson et al. 2012; Kim et al. 2014). Shleifer and Vishny (1986) find that large, undiversified shareholders may force the firm to seek low risk projects and avoid high risk activities, which in turn, imposing costs on well-diversified outside shareholders. Extending this stream of research, this study argues that family-controlled firms can have a particular propensity to mitigate firm risk by affecting the firm's derivatives usage decisions. This finding provides evidence generally consistent with the risk aversion hypothesis, i.e., family-controlled firms tend to be even more risk-averse in their risk management practices.

Third, previous studies have argued that D&O insurance protects D&O from the liability resulting from their corporate decisions, leading to managerial opportunism and reducing incentives to act in the shareholders' best interest (e.g., Core 2000; Chalmers et al. 2002). This study examines the association between D&O insurance and the incentives of risk-taking decisions in family-controlled firms and shows that the more risk-averse behavior in managerial derivatives usage is mitigated if family-controlled firms are covered by D&O insurance. This finding provides another insight into managerial risk management practices.

Finally, our findings also contribute a stream of research on board regulations (e.g., Hsu 2014; Wu et al. 2014; Pan et al. 2019; He and Yu 2022). In 2019, Financial Supervisory Commission (FSC) required that TWSE listed firms "shall

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take out directors and supervisors liability insurance with respect to liabilities resulting from exercising their duties during their term of office".[8] This study indirectly examines the function of this regulation on derivatives decisions by using TWSE listed firms that purchase D&O insurance on voluntary basis before this regulation. Consistent with Chen and Chang (2022), our findings show that family-controlled firms with D&O insurance are willing to bear more risk and, in turn, increase (decrease) trading-purpose (hedging-purpose) derivatives usage. This result thus provides implications for regulators on whether to extend the mandatory D&O insurance requirement to the family-controlled firms that have not complied with the rule (e.g., public but not listed firms).

The remainder of this study is organized in the following way. This study first reviews related literature and develops the testable hypotheses. Then, it outlines the research design and data followed by the empirical results and robustness test results, and concludes the study.

2. Literature review and hypotheses

2.1 Literature review

Business groups in Taiwan have been characterized by a high degree of ownership concentration and are usually held by a dominant family (Claessens et al. 2000). Yeh et al. (2003) also argue that insiders and affiliated outsiders dominate the boards because the controlling family uses its shares to vote collectively in Taiwan. In fact, the controlling family generally oversees the development of a business from its inception. According to Taiwan's, Regulations Governing the Acquisition and Disposal of Assets by Public Companies, board of directors must faithfully monitor and manage the firm's engagement in financial and/or investing activities. Thus, family ownership or control tends to play a dominant role in the decision-making process (e.g., derivatives usage decisions) while inside and/or affiliated directors often have a friendly relationship with controlling families.

Schulze et al. (2001) argued that altruism alters the incentive structure of family firms that many of the agency benefits gained are offset by problems of self-control and moral hazard. This suggests that information is shared through the communication channels among members whose special relationships to one another

[8] The regulation originated from Article 16 of Taiwan Stock Exchange Corporation Operation Directions for Compliance with the Establishment of Board of Directors by TWSE Listed Companies and the Board's Exercise of Powers.

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allow agency problems to be controlled in family-controlled firms. Consequently, family-controlled firms have a positive impact on firm value and efficiency (Anderson and Reeb 2003). Several studies (e.g., Wang 2006; Chen et al. 2008; Martin et al. 2016) use reputation concerns and/or socioemotional wealth (SEW) framework to explain family firms' decision-making behaviors. The results are consistent with that firm value can be increased to the extent that families are stabilized by transferring business assets to the next generation of family managers. However, families represent an important class of large shareholders that potentially have unique incentive structures and a strong voice in the firm (Anderson and Reeb 2003). Family owners may focus more on family control in addition to the survival of the family business, thereby becoming even more risk-averse. Note that Shleifer and Vishny (1986) observe that one of the most important costs that large, undiversified shareholders can impose on the firm is risk aversion or avoidance.

A majority of studies on derivatives usage have been motivated by the risk management theories. Some of them claim that weaker governed (i.e., monitored) firms use derivatives more to speculate than to reduce firm risk (Geczy et al. 2007; Allayannis et al. 2012). As a signal for effective monitors, outside directors actively participate in decisions about derivatives usage to protect shareholders' interests (Borokhovich et al. 2004). However, previous studies (e.g., Adam and Fernando 2006; Allayannis and Ofek 2001; Graham and Rogers 2002) also claim that hedging derivatives can increase firm value in theory.[9] Under this context, if managers are risk-averse and their compensation plans is linked to firm value, hedging derivatives usage will be positively related to these plans because they intend to protect their own wealth in the firm (Smith and Stulz 1985; Tufano 1996; Huang et al. 2018). Nevertheless, limited study investigates whether family-controlled firms are more associated with hedging derivatives usage (Wiseman and Gomez-Mejia 1998; Anderson et al. 2012) than the nonfamily-controlled firms, although family-controlled firms' wealth is closely tied to the firm value.

Firms may engage in a hybrid form of hedging, i.e., puts a hedge on when it thinks the market will make an adverse move and takes a hedge off or remains unhedged when it believes the market will move favorably. Empirical findings also evidence that firms may speculate and/or selectively speculate in executing their

[9] Stulz (1984) posed the optimal hedging model for risk-averse agent. In the model, an optimal hedging in a derivative is of opposite sign to the (expected) exposure of the firm in that derivative, which often denotes the "cash position". In other words, hedging will be optimal if it decreases the risk premium managers take (Graham & Rogers 2002).

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general corporate financial policies (e.g., Adam and Fernando 2006; Baker and Wurgler 2002). Hence, derivatives usage may decrease or increase the risk characteristics of a firm's stock and consequently affect its value (Bartram 2019). The distinct motives for the use of derivatives seems to provide a plausible way to unravel the disputes on the risk management effect of financial derivatives (Chernenko and Faulkender 2011; Junior 2013). Note that the widespread use of derivatives by firms clearly indicates that they are proactive in the management of risk exposures. It is found that the majority of the empirical work examining derivatives usage is US-based (e.g., Geczy et al. 2007; Allayannis and Ofek 2001; Chernenko and Faulkender 2011; Graham and Rogers 2002) and in a European context (e.g., Bodnar and Gebhardt 1999; Bodnar et al. 2013; Jankensgard 2015). More studies on the risk aversion of family-controlled firms in emerging countries are needed.

Two related studies provide evidence for the hedging derivatives usage of family firms. Bodnar et al. (2013) base on the survey data and show that geographical location, rating, industry, access to capital markets and educated management are determinants of currency and interest rate derivatives usage in Italy, which is characterized by a high percentage of small and medium sized family run firms. Difference from Bodnar et al. (2013), this study directly focuses on examining whether the risk management practices of family-controlled firms, compared with the nonfamily-controlled firms, are associated with higher (lower) levels of hedging (trading) derivatives usage. Kim et al. (2014) examine whether family ownership affects the value impact of the operational and financial dimensions of firms' hedging policies. They focus on examining the value impact of hedging policies and the complementarities that exist between operational and financial hedging dimensions of risk management policies in diversified firms. Our study examines family-controlled firms' both hedging and trading derivatives usage decisions and incorporates the moderating role of D&O insurance coverage into our model to examine the incentives behind family-controlled firms' corporate risk-taking decisions. It will provide evidence of a non-U.S. and non-European finding based on systematically and consistently hand-collected data from MOPS in TWSE enriching this line of literature.

Prior studies (e.g., Core 1997; Chalmers et al. 2002; Chung and Wynn 2008; Lin et al. 2011) show that being covered by D&O insurance affects the incentives of

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D&O, which in turn, affect corporate decision-makings and firm values.[10] These studies suggest that D&O insurance insulates D&O from the cost of litigation so they are more likely to act in a self-interested and opportunistic manner.[11] Other literature examines the factors affecting the decision to purchase D&O insurance and finds that the results are generally consistent with the managerial opportunism argument. For example, Zou et al. (2008) show that the demand for D&O insurance in China has a positive relationship with the degree of conflict between controlling shareholders and minority shareholders. The present study examines the association between D&O insurance and the incentives of family-controlled firms' risk-taking decisions. Findings in this study will provide a direct evidence to know the probably more risk averse of family-controlled firms' derivatives usage.

2.2 Hypothesis establishment

Owners in family-controlled firms may have the responsibility of sustaining the firms for succeeding generations. SEW theory suggests that family members view economic issues in terms of how their actions will affect their socioemotional endowment, e.g., a family may wish to bequeath the firm to future generations through its controlling position (Anderson and Reeb 2003). SEW-based transgenerational sustainability may lead family-controlled firms to be even more risk averse and/or to avoid risk-seeking practices as a means of preserving and maintaining the value within the family. Note that family-controlled firms use derivatives for hedging and may exhibit lower or similar levels of risk (Allayannis and Ofek 2001). Families have incentives to use more hedging derivatives to sustain the firms for next generation and/or align their interests with outside shareholders. Thus, it is expected that family-controlled firms use more hedging derivatives than the nonfamily-controlled firms.

Founding families represent the most common types of large, undiversified shareholders (Shleifer and Vishny 1986). Prior studies (e.g., Faccio et al. 2011) have documented that the largest shareholder may reject risky projects that investors with fully diversified portfolios would find desirable. Family owners have strong

[10] Some studies examine the influence of D&O insurance coverage on earnings reporting in Taiwan. For example, Tang et al. (2014) showed that firms with D&O insurance have higher discretionary accruals. Also, Liao et al. (2016) evidenced the D&O insurance coverage is positively associated with earnings conservatism.

[11] On the competing viewpoint, using D&O insurance as a litigation risk proxy, Cao and Narayanamoorthy (2011) find that litigation risk has a positive impact on forecasts of management earnings. Thus, D&O insurance may discourage excessive risk-taking to avoid financial distress and litigation risk.

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incentives to shun risk because they tend to be under-diversified and will be biased toward conservative strategies. In this viewpoint, family owners may try to reduce firm-specific risk by influencing firm hedging program through the use of financial derivatives. Recently, Kim et al. (2014) supported this notion and showed that founding families' need to hedge risk to their undiversified personal wealth portfolio leads to suboptimal risk management decisions. This implies that family owners have incentives to reduce the variance of firm value by using more hedge derivatives. Accordingly, it is expected that family-ownership is possibly associated with higher levels of hedging derivatives than that of shareholders of firms who can diversify the portfolios of their own accounts.[12] Thus, the first hypothesis for hedging derivatives usage is established as follows:

H1a: Ceteris paribus, family-controlled firms use more hedging derivatives than nonfamily-controlled firms.

Nevertheless, financial derivatives are well suited for speculative purposes (Bartram 2019). Managers may incorporate their market views into derivatives usage to trade with the objective of achieving profits through the anticipation of price movements (Stulz 1996; Adam and Fernando 2006). However, Manchiraju et al. (2016) argue that non-hedge derivatives can impose greater firm risk. Bartram (2019) also argues that the speculative purpose of derivatives would be consistent with higher risk (e.g., higher stock return volatility) for derivatives users. Note that this increase in firm risk associated with such derivatives trading should bias against finding a negative relation between derivatives and risk. If family owners focus more on family control as well as the survival of the family business, more risk-averse family owners will not be expected to engage in speculative derivatives activities. Thus, this study hypothesizes that family-controlled firms is associated with a lower level of trading derivatives than nonfamily-controlled firms. The first hypothesis for trading derivatives usage is established as follows:

H1b: Ceteris paribus, family-controlled firms use more hedging derivatives than nonfamily-controlled firms.

However, family owners' risk attitude toward derivatives usage may be related to D&O insurance coverage. In Taiwan, firms attempt to reduce litigations risks, to

[12] Family owners' block investments in focused firms also imply greater exposure to undiversified wealth risk. Yet, Kim et al. (2014) argue that operational hedging of risk management is often unavailable, and focused firms' asset risk is greater. Thus, family owners may use derivatives to hedge their undiversified personal wealth.

臺灣大學會計期刊資料庫

boost firm growth, and to keep talents via D&O insurance coverage (Chen and Pang 2008). Compared with non-family firms, family firms have greater litigation concerns due to the close ties between family wealth and firm assets as well as the intention to pass the firm on to their descendants (Chen and Chen 2015). For this concern, they may buy D&O insurance as a protective umbrella, which insulates D&O from litigations costs derived from their fiduciary duties, and leads them to become less averse to taking risks.

There are two different views on the effect of D&O insurance on the possible changes in managers' risk-taking behaviors, i.e., insurer monitoring hypothesis and managerial opportunism hypothesis. In the insurer monitoring school, D&O insurance increases a monitoring function because D&O insurers monitor D&O in insured firms in order to reduce their exposure and mitigate agency costs (Core 2000; Holderness 1990). For example, Bhagat et al. (1987) argue that with D&O insurance protection, firms are less likely to abandon a profitable, yet risky projects. Recently, Chen and Chang (2022) further indicate that D&O insurance coverage enables the firms to bear appropriate risk, to change its overly conservative attitude toward corporate investments, and to have a lower investment-uncertainty relation. On the other hand, the managerial opportunism view argues that D&O insurance would cause firms to take excessive risks and to have managerial opportunism (e.g., Chen et al. 2016; Li and Liao 2014; Cao and Narayanamoorthy 2011), which could induce unintended moral hazard and reduce the incentive of managers to act in the best interests of stakeholders. For example, Chung and Wynn (2008) document a negative association between D&O insurance and earnings conservatism. Tang et al. (2014) find a positive association between D&O insurance coverage and opportunistic behaviors. Li and Liao (2014) and Chan et al. (2019) further document that D&O insurance coverage triggers the problems with over-investment. Nevertheless, whether the monitoring hypothesis or the opportunism hypothesis is true, D&O insurance affects managerial incentives, which in turn, can play a moderating role in corporate risk-taking decisions (Hwang and Kim 2018).[13]

In the absence of D&O insurance coverage, family owners may behave in a more risk-averse manner (i.e., using more hedging derivatives) due to legal liability based on their financial decisions. D&O insurance could be used to protect the controlling family and their agents (D&O) against litigation risks arising from the

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[13] The moderating role of D&O insurance coverage is also evidenced by the study of Chen et al. (2017), who found that D&O insurance coverage motivates CEOs allocating more resources to R&D activities, thereby improves the link between compensation and these activities.

expropriation of minority interests with respect to the degree of conflict between controlling owners and minority shareholders (Zou et al. 2008). In case of insurer monitoring, compared to the nonfamily-controlled firms, it is expected that D&O insurance coverage will encourage family-controlled firms to appropriately engage in hedging rather than being more risk-averse in using hedging derivatives. Thus, the phenomenon that family-controlled firms use more hedging derivatives than the nonfamily-controlled firms can be mitigated in the presence of D&O insurance coverage. In the managerial opportunism hypothesis, D&O insurance coverage motivates both family-controlled firms and nonfamily-controlled firms to decrease the use of hedging derivatives. In this school, the use of hedging derivatives covered by D&O insurance in family-controlled firms would not be expected to be different from those of similar transactions conducted with nonfamily-controlled firms. Collectively, this study hypothesizes that D&O insurance to some extent can mitigate the problems of more risk-averseness in the corporate risk management practices of family-controlled firms. In other words, the positive association between family-controlled firms and hedging derivatives usage is expected to be more pronounced in the case of family-controlled firms without D&O insurance coverage.

In the trading derivatives setting, firms can create value by incorporating speculative or selective hedging components into their derivatives usage activities (Tufano 1996; Adam and Fernando 2006; Chernenko and Faulkender 2011). Yet, the potential boost to earnings volatility in the trading derivatives may make family owners feel increasingly exposed to litigation risk (Lin et al. 2011). If family owners perceive D&O insurance as insulating D&O from this risk of litigation and recouping the firm's indemnification costs (Wynn 2008), according to the issuer monitoring school, family-controlled firms are expected to be more willing to increase their trading activities, thereby mitigating the risk-averse decision-making that could lead to less usage of trading derivatives. In the managerial opportunism viewpoint, this study conjectures that D&O insurance coverage will encourage more trading derivatives in both family-controlled firms and nonfamily-controlled firms. Thus, the use of trading derivatives covered by D&O insurance would not be expected to have a significant difference between family-controlled firms and nonfamily-controlled firms. Accordingly, this study hypothesizes that D&O insurance coverage can mitigate the problems of more risk-averseness in the use of trading derivatives of family-controlled firms.

On the other hand, family-controlled firms focus on localized, narrow-scope markets and facilitate the fast and decisive seizure of opportunities that are difficult for professional managers to act upon (Stulz 1996), which in turn generates a series

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of advantages with regard to their real business activities. If family-controlled firms typically have a competitive advantage with regard to taking risks on the real side of their business and are better able to take these operating risks than nonfamily-controlled firms, it is expected that they may use more trading derivatives to create value for shareholders, particularly when covered by D&O insurance. Thus, with D&O insurance coverage, family-controlled firms have less risk-averseness problems in trading derivatives usage. In other words, the negative association between family-controlled firms and trading derivatives usage is expected to be more pronounced in the case of family-controlled firms without D&O insurance coverage.[14] Accordingly, risk-taking strategies for both hedging and trading derivatives in family-controlled firms are correlated with D&O insurance coverage. The second hypothesis for hedging and trading derivatives usage covered by D&O insurance is established as follows:

H2: Ceteris paribus, the positive (negative) association between family-controlled firms and hedging (trading) derivatives usage is more pronounced in the case of family-controlled firms without D&O insurance coverage.

3. Research design

3.1. Data and sample

The years 2009-2018 are chosen as the observation periods. The year 2009 is chosen as the beginning year because it marks the implementation of International Accounting Standards No.39 (IAS 39), Financial Instruments: Recognition and Measurement, in Taiwan.[15] The sample firms are composed of publicly traded firms listed on the TWSE. The derivatives usage data is hand-collected from the MOPS of the TWSE. Firm characteristics and control variables are retrieved from the Taiwan

[14] A competing view is that family-controlled firms focus on transgenerational sustainability, desire to maintain control, and have relatively few outside shareholders, thereby D&O insurance coverage has no role in family-controlled firms' risk averseness and the decisions of derivatives usage. Oppositely, nonfamily-controlled firms are less likely to have the aforementioned concerns, making their derivatives usage decisions more relevant to D&O insurance coverage. Consequently, the moderating role of D&O insurance coverage in firms' hedging (trading) derivatives usage may be more pronounced for the nonfamily-controlled firms. This possibility adds tension to our hypothesis and makes it difficult for us to observe an appositive relationship between D&O insurance and family-controlled firms' derivatives usage decisions

[15] IAS 39 establishes principles for recognizing and measuring financial assets, financial liabilities and some contracts to buy or sell non-financial items. It also outlines principles for derecognizing financial instruments and for hedge accounting. IAS 39 was replaced by IFRS 9, which became effective in 2018 in Taiwan. The results do not qualitatively change excluding the year 2018 observations.

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Economic Journal (TEJ) Database.

A total of 10,418 firm year samples were obtained from the TEJ database for 2009~2018 (excluding finance-related institutions because these firms are subject to different disclosure requirements). This study respectively deleted 2,660 and 98 observations due to missing derivatives usage and family-controlled measure data. A further 243 observations were excluded for data unavailability of other control variables. The procedure yielded a final sample of 7,417 firm year observations, i.e., 2,941 with versus 4,476 without derivatives usage, for empirical analysis. The derivatives usage sub-sample includes 2,348 observations that only use hedging derivatives, 237 observations that only use trading derivatives, and 356 observations (approximately 12% of the hedging sample) that use both hedging and trading derivatives.

Table 1 Sample Selection

Descriptions		N
TSE Listed Firms on TEJ during 2009-2018 (Excluded finance-related industries)		10,418
Less:		
Without derivatives usage data on MOPS		(2,660)
Missing family-controlled firm data		(98)
Data unavailability for other related control variables		(243)
Final empirical observations		7,417
Derivatives usage		2,941
Hedging purpose only	2,348	
Trading purpose only	237	
Both hedging and trading purposes	356	
Without derivatives usage		4,476

Table 2 presents industry breakdown of the sample. This table shows that the sample is distributed across 14 industries with about 47 percent in the electronics industry. It also documents that family-controlled listed firms are only 29 percent in the electronics industry. However, listed firms controlled by a specific family are widespread in remaining industries, such as food (73%), plastic (82%), textile (69%), appliance and cable (62%), rubber (62%), construction (66%), and transportation (56%) industries. Finally, the right two columns in Table 2 show that derivatives usage is prevalent in plastic (52%) and appliance and cable industries (54%), yet, is unlikely industry specific.

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Table 2 Industry Breakdown

Industry	Full Sample	Family-controlled		Derivatives Usage	
		FF Subsample	Non-FF Subsample	No Derivatives Subsample	Derivatives Subsample
Food	200(3%)	145(73%)	55(27%)	134(67%)	66(33%)
Plastic	228(3%)	186(82%)	42(18%)	109(48%)	119(52%)
Textiles	485(7%)	335(69%)	150(31%)	304(63%)	181(37%)
Electric & machinery	487(7%)	202(41%)	285(59%)	286(59%)	201(41%)
Appliance & cable	97(1%)	60(62%)	37(38%)	45(46%)	52(54%)
Chemicals & biotechnology	432(6%)	141(33%)	291(67%)	299(69%)	133(31%)
Steel & iron	331(4%)	154(47%)	177(53%)	170(51%)	161(49%)
Rubber	101(1%)	63(62%)	38(38%)	58(57%)	43(43%)
Electronics	3,488(47%)	999(29%)	2,489(71%)	1,838(53%)	1,650(47%)
Construction	556(7%)	369(66%)	(34%)	524(94%)	32(6%)
Transportation	194(3%)	108(56%)	86(44%)	114(59%)	80(41%)
Tourism	116(2%)	43(37%)	73(63%)	96(83%)	20(17%)
Wholesale & Retail	108(1%)	49(45%)	59(55%)	88(81%)	20(19%)
Others	594(8%)	386(65%)	208(35%)	411(69%)	183(31%)
	7,417	3,240(44%)	4,177(56%)	4,476(60%)	2,941(40%)

臺灣學術期刊資料庫

3.2. Variables

Dependent variable: the magnitude of derivatives usage (***DER***). This study follows prior studies (e.g., Graham and Rogers 2002; Borokhovich et al. 2004; Bartram et al. 2009; Allayannis et al. 2012) in developing the *DER* measure. As a continuous measure of the extent of derivatives usage, we manually collected the total notional value of derivatives (include offsetting and non-offsetting positions in the fiscal year) from the MOPS of the TWSE. Derivatives (*DER*) are defined as all forwards, futures, options, swaps, and other financial instruments. The MOPS database includes both hedging-purpose (*HDER*) and trading-purpose (*TDER*) derivatives usage and allows this study to examine the different motives for family-controlled firms' derivatives usage decisions.[16] The hedging derivatives usage (*HDER*) is calculated as all hedging-purpose forwards, futures, options, swaps, and other financial instruments. Equally, trading derivatives usage (*TDER*) is calculated as all trading-purpose forwards, futures, options, swaps, and other financial instruments. Following previous research (e.g., Barton 2001; Choi et al. 2015), these measures are scaled by total assets.

Pivotal explanatory variable: a dummy for family-controlled firms (***FF***). Family-controlled firms (*FF*) is a dummy variable for a family firm. Following Lin et al. (2016), the variable *FF* equals 1 if the ultimate family owner satisfies the following two conditions, and 0 otherwise: (1) the ultimate owner has 50 % or more of the seats on the board via individual and affiliated firms (e.g., listed firms and non-listed firms he/she controls), and (2) the ultimate owner holds more than 10 % of a firm's outstanding shares.

Moderating variable: liability coverage for directors & officers (***D&O***). The coverage of D&O insurance is proxied as a dummy variable assigned for firms carrying D&O insurance, which equals 1 if a firm covered by D&O insurance and 0 otherwise.

Control variables. This study briefly describes the widely cited theories and predictions for the independent variables that explain derivatives usage. Following Barton (2001) and Bartram et al. (2009), this study adds firm size (*SIZE*), market-to-book ratio (*MB*), leverage (*LEV*), capital expenditures (*GR*), quick ratio (*QR*), dividend yield (*DIV*), short maturity debts (*SDT*), R&D intensity (*RD*), and

[16] For the TSMC case in Appendix, non-trading (trading) purpose contracts is denoted as hedging-(trading-) purpose derivatives in this study. When computing *HDER* or *TDER*, we sum up the contract amount of outstanding (non-offsetting) position and settled (offsetting) position.

長庚大學學術期刊資料庫

executive compensation (*OPT*) as control variables.

Smaller firms incur proportionally higher bankruptcy costs and they are more likely to use derivatives (Nance et al. 1993). This implies a negative relationship between firm size and derivatives usage. However, large firms might exhibit economies of scale using derivatives, which would imply a positive relationship (Allayannis et al. 2012; Borokhovich et al. 2004; Graham and Rogers 2002). The natural logarithm of market value of common equity, denoted as *SIZE*, is the proxy of firm size in this study.[17]

Smith and Stulz (1985) argue that, as derivatives usage decreases the probability of realizing these left tail outcomes, it lowers the expected costs of financial distress. This implies that financial risk management can reduce the probability of encountering such states and thus lower the expected value of costs associated with financial distress. This study focuses on leverage (*LEV*), quick ratio (*QR*), dividend yield (*DIV*) and short maturity debts (*SDT*) to proxy the influence of costs of financial distress of derivatives usage. The extent that hedging increases a firm's value is related to the direct and indirect costs of financial distress relative to the costs of the hedging program. It is expected that *LEV* will be positively associated with derivatives usage. Froot et al. (1993) also indicate that asset liquidation is negatively associated with the use of derivatives. Therefore, quick ratio (*QR*) is used as a proxy for a firm's liquidation. Firms with higher dividend yield are less likely to be financially constrained since these firms probably have stable cash flows and lower financial constraints. Barton (2001) documents that large expected dividend yields increase a firm's cash needs, leading managers to hedge against volatility in cash flow. Dividend yield (*DIV*) is expected to be positively correlated with *DER*. Firms with shorter debt maturity (*SDT*) are more likely to use interest rate swaps to hedge risk exposure, and thus a positive correlation between *SDT* and *DER* is expected (Barton 2001).

Firms with investment or growth opportunities will therefore benefit from derivatives usage. This study follows several previous studies in controlling for firm investment opportunities (e.g., Geczy et al. 1997; Froot et al. 1993). These studies show that firms with greater growth opportunities are more likely to engage in hedging. This study incorporates the market-to-book ratio (*MB*), R&D intensity (*RD*) and capital expenditures (*GR*) into the empirical models to capture the relationship

臺灣大學學術期刊資料庫

[17] We also use the natural logarithm of total assets to measure firm size. The empirical results remain unaltered.

between investment growth and the derivatives usage. In addition, firms appear to use financial derivatives to manage earnings and to speculate when their executive compensation contracts are more performance sensitive (Geczy et al. 2007; Chernenko and Faulkender 2011). A dummy variable for firms with board/CEO stock options (*OPT*) is also incorporated into the regression to control for whether firms in which compensation of senior management is more sensitive to (stock) performance are more likely to use derivatives for trading purposes. Finally, dummy variables for fiscal years are also included in the analysis to control for the potential time-specific effects.

3.3. Model specification

To identify distinctive patterns in family-controlled firms' hedging and trading derivatives usage decisions, when compared against nonfamily-controlled firms, the empirical regressions are presented as Reg. (1). In addition, the independent variables are measured on a one-year lag basis to control for possible endogeneity issues.

$$\begin{aligned} DER_{i,t} = {} & \alpha_0 + \alpha_1 FF_{i,t-1} + \alpha_2 SIZE_{i,t-1} + \alpha_3 MB_{i,t-1} + \alpha_4 LEV_{i,t-1} + \alpha_5 GR_{i,t-1} \\ & + \alpha_6 QR_{i,t-1} + \alpha_7 DIV_{i,t-1} + \alpha_8 SDT_{i,t-1} + \alpha_9 RD_{i,t-1} + \alpha_{10} OPT_{i,t-1} \\ & + \text{Year Effects} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where:

$DER_{i,t}$: a firm's magnitude of derivatives usage. As its measure, it takes the disclosed notional/nominal amount of financial derivatives scaled by total assets of the fiscal year. The magnitude of derivatives usage is either 0 (without derivatives usage) or a positive value. This study further classifies a firm's magnitude of derivatives usage into hedging (*HDER*) versus trading (*TDER*) derivatives usage. As a firm's magnitude of hedging (trading) derivatives usage measure, it takes the disclosed notional/nominal amount of hedging (trading) derivatives scaled by the total assets of the fiscal year. The magnitude of hedging (trading) derivatives usage is either 0 (without derivatives usage) or a positive value;

$FF_{i,t\text{-}1}$: a dummy variable for family-controlled firms at the end of fiscal year *t*-1, which equals 1 if the ultimate owner has (1) 50 % or more of the seats on the board via individual and affiliated firms and (2) more than 10 % of a firm's outstanding shares, and 0 otherwise;

$SIZE_{i,t\text{-}1}$: the natural logarithm of market value of common equity of firm *i* at the end of fiscal year *t*-1;

$MB_{i,t\text{-}1}$: the ratio of market value of equity to book value of equity of firm *i* at the end of fiscal year *t*-1;

$LEV_{i,t\text{-}1}$: a firm's leverage measured as total debt divided by total assets of firm *i* at the end of fiscal year *t*-1;

$GR_{i,t\text{-}1}$: the net capital expenditures which are defined as the ratio of net capital expenditures to net sales of firm *i* at the end of fiscal year *t*-1;

$QR_{i,t\text{-}1}$: a firm's liquidation which is defined as the ratio of quick assets to current liabilities at the end of fiscal year *t*-1;

$DIV_{i,t-1}$: the dividend yield which is measured as the ratio of cash dividends to market value of common stocks of firm *i* at the end of fiscal year *t*-1;
$SDT_{i,t-1}$: the short maturity debt which is measured as current liabilities divided by total liabilities of firm *i* at the end of fiscal year *t*-1;
$RD_{i,t-1}$: the R&D intensity which is defined as the ratio of R&D expense to net sales of firm *i* at the end of fiscal year *t*-1;
$OPT_{i,t-1}$: a dummy variable for firms with boards/CEO stock option at the end of fiscal year *t*-1, and 0 otherwise.

Based on hypothesis 1a (1b), the coefficient of *FF* (α_1) in Reg. (1) is expected to be positive (negative) to reflect the relatively greater hedging (lower trading) derivatives usage by family-controlled firms. In addition, to test hypothesis 2, this study further divides the full sample into two mutually exclusive subsamples based on D&O insurance coverage and perform the regression in Reg. (1). This study splits the sample rather than estimating interaction terms, allowing the coefficients on all the control variables to also vary between the with versus without D&O insurance coverage subsample.

This study hypothesizes that the positive (negative) association between family-controlled firms and hedging (trading) derivatives usage is more pronounced for family-controlled firms without D&O insurance coverage. Thus, the positive (negative) association between family-controlled firms and hedging- (trading-) purpose financial derivatives usage is expected to gain empirical support in the case of firms without D&O insurance coverage. However, this study hypothesizes that family-controlled firms' hedging and trading derivatives usage with D&O insurance coverage would not be expected to be different from those of similar hedging and trading activities conducted by nonfamily-controlled firms. Thus, the coefficient of *FF* (α_1) in Reg. (1) is expected to be statistically insignificant for family-controlled firms with D&O insurance coverage (*D&O*=1).

Chernenko and Faulkender (2011) suggest that panel data can distinguish between derivatives practices that endure over time and are thus more likely to result from hedging, and those that are more consistent with trading. Note that derivatives usage decisions may differ markedly between firms due to unobservable firm-specific traits. Using panel data analysis, especially as the estimation focuses on variations within firms, omitted variable bias can be avoided provided the omitted variable is constant over the examined time frame. However, the need to report data consistently across every year in the panel creates difficulty through potential sample attrition and survivorship bias. This study thus employs an unbalanced-panel regression which controls for firm characteristics to test the hypotheses. This model is expected to provide confirmatory findings to support the

臺灣人文學術期刊資料庫

hypotheses.[18]

4. Empirical results

4.1. Descriptive statistics

Table 3 presents the descriptive statistics of related variables winsorized for the top and bottom 1% of outliers for all continuous variables. From Table 3, the mean of total, hedging, and trading derivatives usage, i.e., *DER*, *HDER*, and *TDER*, is 0.120 (median is 0), 0.115 (median is 0), and 0.005 (median is 0) respectively in the full sample. This suggests that the hedging derivatives is more commonly used than trading derivatives in the sample. The mean of *DER*, *HDER*, and *TDER* in the family-controlled sub-sample is 0.107, 0.103, and 0.004, which is smaller than that of nonfamily-controlled sub-sample. It suggests that, without considering a firm's characteristics, family-controlled firms use less financial derivatives. The mean of the dummy variable of family-controlled firms (*FF*) is 0.437 (median is 0). This shows that approximately 44% of the samples are classified as family-controlled firms, which is slightly smaller than found by Lin and Chang (2009) and Lin et al. (2016). The mean of D&O insurance coverage (*D&O*) is 0.600 (median is 1) and evidences 60% of the observations with legal liability coverage for D&O. The mean of *DER* and *HDER* in the D&O sub-sample is 0.150 and 0.145, which is larger than that of the non-D&O sub-sample. The legal liability coverage for D&O is likely to be positively associated with hedging derivatives.

[18] This study begins with the least-squares regression of the pooled data followed by an assessment of the validity of the pooled model's assumption of a single, overall intercept term. The redundant fixed effects test rejects using the pooled cross-sectional model (F=30.50 in HDER regression and F=10.16 in TDER regression), which implies heterogeneous intercepts, thus the panel data model offers a more powerful approach.

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Table 3 Descriptive Statistics of the Related Variables

	Full Sample (N=7,417)					FF vs. Non-FF Subsample (N=3,240 vs. N=4,177)			D&O vs. Non-D&O Subsample (N=4,447 vs. N=2,970)		
	Mean	Std	Q1	Median	Q3	Mean of FF	Mean of Non-FF	Mean Diff.	Mean of D&O	Mean of Non-D&O	Mean Diff.
DER	0.120	0.375	0.000	0.000	0.059	0.107	0.130	-0.023[a]	0.150	0.076	0.074[a]
HDER	0.115	0.371	0.000	0.000	0.045	0.103	0.125	-0.022[a]	0.145	0.071	0.074[a]
TDER	0.005	0.025	0.000	0.000	0.000	0.004	0.005	-0.001[c]	0.005	0.005	0.000
FF	0.437	0.496	0.000	0.000	1.000	1.000	0.000	1.000[a]	0.341	0.581	-0.240
D&O	0.600	0.490	0.000	1.000	1.000	0.468	0.702	-0.234[a]	1.000	0.000	1.000[a]
SIZE	15.576	1.388	14.621	15.460	16.332	15.598	15.559	0.039	15.794	15.250	0.545[a]
MB	1.597	1.213	0.850	1.250	1.890	1.462	1.703	-0.241[a]	1.655	1.510	0.145[a]
LEV	0.358	0.172	0.228	0.346	0.474	0.370	0.350	0.020[a]	0.354	0.365	-0.010[b]
GR	-0.056	0.314	-0.107	-0.031	-0.001	-0.049	-0.061	0.011	-0.061	-0.048	-0.013
QR	1.726	2.443	0.633	1.071	1.822	1.509	1.894	-0.385[a]	1.693	1.775	-0.083
DIV	0.036	0.035	0.000	0.031	0.055	0.033	0.038	-0.005[a]	0.038	0.033	0.006[a]
SDT	0.705	0.235	0.529	0.751	0.912	0.661	0.739	-0.078[a]	0.726	0.675	0.051[a]
RD	0.031	0.052	0.000	0.012	0.036	0.020	0.040	-0.020[a]	0.038	0.020	0.019[a]
OPT	0.134	0.341	0.000	0.000	0.000	0.089	0.169	-0.081[a]	0.177	0.069	0.108[a]

Legends:

1. *DER*: total derivatives usage that is calculated as all derivatives usage, i.e., forwards, futures, options, swaps, and other financial instruments, scaled by total assets. *HDER* (*TDER*): hedging (trading) derivatives usage that is calculated as all hedging- (trading-) purpose forwards, futures, options, swaps, and other financial instruments scaled by total assets. *FF*: a dummy variable for a family-controlled firm, which equals 1 if the ultimate owner satisfied the following two conditions, and 0 otherwise: (1) the ultimate owner has 50 % or more of the seats on the board via individual and affiliated firms (e.g., listed firms and non-listed firms he/she controls), and (2) the ultimate owner holds more than 10 % of a firm's outstanding shares. *D&O:* a dummy variable for directors' & officers' insurance, which equals 1 if a firm with D&O insurance, and 0 otherwise. *SIZE*: natural logarithm of market value of common equity. *MB*: the ratio of market value of equity to book value of equity. *LEV*: a firm's leverage measured as total debt divided by total assets. *GR*: net capital expenditures, which are defined as the ratio of net capital expenditures to net sales. *QR*: a firm's liquidation, which is defined as the ratio of quick assets to current liabilities. *DIV*: dividend yield, which is measured as the ratio of cash dividends to market value of common stocks. *SDT*: short maturity debt, which is measured as current liabilities divided by total liabilities. *RD*: R&D intensity, which is defined as the ratio of R&D expense to net sales. *OPT*: a dummy variable for firms with boards/CEO stock option.
2. "a", "b" and "c" denote the significance on the 1%, 5% and 10% levels respectively, based on two-tailed tests.

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It is found that, except for *SIZE* and *GR*, the mean difference of the controlling variables between family-controlled firms and nonfamily-controlled firms are statistically significant. Thus, firm characteristics correlated with derivatives usage may determine the level of the utilization of derivatives. Finally, similar to Lai and Tai (2019) that equally use Taiwan data, the mean of legal liability coverage for D&O is 0.468 in family-controlled firms compared to 0.702 in the nonfamily-controlled firms. Family-controlled firms use less D&O coverage to mitigate personal legal liability and recoup their firms' indemnification costs. Two possible reasons could explain this phenomenon. First, prior studies find that more independent directors in the board are associated with a higher probability to purchase D&O insurance (Core 1997; O'Sullivan 1997) and less than half of family-controlled firms in Taiwan have independent directors on their board (Yeh et al. 2003). Family-controlled firms have relatively fewer outside directors in the board and, in turn, use less D&O coverage in our study. Second, Holderness (1990) and O'Sullivan (1997) argued that D&O insurance is a monitoring mechanism, which cause the insurer to ex ante and ex post scrutinizes the insured firms thoroughly. As a result, family-controlled firms have less demand to purchase D&O insurance. The last column in Table 3 also shows that, except for *GR* and *QR*, the mean difference of the controlling variables between firms with and without D&O coverage are statistically significant. It suggests that the firm characteristics vary between with and without D&O coverage subsamples.

Finally, un-tabulated Pearson and Spearmen correlations show the dummy variable of legal liability coverage for D&O (*D&O*) is positively associated with hedging derivatives usage (*HDER*). While most of the independent variables are highly correlated with the others, the variance inflation factors (VIF) of the pivotal variable, i.e., *FF* in Reg. (1) is less than 1.500 in both the HDER and TDER models, and do not suggest severe multicollinearity problems (Neter et al. 1996).

4.2. Regression results

Note that the derivatives usage decision may include two facets: decide to use derivatives and then determine the extent of usage (Haushalter 2000). This study thus firstly uses the binary logistic regression to examine the effects of family-controlled firms on derivatives usage decisions. The magnitude of the derivatives usage variable (*HDER* and *TDER*) is replaced by a dummy variable of firms' using derivatives in Reg. (1). The dummy variable for derivatives usage in this test is denoted as 1 for firms with positive hedging (trading) derivatives positions, and 0 otherwise. The un-tabulated results from binary logistic regression show that the coefficient of family-controlled firms (*FF*) is 0.927 (z=4.339) in the HDER model. The coefficient of family-controlled firms (*FF*) is -0.486 (z=-1.700)

臺灣大學財務期刊資料庫

in the TDER model. Accordingly, this preliminary testing provides evidence of whether the pivotal explanatory variable, i.e., family-controlled firms (*FF*), can explain a firm's derivatives usage.

We report the main results of the tests of H1 and H2 by showing the entire sample, the with D&O coverage subsample (*D&O*=1), and the without D&O coverage subsample (*D&O*=0). The empirical results from Reg. (1) are reported in Table 4. From "Full Model" in Table 4, the coefficients of *FF* are 0.012 (t=1.805) and -0.001 (t=-1.795) respectively in the HDER and TDER models. The coefficients are statistically significant at the 10% level, suggesting that family-controlled firms use more (less) hedging (trading) derivatives than nonfamily-controlled firms, thus supporting H1a and H1b.

Table 4 Family-Controlled Firms' Derivatives Usage Decisions

$$DER_{i,t} = \alpha_0 + \alpha_1 FF_{i,t-1} + \alpha_2 SIZE_{i,t-1} + \alpha_3 MB_{i,t-1} + \alpha_4 LEV_{i,t-1} + \alpha_5 GR_{i,t-1} + \alpha_6 QR_{i,t-1} + \alpha_7 DIV_{i,t-1} + \alpha_8 SDT_{i,t-1} + \alpha_9 RD_{i,t-1} + \alpha_{10} OPT_{i,t-1} + \text{Year Effects} + \varepsilon_{i,t}$$

	HDER Model			TDER Model		
	Full	***D&O*=1**	***D&O*=0**	**Full**	***D&O*=1**	***D&O*=0**
Variables	*α* (t-statistic)	*α* (t-statistic)	*α* (t-statistic)	*α* (t-statistic)	*α* (t-statistic)	*α* (t-statistic)
Constant	-0.441[b]	-0.325	-0.180[b]	0.007	-0.007	0.030[c]
	(-2.907)	(-1.367)	(-3.100)	(0.365)	(-0.237)	(1.797)
FF	0.012[c]	0.017	0.018[b]	-0.001[c]	0.001	-0.005[c]
	(1.805)	(1.364)	(2.284)	(-1.795)	(0.619)	(-2.009)
SIZE	0.023[b]	0.016	0.010[b]	-0.000	0.000	-0.002
	(2.570)	(1.152)	(2.943)	(-0.308)	(0.209)	(-1.472)
MB	-0.004	0.001	-0.008[a]	-0.000	0.000	-0.000
	(-0.750)	(0.087)	(-3.473)	(-1.250)	(0.531)	(-0.775)
LEV	0.077[b]	0.022	0.085[a]	0.002	-0.007	0.003
	(2.907)	(0.653)	(3.488)	(0.503)	(-1.253)	(0.922)
GR	0.005	0.003	0.005	-0.000	-0.001	-0.000
	(1.307)	(0.502)	(1.137)	(-0.485)	(-1.082)	(-0.781)
QR	0.003[c]	0.004	0.002[b]	0.000	0.000	0.000
	(2.084)	(0.959)	(2.897)	(1.212)	(0.826)	(0.208)
DIV	0.020	0.094	-0.214[b]	0.025[c]	0.031[b]	0.006
	(0.294)	(0.824)	(-2.565)	(1.931)	(2.806)	(0.293)
SDT	0.056[b]	0.091[a]	0.023	-0.003	-0.002	-0.002
	(3.064)	(4.388)	(0.759)	(-1.313)	(-0.676)	(-1.270)
RD	-0.040	0.141	-0.568[a]	-0.011	-0.014	0.013
	(-0.424)	(1.413)	(-4.336)	(-1.185)	(-0.766)	(1.498)
OPT	0.028[b]	0.025[c]	0.027	0.002[c]	0.000	0.003[c]
	(2.837)	(2.035)	(0.921)	(2.016)	(0.276)	(2.108)
Year Effect	Included	Included	Included	Included	Included	Included
N	7,417	4,447	2,970	7,417	4,447	2,970
Adj. R^2	0.800	0.835	0.776	0.557	0.631	0.563

Legends:

1. The definition of variables is presented in Table 3.
2. "a", "b" and "c" denote the significance on 1%, 5% and 10% levels respectively, based on two-tailed tests. The equations to test our hypotheses are estimated using unbalanced-panel model with both firm and year fixed-effects and significance levels based on White (1980) standard errors adjusted for heteroskedasticity.

國家圖書館期刊資料庫

In the with D&O insurance coverage subsample (*D&O*=1), the coefficients of *FF* are 0.017 (t=1.364) and 0.001 (t=0.619) respectively in the HDER and TDER models; both are statistically insignificant. This suggests that the positive (negative) relationship between family-controlled firms and hedging (trading) derivatives usage disappears in the presence of the D&O insurance coverage. Namely, family-controlled firms are no longer more risk averse in this situation, thereby their derivatives usage are not significantly different from nonfamily-controlled firms. Interestingly, in the subsample without D&O insurance coverage (*D&O*=0), the coefficient of *FF* is 0.018 (t=2.284) and positively significant in the HDER model but is -0.005 (t=-2.009) and negatively significant in the TDER model. The derivatives usage reveals distinctive patterns in the case of firms without D&O insurance coverage. It is likely that family-controlled firms use more hedge derivatives but less trading derivatives in the without D&O insurance coverage situation. Hypothesis 2 thus gains empirical support in the subsample examination. These results indirectly confirm that D&O insurance regulation may have a positive contribution to the derivatives usage decisions in family-controlled firms while FSC required TWSE listed firms to take out directors and supervisors liability insurance in 2019.

In terms of other explanatory variables, positive and statistically significant coefficients are observed for *SIZE*, *LEV*, and *QR* in the full and *D&O*=0 sample of HDER model.[19] These results indicate that a firm's size, leverage, and liquidation are positively associated with its hedging derivatives usage, but is conditional in the *D&O*=0 case. The coefficients of *SDT* are positive and statistically significant in the full and *D&O*=1 samples of the HDER model. Thus, firms with shorter debt maturity are more likely to use hedging derivatives to hedge risk exposure (Barton, 2001). The coefficients of executive compensation (*OPT*) are positive and significant in the full sample of the HDER and TDER models. This reveals that firms use more derivatives when their executive compensation contracts are more performance-sensitive (Geczy et al. 2007; Chernenko and Faulkender 2011).

Note that the selective hedgers significantly change the volume of financial derivatives used during the period, but used them in line with their risk exposure. This type of derivatives users to some extent incorporate their own forecast about

[19] The variables in the TDER model are statistically insignificant. The possible reason is that trading derivatives practices are more likely to result from transient decisions and don't endure over time in the panel data setting.

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the trajectory of the economy in their decisions by continuously changing the volume, timing, or position of derivatives used to time the market according to these views (Junior 2013). The 356 observations using both hedging and trading derivatives in the initial analysis are similar to the selective hedgers. The main reason for this type of firms to use derivatives may differ from the other two types of derivatives users, i.e., hedgers and trading users. This study thus excludes the 356 observations and reruns the HDER and TDER models. The un-tabulated results show approximately the same patterns in this diagnostic check. The coefficients of family-controlled firms (*FF*) are 0.009 (t=1.759), 0.004 (t=0.310), and 0.018 (t=2.133) respectively in the full, with D&O (*D&O*=1), and without D&O (*D&O*=0) samples of the HDER model. The coefficients of family-controlled firms (*FF*) are -0.001 (t=-1.494), 0.001 (t=1.458), and -0.004 (t=-2.605) in the full, with D&O (*D&O*=1), and without D&O (*D&O*=0) samples of the TDER model.

This study also replaces the lagged value of independent variables (year *t*-1) by the current value of independent variables (year *t*) and reexamines the regression. The un-tabulated results show that the coefficients of family-controlled firms (*FF*) are 0.012 (t=1.751), 0.019 (t=1.497), and 0.018 (t=2.339) respectively in the full, with D&O (*D&O*=1), and without D&O (*D&O*=0) samples of the HDER model. The coefficients of family-controlled firms (*FF*) are -0.001 (t=-1.714), 0.001 (t=0.635), and -0.005 (t=-2.261) respectively in the full, with D&O (*D&O*=1), and without D&O (*D&O*=0) samples of the TDER model. These tests again reveal that family-controlled firms use more derivatives to hedge and use less trading derivatives in the without D&O insurance coverage subsample. Thus, the findings are robust to the current value of independent variable (year *t*) measures. Moreover, we observe a similar pattern for family-controlled firms and derivatives usage in different periods.

5. Additional analysis

5.1. Model specification tests

An alternative model. Since the derivatives usage is either 0 (i.e., without derivatives usage) or greater than zero (i.e., positive derivatives position), the *DER* variable presents a continuous dependent variable which is confined to a lower limitation of zero. Previous studies of the extent of firm derivatives usage used a Tobit model (e.g., Tufano 1996; Knopf et al. 2002; Rogers 2002). This study thus uses the Tobit derivatives

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usage model (i.e., Tobit model) to retest the hypotheses.[20]

Table 5 presents the empirical results. In Table 5, the coefficients of *FF* are 0.071 (t=3.178) and -0.020 (t=-1.851) respectively in the full sample of HDER and TDER models. The former (latter) coefficient is statistically significant at the 1% (10%) level. In *D&O*=1 subsample, the coefficients of *FF* are 0.064 (t=2.542) and 0.014 (t=1.149) respectively in the HDER and TDER models; the former coefficient is statistically significant at the 5% level. The coefficient of *FF* in *D&O*=0 subsample is 0.095 (t=2.695) in the HDER model, yet it is -0.062 (t=-3.027) in the TDER model. These results imply the findings are robust to the Tobit model testing. Considering lots of sample firms in our study do not use derivatives, we use the Tobit model in subsequent tests.

Table 5 Family-Controlled Firms' Derivatives Usage Decisions---Tobit Model Tests

$$DER_{i,t} = \alpha_0 + \alpha_1 FF_{i,t-1} + \alpha_2 SIZE_{i,t-1} + \alpha_3 MB_{i,t-1} + \alpha_4 LEV_{i,t-1} + \alpha_5 GR_{i,t-1} + \alpha_6 QR_{i,t-1} + \alpha_7 DIV_{i,t-1} + \alpha_8 SDT_{i,t-1} + \alpha_9 RD_{i,t-1} + \alpha_{10} OPT_{i,t-1} + \text{Year Effects} + \text{Firm Effects} + \varepsilon_{i,t}$$

	HDER Model			TDER Model		
	Full	***D&O*=1**	***D&O*=0**	**Full**	***D&O*=1**	***D&O*=0**
Variables	α (t-statistic)	α (t-statistic)	α (t-statistic)	α (t-statistic)	α (t-statistic)	α (t-statistic)
Constant	-1.696[a]	-1.002[c]	-1.145[c]	-0.359	-0.389[a]	-0.039
	(-4.137)	(-1.913)	(-1.850)	(0.000)	(-4.650)	(0.000)
FF	0.071[a]	0.064[b]	0.095[a]	-0.020[c]	0.014	-0.062[a]
	(3.178)	(2.542)	(2.695)	(-1.851)	(1.149)	(-3.027)
SIZE	0.083[a]	0.045	0.057	-0.003	0.002	-0.023
	(3.622)	(1.536)	(1.635)	(-0.316)	(0.186)	(-1.231)
MB	-0.027[b]	-0.008	-0.053[a]	-0.006	-0.005	0.000
	(-2.101)	(-0.503)	(-2.839)	(-1.334)	(-0.864)	(0.001)
LEV	0.268[a]	0.080	0.443[a]	0.072[c]	-0.033	0.163[b]
	(3.018)	(0.665)	(3.362)	(1.868)	(-0.746)	(2.100)
GR	0.026	-0.008	0.088b	-0.004	-0.020	0.001
	(1.034)	(-0.259)	(2.292)	(-0.519)	(-1.582)	(0.067)
QR	0.016	0.015	0.018[c]	0.004	0.001	0.009[b]
	(1.442)	(1.017)	(1.688)	(1.494)	(0.260)	(2.282)
DIV	0.034	0.183	-0.556[c]	0.240[a]	0.207[b]	0.200
	(0.162)	(0.741)	(-1.766)	(2.729)	(2.233)	(1.230)
SDT	0.194[a]	0.246[a]	0.099	-0.027	-0.014	-0.042
	(3.946)	(4.098)	(1.044)	(-1.337)	(-0.655)	(-0.932)
RD	0.056	0.324	-3.354[a]	-0.002	0.075	0.567
	(0.189)	(1.058)	(-2.969)	(-0.011)	(0.552)	(0.970)
OPT	0.065[a]	0.053[b]	0.056	0.020[b]	0.003	0.068[a]
	(2.900)	(2.178)	(1.156)	(2.356)	(0.286)	(3.121)
Year Effect	Included	Included	Included	Included	Included	Included
Firm Effect	Included	Included	Included	Included	Included	Included
N	7,417	4,447	2,970	7,417	4,447	2,970
Pseudo R^2	0.796	0.821	0.878	1.413	1.563	1.409

Legends:

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[20] As a sensitivity test, this study deletes the sample which is without derivatives usage and reruns the regressions. The empirical results remain unchanged other than H1a.

1. The definition of variables is presented in Table 3.
2. “a”, “b” and “c” denote the significance on 1%, 5% and 10% levels respectively, based on two-tailed tests. The equations to test our hypotheses are estimated using unbalanced-panel model with both firm and year fixed-effects and significance levels based on White (1980) standard errors adjusted for heteroskedasticity.

An alternative measurement of derivatives use. In terms of hedging-purpose derivatives usage (*HDER*), the optimal deflator is the amount of risk exposure which a firm attempt to hedge (Tufano 1996; Barton 2001). Because such information is not available, this study follows prior literature (e.g., Barton 2001; Chou et al. 2015) and uses total assets instead to scale the derivatives usage. Namely, our empirical findings may potentially subject to the measurement error. To reduce this concern, this study uses the amount of all derivatives usage (i.e., the sum of *HDER* and *TDER*) as a deflator and recalculates the *HDER* measure. The variable *HDER* thus represents the relative usage of hedging purpose and trading purpose derivatives and, thereby can be used to test hypotheses on these two types of derivatives simultaneously. This study also deletes the sample without derivatives usage to perform this diagnostic check. Similar to the first three columns in Table 4, the empirical results (un-tabulated) show that the coefficients of *FF* are 0.037, 0.002, and 0.104 in the full sample, the *D&O*=1 subsample, and the *D&O*=0 subsample, respectively. The coefficients are only statistically significant in the full sample (t=2.352) and *D&O*=0 subsample (t=2.720). Family firms use more hedging (less trading) derivatives than non-family firms. This phenomenon occurs in the absence of D&O insurance.

Alternative specifications of D&O insurance. To test H2, this study performs the regression in Reg. (1) by the subsample with D&O insurance and the subsample without D&O insurance, respectively. However, this approach does not directly examine the moderating effect of D&O insurance. This study thus uses another specification which adds the main and interaction effects of D&O insurance to Reg. (1). The Tobit regression is reported as follows:

$$DER_{i,t} = \alpha_0 + \alpha_1 FF_{i,t-1} + \alpha_2 D\&O_{i,t-1} + \alpha_3 FF_{i,t-1} \times D\&O_{i,t-1} + \beta CV_{i,t-1} + \text{Year Effects} + \text{Firm Effects} + \varepsilon_{i,t} \quad (2)$$

where:

$D\&O_{i,t-1}$: a dummy variable that equals 1 if a firm had D&O insurance at the end of fiscal year t-1, and 0 otherwise.

$CV_{i,t-1}$: A set of control variables in Reg. (1), which include *SIZE*, *MB*, *LEV*, *GR*, *QR*, *DIV*, *SDT*, *RD*, and *OPT*.

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The interaction variable (*FF*× *D&O*) is used to test H2 in the analysis. Corresponding to the empirical results of H2, the findings (untabulated) show that the coefficient of *FF*× *D&O* is negative and statistically significant at the 10% level (coefficient=-0.061, t=-1.886) in the HDER mode and positive and statistically significant at the 10% level (coefficient=0.027, t=1.733) in the TDER model.

Considering the magnitude of derivatives usage may be associated with the level of D&O insurance. This paper follows prior literature (e.g., Chen and Chang 2022; Huang and Chang 2022) and uses two continuous variables of D&O insurance instead of the variable *D&O* in Reg. (2). The first is D&O insurance scaled by the total assets (*D&O*%). The second is the natural logarithm of one plus D&O insurance coverage (*lnD&O*). However, the amount difference of D&O insurance coverage is enormous across firms. To exclude the effect of outliers on the empirical results, firms with D&O insurance is ranked into deciles based on the amount of *D&O*% and *lnD&O*. These variables are then rescaled to range an interval between zero and one. The sample size is reduced to 7,154 observations due to missing the amount of D&O insurance. Again, the results (untabulated) document that the coefficients of *FF*× *D&O%* and *FF*× *lnD&O* are -0.084 and -0.090 respectively in the HDER model. The coefficient is significant at the 10% level in the lnD&O model. In addition, the coefficients of these interaction items are both positive (0.050 and 0.046) and statistically significant (t=1.812 and 2.086) in the TDER model.

We observe that family-controlled firms with a lower amount of D&O insurance, compared to the nonfamily-controlled firms, are associated with less trading (more hedging) derivatives usage. Specifically, as *lnD&O* is proxied as the D&O insurance, it is found that the coefficient of *FF* is 0.118 in the HDER model while it is -0.046 in the TDER model. The combined coefficient of *FF* and *FF*× *lnD&O* is 0.028 (i.e., 0.118 plus -0.084) in the HDER model while it is close to zero (i.e., -0.046 plus 0.046) in the TDER model. After controlling firm characteristics in the regression, this result implies that family-controlled firms' risk aversion cannot vanish completely until they purchase a relatively higher amount of D&O insurance.[21]

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[21] We use the matched sample with the same firm characteristics (in Section 5.4) to perform the analysis in Reg. (2) and identically obtain the same inference.

5.2. Forward contracts versus non-forward contracts usage examination

Note that large export (import) proportions of sales (purchases) are directly connected to the nature of a non-financial firm's international involvement. This leads listed firms to pursue an asymmetric focus on the use of currency forward derivatives to mitigate exposure to foreign exchange rate risk in Taiwan. The most commonly used derivatives instrument in this study is forward contracts, i.e., 81.50% of the 2,941 derivatives usage sample. This is consistent with the findings of previous studies, including Bodnar et al. (1998) for US firms, Bodnar et al. (2003) for Dutch firms and Bodnar et al. (2013) for Italian non-financial firms. This study thus divides the derivatives usage into two groups, forward contracts and non-forward contracts derivatives that include the remaining derivatives. The concise results denoted as "Forward Contracts Model" and "Non-Forward Contracts Model" are reported respectively in Table 6.

From "Forward Contracts Model" in Panel A, the coefficients of *FF* are 0.038 (t=2.054) and 0.055 (t=1.922), statistically significant respectively in both the full and *D&O*=0 sample of HDER model. It is likely the family-controlled firms use more forward contracts than their counterparts in hedging activities. However, the coefficients of *FF* are -0.006(t=-2.008) and -0.006 (t=-2.213), statistically significant respectively in the full and *D&O*=0 sample of TDER model. In the "Non-Forward Contracts Model", the coefficients of *FF* are -0.017 (-1.959) and -0.016 (t=-1.912), statistically significant respectively in the full and *D&O*=0 samples of TDER regression. The results are approximately the same as the findings based on the total trading derivatives usage and suggest that family-controlled firms use less futures, options, swaps, and other trading derivatives than the nonfamily-controlled firms. Nevertheless, in the HDER regression, the coefficients of *FF* are statistically insignificant in the full and *D&O*=0 sample. This additional check suggests that the positive association between family-controlled firms and hedging derivatives usage is related to the hedging purpose of forward contracts usage. Collectively, the results qualitatively retain unaltered.

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Table 6 Family-Controlled Firms' Different Type Derivatives Usage Decisions

$$DER_{i,t} = \alpha_0 + \alpha_1 FF_{i,t-1} + \alpha_2 SIZE_{i,t-1} + \alpha_3 MB_{i,t-1} + \alpha_4 LEV_{i,t-1} + \alpha_5 GR_{i,t-1} + \alpha_6 QR_{i,t-1} + \alpha_7 DIV_{i,t-1} + \alpha_8 SDT_{i,t-1} + \alpha_9 RD_{i,t-1} + \alpha_{10} OPT_{i,t-1} + \text{Firm Effects} + \varepsilon_{i,t}$$

	HDER Model			TDER Model		
	Full	***D&O*=1**	***D&O*=0**	**Full**	***D&O*=1**	***D&O*=0**
Variables	α (t-statistic)	α (t-statistic)	α (t-statistic)	α (t-statistic)	α (t-statistic)	α (t-statistic)
Panel A: Forward Contracts Model						
FF	0.038[b]	0.027	0.055[c]	-0.006[b]	0.003	-0.006[b]
	(2.054)	(1.173)	(1.922)	(-2.008)	(1.271)	(-2.213)
Control Var.	Included	Included	Included	Included	Included	Included
Firm Effect	Included	Included	Included	Included	Included	Included
N	2,397	1,696	829	2,397	1,696	829
Pseudo R^2	1.772	1.575	2.782	9.336	1052.648	-3.608
Panel B: Non-Forward Contracts Model						
FF	-0.021	-0.009	-0.016	-0.017[c]	-0.015[c]	-0.016[c]
	(-0.758)	(-0.279)	(-0.348)	(-1.959)	(-1.850)	(-1.912)
Control Var.	Included	Included	Included	Included	Included	Included
Firm Effect	Included	Included	Included	Included	Included	Included
N	1,540	1,201	844	1,540	1,201	844
Pseudo R^2	1.370	1.247	1.315	14.539	-8.987	-1.979

Legends:

1. The definition of variables is presented in Table 3.
2. "a", "b" and "c" denote the significance on 1%, 5% and 10% levels respectively, based on two-tailed tests. The equations to test our hypotheses are estimated using unbalanced-panel model with firm fixed-effects and significance levels based on White (1980) standard errors adjusted for heteroskedasticity.

5.3. Endogeneity problems

D&O insurance decisions are unlikely exogenous and may involve in the self-selection problem in this study. To eliminate this concern, this study implements the propensity score-matching approach. To estimate the propensity scores, we firstly conduct a prediction model of D&O insurance regressed by several determinants that are derived from prior literature (Huang and Chang 2022; Li and Liao 2021; Liao et al. 2021; Chang, Chen, Chen, and Wang 2016; Chou et al. 2015; Hsu and Lin 2013). The Probit regression is reported as follows:

$$D\&O_{i,t} = \alpha_0 + \alpha_1 INDD\&O_{i,t} + \alpha_2 ROE_{i,t} + \beta CV_{i,t} + \gamma CG_{i,t} + \delta IND_{i,t} + \varepsilon_{i,t} \quad (3)$$

where:

$D\&O_{i,t}$: a dummy variable that equals 1 if firm *i* had D&O insurance at fiscal year *t*, and 0 otherwise.

$INDD\&O_{i,t}$: the proportion of firms with D&O insurance in the same industry in fiscal year *t*.

$ROE_{i,t}$: return on equity of firm *i* at the end of fiscal year *t*.

臺灣大學學術期刊資料庫

$CV_{i,t}$: A set of control variables in Reg. (1), which represent firm characteristics and include *SIZE*, *MB*, *LEV*, *GR*, *QR*, *DIV*, *SDT*, *RD*, and *OPT*.[22]

$CG_{i,t}$: a set of variables that represent governance characteristics at the end of fiscal year *t*. These characteristics include board size, director ownership, the largest shareholder's ownership, managerial ownership, institutional ownership, and the ratio of independent directors.[23]

$IND_{i,t}$: a set of dummy variables that represent various industries.

Next, each firm having D&O insurance is matched to a firm having no D&O insurance with the closest propensity score without replacement. Following Chang, Chen, Chen, and Wang (2016), the difference on propensity scores is limited to be within ±0.001.[24] There are 1,781 matched pairs, each of which has no significant difference on firm and governance characteristics. Finally, these matched pairs are used to duplicate the analysis of D&O insurance (i.e., Columns (3), (4), (6), and (7)) in table 5).[25] As in Table 4, the coefficients of *FF* are 0.094 (t=1.878) and -0.057 (t=-2.866), which are statistically significant, in the *D&O*=0 subsample of the HDER and TDER model. These results reveal approximately the same patterns as the main results.

6. Conclusion

This study first examines whether risk averse family owners, focusing on maintaining family control, are associated with higher (lower) levels of hedge (trading) derivatives usage. D&O insurance may limit the potential legal liabilities associated with negative outcomes from D&O decisions. This study further examines the association between D&O insurance and family-controlled firms' derivatives usage decisions. Empirical results indicate that family-controlled firms are more likely to engage in hedging derivatives, but use fewer trading derivatives than nonfamily-controlled firms. Further evidence shows that these results are particularly pronounced for family-controlled firms that do not have D&O insurance coverage. These results provide evidence that, in emerging markets like Taiwan, family-controlled firms without D&O insurance coverage tend to be more risk

[22] We follow Chang, Chen, Chen, and Wang (2016) and Chou et al. (2015) to incorporate the control variables in the main model (i.e., Reg. (1)) into the prediction model.

[23] We also put these six governance variables and CEO duality into Reg. (1) to control the effect of governance characteristics on derivatives usage. As a result, we obtain the same findings in Table 5.

[24] The results retain unchanged even if the absolute value of this score difference is limited to be within ±0.03 (Liao et al. 2021) or ±0.01 (Chen and Chang 2022) on the basis of the standard in other literature.

[25] We use this matched sample to perform the analysis in Reg. (2) and approximately obtain the same results.

臺灣大學學術期刊資料庫

averse, and such behavior is actually mitigated by the D&O insurance mechanism.

The findings in this study are subject to a number of limitations and should be interpreted with caution. First, the listed firms in Taiwan are required to post derivatives usage information, i.e., purposes, positions, and whether hedge accounting is applicable, on the MOPS of the TWSE. This study cannot exclude the possibility that firms use derivatives to disguise speculative activities as hedging transactions. Second, hedging derivatives usage is hard to measure accurately due to data limitation on hedged assets/liabilities. The possible measurement error should be concerned in interpreting the results. Third, note that, as of 2019, FSC stipulated that all listed firms must be covered by D&O insurance and indemnification. Our findings are based on voluntary D&O insurance and indemnification, and the impact of mandated D&O coverage on family-controlled firms' derivatives usage must be empirically determined. However, this study finds that family-controlled firms with a lower amount of D&O insurance are identically associated with less trading (more hedging) derivatives usage than the nonfamily-controlled firms. This suggests that the magnitude of D&O insurance matters for family-controlled firms' derivatives usage decisions. Note that the regulation in TWSE only requires the listed firms must be covered by the D&O insurance, but does not stipulate a minimum amount of that insurance. A re-examination of the presented findings using mandatory D&O insurance data to examine whether further requirements for a minimum amount of D&O insurance could improve policy effectiveness will provide another insight. Finally, there can be a complicated and/or mutually interactive relationship between family-controlled firms' derivatives usage and D&O insurance coverage decisions. Thus, difficulties associated with determining the moderating role of D&O insurance coverage may lead to potentially imprecise inferences in this study. Further study could examine the role of D&O insurance coverage on other financial or operating decisions in family-controlled firms to enrich this stream of research.

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Appendix TSMC' Derivatives Usage Disclosure on MOPS

Taiwan Semiconductor Manufacturing Company Limited (TSMC) is established in 1987 and listed on the Taiwan Stock Exchange. It pioneered the pure-play foundry business model by focusing solely on manufacturing customers' products. It provides customer service, account management and engineering services through offices in North America, Europe, Japan, China, and South Korea. More than 90% of TSMC's revenue is denominated in U.S. dollar and over one-half of its capital expenditures are denominated in currencies other than NT dollar, primarily in U.S. dollar, Japanese yen, and Euro. Any significant fluctuations to its disadvantage in exchange rate of NT dollar against such currencies would have an adverse impact on the company's revenue and profit as expressed in NT dollar. To protect against currency exchange rate risks, TSMC uses foreign currency derivatives contracts, such as currency forwards and cross-currency swaps. The formalized table presented as follow is TSMC' derivatives usage disclosure information on December, 2018 in the MOPS.

臺灣大學學術期刊資料庫

(In thousands of new Taiwan dollars)

Type of contract				Futures	Options	Forwards	Swaps	Hybrid instruments	Others
Non-trading purpose contracts	that do not meet the criteria for hedge accounting	Margins Paid		-	-	-	-	-	-
		Premiums Received (Paid)		-	-	-	-	-	-
		Outstanding Position	Total amount of contract	-	-	31,702,026	-	-	-
			Fair value	-	-	19,440	-	-	-
			The amount of unrealized gain(loss) recognized this year	-	-	-316,545	-	-	-
		Settled Position	Contract amount	-	-	519,986,712	-	-	-
			The amount of realized gain(loss) recognized this year	-	-	-1,182,311	-	-	-
	that meet the criteria for hedge accounting	Margins Paid		-	-	-	-	-	-
		Premiums Received (Paid)		-	-	-	-	-	-
		Outstanding Position	Total amount of contract	-	-	3,917,657	-	-	-
			Fair value	-	-	26,000	-	-	-
			The amount of unrealized gain(loss) recognized this year	-	-	21,317	-	-	-
		Settled Position	Contract amount	-	-	4,250,861	-	-	-
			The amount of realized gain(loss) recognized this year	-	-	13,247	-	-	-
Trading purpose contracts		Margins Paid		-	-	-	-	-	-
		Premiums Received (Paid)		-	-	-	-	-	-
			Total amount of contract	-	-	-	-	-	-
			Fair value	-	-	-	-	-	-
			The amount of unrealized gain(loss) recognized this year	-	-	-	-	-	-
		Settled Position	Contract amount	-	-	-	-	-	-
			The amount of realized gain(loss) recognized this year	-	-	-	-	-	-

臺灣大學學術期刊資料庫

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