Does D&O insurance matter for stock price crash risk? Evidence from an Asian emerging market

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Abstract

Purpose – The purpose of this paper is to address the opposing views of the relationship between directors' and officers' liability insurance (D&O insurance) and stock price crash risk in a major Asian emerging stock market.
Design/methodology/approach – This paper finds an endogenous relationship between D&O insurance and stock price crash risk. Hence, the two-stage least squares regression analysis is used to address the endogeneity issue when the relationship is examined. Moreover, this paper further controls the quality of other corporate governance mechanisms to investigate whether D&O insurance still has an effect on stock price crash risk.
Findings – The effect of D&O insurance coverage is significantly negatively related to firm-specific stock price crash risk in Taiwan. More importantly, even when the quality of other corporate governance mechanisms is controlled, the negative relationship between D&O insurance coverage and firm-specific stock price crash risk remains significant. The evidence supports that D&O insurance serves as an effective external monitoring mechanism, strengthens corporate governance, and thus reduces stock price crash risk.
Originality/value – Emerging Asian markets suffer a dearth of research on the relationship of D&O insurance coverage and the firm-specific stock price crash risk. Investigating the relationship in Taiwan, the present study fills the research void. The findings show that D&O insurance plays an important role in reducing stock price crash risk of Taiwanese firms even when other corporate governance mechanisms are in place.
Keywords Taiwan, Corporate governance, Emerging market, Crash risk, Directors' and officers' (D&O) insurance
Paper type Research paper

1. Introduction

Directors' and officers' liability insurance (hereafter referred to as D&O insurance) is commonly purchased by firms to protect their executives and directors from the risk of litigation brought by stakeholders for alleged wrongdoing in performing their duties. D&O insurance was first introduced in England in 1930 (Chen *et al.*, 2015), and it is so far more pronounced in developed markets. About 97 percent of firms in the USA, 86 percent in Canada and up to 90 percent in Hong Kong already have D&O insurance (Yuan *et al.*, 2016).

Purchasing D&O insurance obviously is a common phenomenon in developed markets, but its financial implication is still a controversial issue. There are several arguments about the financial implication of D&O Insurance. First, from the corporate governance perspective, governance quality can be strengthened and improved by D&O insurance (O'Sullivan, 1997). Moreover, the proactive monitoring function of D&O insurance (Holderness, 1990) can further reduce agency costs, enhance stakeholder protection mechanisms and thus improve corporate governance. Second, managerial opportunism may induce the purchase of D&O insurance (Core, 1997; Chalmers *et al.*, 2002). For private benefits, managers may use corporate resources

to buy D&O insurance to lower the potential litigation risk caused by their future wrongdoing (Chalmers *et al.*, 2002). Third, based on the moral hazard theory, D&O insurance increases the extent of the managers' protection and thus may induce moral hazard and inflict harm on stakeholders' benefits (Chung and Wynn, 2008; Lin *et al.*, 2013; Chen *et al.*, 2015).

As a shield protecting the management team from litigation risk, some scholars suggest D&O insurance is a valid compensation mechanism. Therefore D&O insurance can facilitate recruiting qualified independent directors (Priest, 1987; Daniels and Hutton, 1993) and attract and retain top talent (Brook and Rao, 1994; Bhagat *et al.*, 1987). It is also documented that D&O insurance can improve the information disclosure quality (Lin *et al.*, 2015) and increase the operating performance of a firm (Chen and Li, 2010). D&O insurance is also viewed as an external monitoring mechanism which can improve corporate governance of insured firms (Holderness, 1990; O'Sullivan, 1997) by inducing management incentives to act prudently (Lin *et al.*, 2015), and thus generating larger benefits than costs to shareholders (Bhagat *et al.*, 1987). Consistent on these studies, having D&O insurance in China is found to be associated with lower stock price crash risk (Yuan *et al.*, 2016).

However, other scholars suggest that by mitigating litigation risk, D&O insurance might increase managers' negligence in business activities and thus could increase the likelihood of claims brought by stakeholders (Gutiérrez, 2003). With D&O insurance protection, managers may be more readily tempted to manipulate the price of initial public offerings (Chalmers *et al.*, 2002). In this case, firms with D&O insurance might face higher litigation risk (Chen and Li, 2010), larger swings in stock price (O'Sullivan, 2002) and greater stock price crash risk.

Unlike many other economic entities, China is the world's second largest economic entity and has a socialist market economy where legal protection of private investors is limited (Chen *et al.*, 2009; Zou *et al.*, 2008; Yuan *et al.*, 2016). Until 2002, private securities litigation was usually not allowed (Yuan *et al.*, 2016). Moreover, Chinese firms are not required to purchase D&O insurance or to disclose the relevant information.

The economic environment in Taiwan is very different to China. Taiwan is a small economy (Chow, 2013) and is a well-recognized major emerging Asian market. Starting from 2008, Taiwanese firms are required to disclose the details of their D&O insurance policies to investors. In 2016, there were approximately 66 percent of public firms having D&O insurance. The proportion of firms having D&O insurance in Taiwan is much higher than that in China, but is less than those in developed markets, for example, Canada, Hong Kong, Singapore and the USA.

This research attempts to examine whether D&O insurance has an influence on stock price crash risk in Taiwan because of lack of such research in emerging Asian markets. Moreover, this research simultaneously considers the influence of the corporate governance system because it might influence the impact of D&O insurance on the firms' stock price crash risk.

This research provides several contributions. First, this study provides an insight of the impact of D&O insurance on stock price crash risk in an emerging Asian market. Although Yuan *et al.* (2016) document the impact of having D&O insurance on stock price crash risk in China, the economic environment in China is very different than those in other Asian emerging markets. Government intervention is much stronger in China is than in other Asian emerging markets. Therefore, the present study can fill the void in the literature on D&O insurance.

Second, this study documents the effect of D&O insurance on stock price crash risk in Taiwan, which is an important emerging Asian market. The total market capitalization of the Taiwan Stock Exchange (TWSE) was $8.43 trillion in November 2016, ranked seventh among Asian stock exchanges. In August 2016, Taiwan's weightings in the MSCI emerging markets index and the MSCI emerging markets Asia index were 12.30 and 17.49 percent, respectively. Taiwanese stock market is clearly a major market in both Asian and global stock markets.

Third, this study contains policy implications for policy-makers in emerging markets. Believing D&O insurance is advantageous to shareholders; Taiwanese authorities have been encouraging firms to purchase the insurance since 2008. Whether having D&O insurance reduces stock price crash risk clearly affect shareholders' benefit. Therefore, the present study could have implications for relevant authorities in Taiwan as well as in other emerging markets in terms of whether to continue encouraging or start to encourage firms to purchase D&O insurance.

The remainder of this paper is structured as follow. Section 2 reviews the literature. Section 3 describes the sample, the variables and the research design. Section 4 presents the empirical results. Section 5 concludes the paper.

2. Literature review

Managers have discretion in deciding whether to purchase D&O insurance for executives and directors depending on their litigation and distress risk (Core, 1997). From the corporate governance viewpoint, Holderness (1990) and Baker and Griffith (2007) both argue that D&O insurance serves as an external monitoring mechanism, which is useful in monitoring the operations of the insured firms and thus results in further improvement to corporate governance. D&O insurance is also helpful in attracting and retaining top talent and outside directors, resulting in improving shareholders' role in monitoring the activities of the board in public companies (Priest, 1987; Daniels and Hutton, 1993; O'Sullivan, 2002).

From the risk management viewpoint, before underwriting D&O insurance, insurance companies will carefully screen the insurance applicants. Therefore firms with D&O insurance likely have been screened for having better future operating potential and lower operational risk. Besides, because of the insurance companies' monitoring, having D&O insurance may also provide incentives for managers to do a better job. Based on this perspective, firms with D&O insurance can be expected to have better future operating performance (Chen and Li, 2010), have lower discretionary accruals (Chung and Wynn, 2008), engage in less earnings management (Bhagat et al., 1987), improve the quality of information disclosures (Lin et al., 2015), increase the level of corporate diversification (Chi et al., 2013) and enhance the efficiency of capital allocation (Chung et al., 2013). D&O insurance is helpful for firms to improve corporate governance and manage business risk, because the insurance protects directors and executives against claims from lawsuits and also protects and compensates shareholders from the damage of getting loss from the managers' negligence activities (Romano, 1991; Gutiérrez, 2003). Based on the studies, the present study argues that corporate governance quality can be strengthened by D&O insurance, which induces better information disclosure and less earnings management and thus mitigates stock price crash risk.

However, because protecting directors and executives, if the situation qualifies, from damages in lawsuits, D&O insurance is also likely to induce them to behave opportunistically (Core, 1997; Chalmers et al., 2002). Based on managerial opportunism theory, when their companies have D&O insurance, managers may be induced to use their private information to engage in activities that increase their own interests (Chalmers et al., 2002; Kang, 2011). This argument is supported by Chalmers et al. (2002), who further argue that firms with more D&O insurance coverage are more likely to engage in egregious manipulation of the stock price at the time of initial public offering, resulting in damage to the wealth of their shareholders.

Studies also show that D&O insurance might induce the managers to opportunistic behavior which results in higher litigation risk (Gutiérrez, 2003), poor accrual quality (Chung and Wynn, 2008), lower shareholder value (Chi et al., 2013), higher audit fees (Chung and Wynn, 2014) and more severe earnings manipulation (Tang et al., 2014). Following this scenario, D&O insurance might induce the managers to reveal less bad news through

management earnings forecasts (Wynn, 2008), which may increase stock price crash risk in the future.

Together the above studies imply an ambiguous relationship between D&O insurance and stock price crash risk. Clearly there is a need for empirical investigations on the relationship. Recently Yuan *et al.* (2016) empirically document that the D&O insurance in China is significantly negatively associated with stock price crash risk. However, China is the world's second largest economic entity and has a socialist market economy. The economic environment in China is different from other countries. The finding in China may not directly applicable to other countries, including emerging Asian countries. The present study examines the relationship in Taiwan which is a well-recognized emerging Asian market. The research finding can provide insight about the impact of D&O insurance on stock price crash risk for emerging markets.

3. Empirical methodology and data description
3.1 Empirical methodology
This study aims to test the association between D&O insurance and stock price crash risk. The present study recognizes that firms with higher stock price crash risk might show more interest in having D&O insurance to prevent the potential litigation claim. Therefore, there may be an endogenous issue in our research sample. As expected, the Hausman (1978) test confirms a significant endogenous relationship between D&O insurance and stock price crash risk. To address the endogeneity problem, the present study uses two-stage least squares (2SLS) regression analysis. Moreover, this study applies the Arellano and Bond's (1991) approach to obtain robust standard errors to test the relationship between D&O insurance and stock price crash risk.

Following Chen *et al.* (2001), Kim *et al.* (2011a, b, 2014), Kim and Zhang (2016), Lee (2016) and Yuan *et al.* (2016), two proxies are used to measure firm-specific crash risk: negative conditional skewness (*NCSK*) and down-to-up volatility (*DUV*). Both measures are based on firm-specific weekly returns derived from the expanded market model described below:

$$r_{i,t} = \alpha_0 + \alpha_{1i} r_{m,t-2} + \alpha_{2i} r_{m,t-1} + \alpha_{3i} r_{m,t} + \alpha_{4i} r_{m,t+1} + \alpha_{5i} r_{m,t+2} + \varepsilon_{i,t}, \tag{1}$$

where $r_{i,t}$ is the stock return of firm i in week t and $r_{m,t}$ is the return of the Taiwan Capitalization Weighted Stock Index in week t. The lead and lag terms are introduced to account for non-synchronous trading (Dimson, 1979). Firm-specific weekly returns (*WR*) are calculated as the natural logarithm of one plus the residual values from Equation (1), that is $WR_{i,t} = \ln(1+\varepsilon_{i,t})$.

The first measure of crash risk (*NCSK*) is the negative conditional skewness of firm-specific weekly returns over a fiscal year. Specifically, $NCSK_{i,t}$ for a given firm i in a fiscal year t is calculated as follows:

$$NCSK_{i,t} = -\left[n(n-1)^{3/2} \sum WR_{i,t}^3 \right] / \left[(n-1)(n-2) \left(\sum WR_{i,t}^2 \right)^{3/2} \right], \tag{2}$$

where $WR_{i,t}$ is firm-specific weekly return of firm i year t, and n is the number of weekly returns during year t. A higher value of *NCSK* indicates greater stock price crash risk.

The second measure of crash risk is the down-to-up volatility measure (*DUV*) of the crash likelihood. Specifically, $DUV_{i,t}$ is calculated as follows:

$$DUV_{i,t} = \ln \left[(n_u - 1) \sum_{\text{Down}} WR_{i,t}^2 / (n_d - 1) \sum_{\text{Up}} WR_{i,t}^2 \right], \tag{3}$$

where n_u and n_d are the number of up and down weeks of firm i in year t, respectively. A greater value of DUV implies higher stock price crash risk. Compared with $NCSK$, DUV is less influenced by extreme weekly returns because it does not involve the third moments (Chen *et al.*, 2001).

In this study, the 2SLS regression analysis consists of the following two stages. The first stage is to estimate Equation (4):

$$LNDOM_{i,t-1} = \alpha_0 + \alpha_1 TESO_{i,t-1} + \alpha_2 EPS_{i,t-1} + \alpha_3 BIG4_{i,t-1} + \alpha_4 CrashRisk_{i,t-1}$$
$$+ \alpha_5 DTurn_{i,t-1} + \alpha_6 RET_{i,t-1} + \alpha_7 MTB_{i,t-1} + \alpha_8 SIZE_{i,t-1}$$
$$+ \alpha_9 SIGMAR_{i,t-1} + \alpha_{10} LEV_{i,t-1} + \alpha_{11} ROA_{i,t-1} + \alpha_{12} ABACC_{i,t-1}$$
$$+ Industry\ Fixed\ Effect + Year\ Fixed\ Effect + v_{i,t-1}. \tag{4}$$

In the equation, $LNDOM_{i,t-1}$ is the natural logarithm of D&O insurance coverage of firm i in year $t-1$. In addition to the exogenous variables appeared in equations of both stages, which are presented later, this equation includes three firm characteristic variables, $TESO_{i,t-1}$, $EPS_{i,t-1}$, and $BIG4_{i,t-1}$. $TESO_{i,t-1}$ is equal to one if firm i in year $t-1$ is listed on the TWSE and zero otherwise. $EPS_{i,t-1}$ is the earnings per share of firm i in year $t-1$. $BIG4_{i,t-1}$ is equal to one if the audit firm of firm i in year $t-1$ is a Big4 auditor and zero otherwise.

These variables are included in Equation (4) because of their usefulness in constructing the instrumental variable of D&O insurance coverage which, despite of resembling D&O insurance coverage, is uncorrelated with the error terms of the second step equation, Equation (5) which is presented later in this section (Gujarati and Porter, 2009). Specifically, $TESO_{i,t-1}$ is included because more mature firms may be more willing to purchase D&O insurance and have higher D&O insurance coverage. $EPS_{i,t-1}$ is included because, to protect their bright future, firms with higher expected earnings per share may be more willing to purchase D&O insurance to reduce the liability risk of managers and directors. $BIG4_{i,t-1}$ is included because firms audited by Big 4 audit firms are bigger firms and bigger firms usually can afford higher D&O insurance coverage.

The exogenous variables in Equation (5) are included because they are determinants of $CrashRisk_{i,t}$, which is correlated with $LNDOM_{i,t-1}$, and thus should be related to $LNDOM_{i,t-1}$ The choice of these variables is supported by the weak instrument test and the over-identification restriction test presented in the empirical results section. $LND\hat{O}M_{i,t-1}$ which denotes the predictive values of $LNDOM_{i,t-1}$ obtained from Equation (4), is inserted into the second-stage equation to control for the endogeneity issue.

The second-stage is to estimate Equation (5):

$$CrashRisk_{i,t} = \beta_0 + \beta_1 LND\hat{O}M_{i,t-1} + \beta_2 CrashRisk_{i,t-1} + \beta_3 DTurn_{i,t-1}$$
$$+ \beta_4 RET_{i,t-1} + \beta_5 MTB_{i,t-1} + \beta_6 SIZE_{i,t-1} + \beta_7 SIGMAR_{i,t-1}$$
$$+ \beta_8 LEV_{i,t-1} + \beta_9 ROA_{i,t-1} + \beta_{10} ABACC_{i,t-1}$$
$$+ Industry\ Fixed\ Effect + Year\ Fixed\ Effect + \mu_{i,t}. \tag{5}$$

In the equation, $CrashRisk_{i,t}$ is the stock price crash risk of firm i in year t which could be either the negative conditional skewness ($NCSK_{i,t}$) or the down-to-up volatility ($DUV_{i,t}$). $DTurn_{i,t-1}$ is the change in the monthly share turnover of firm i in year $t-1$, which is the average monthly share turnover over the current fiscal year minus the average monthly share over the previous fiscal year. Following Chen *et al.* (2001), the change in trading volumes is included as a proxy for the divergence of opinions among investors. Harvey and Siddique (2000) and Chen *et al.* (2001) find that the change in trading volume predicts future crash risk. However, Lee (2016) finds no evidence that the change in trading volume has a significant effect on crash risk. As a control variable, the sign of $DTurn_{i,t-1}$ is not predicted.

$RET_{i,t-1}$ is a proxy for a firm's stock price bubble and is measured by the mean of firm-specific weekly returns over the previous fiscal year. Chen *et al.* (2001) suggest that past returns are helpful to forecast the crash risk. Higher past returns indicates larger stock price bubbles and thus might result in higher stock crash risk. This argument is supported by Harvey and Siddique (2000), Lee (2016), and Kim and Zhang (2016). Therefore, it is predicted that the stock price bubble variable may have a significant and positive impact on stock price crash risk.

$MTB_{i,t-1}$ measures firm growth and is defined as the ratio of the market value of equity to the book value of equity of firm i in year $t-1$. Kim *et al.* (2014) report that higher firm growth indicates greater crash risk. Similar results are also reported by Harvey and Siddique (2000) and Lee (2016), who state that glamour stocks are more crash prone. Thus, this study predicts a positive relationship between MTB and crash risk.

$SIZE_{i,t-1}$ is firm size measured as the natural logarithm of the market value of equity of firm i in year $t-1$. Harvey and Siddique (2000) suggest that firm size is positively associated with crash stock. Chen *et al.* (2001) and Lee (2016) also show that firm size has positive effect on stock price crash risk. This paper expects that firm size has a positive and significant effect on crash risk.

$SIGMAR_{i,t-1}$ is stock return volatility and is calculated as the standard deviation of the firm-specific weekly returns over the previous fiscal year. Chen *et al.* (2001) and Kim *et al.* (2014) document a positive relationship between firms with stock return volatility are more prone to crash. However, Kim and Zhang (2016), Lee (2016) and Yuan *et al.* (2016) reveal that past stock return volatility is not significantly associated with crash risk. As a control variable, the sign of $SIGMAR_{i,t-1}$ is not predicted.

$LEV_{i,t-1}$, is as a proxy for financial leverage and is calculated as total long-term debt to total asset ratio of firm i in year $t-1$. Kim and Zhang (2016) provide evidence that firms with higher financial leverage have lower stock price crash risk. However, Lee (2016) finds that leverage ratio is negatively but not significantly related to crash risk. As a control variable, the sign of $LEV_{i,t-1}$ is not predicted.

$ROA_{i,t-1}$ measures operating performance and is calculated as the return on assets of firm i in year $t-1$. Hutton *et al.* (2009) and Kim *et al.* (2011a, b) suggest that more effective operating performance implies lower future crash risk. Lee (2016) finds that past operating performance is negatively and significantly associated with crash risk. However Kim and Zhang (2016) find that operating performance is not significantly related to crash risk. As a control variable, the sign of $ROA_{i,t-1}$ is not predicted.

$ABACC_{i,t-1}$ is a proxy for earnings management and is defined as the absolute value of the abnormal accruals of firm i in year $t-1$. Following Dechow *et al.* (1995) and Hutton *et al.* (2009), this study uses the modified Jones model to estimate abnormal accruals for individual firms. Hutton *et al.* (2009) find that firms with higher levels of earnings management have higher crash risk. Nevertheless, Yuan *et al.* (2016) and Lee (2016) find that earnings management has no significant impact on stock price crash risk. As a control variable, the sign of $ABACC_{i,t-1}$ is not predicted. In addition, the crash risk may vary each year and each industry. Hence, this study adds dummy variables for year and industry fixed effects to Equation (5).

When instrumental variables are weak and have very low correlations with endogenous variables, 2SLS regression analysis yields inconsistent estimators of parameters (Wooldridge, 2002). Thus, this study applies the approach proposed by Stock and Yogo (2005) to test whether the instrumental variables used in this study are appropriate. Staiger and Stock (1997) suggest that if the F-statistic exceeds 10, the instrumental variables are sufficiently strong. The present study also follows Sargan's (1958) test of over-identifying restrictions to examine the validity of instrumental variables. If the Sargen's test cannot reject the null hypothesis, then the instrumental variables are valid.

3.2 Data description

In this study, the weekly returns to estimate stock crash measures, D&O insurance, firm-specific financial information, including firm market value and corporate governance, are all collected from the *Taiwan Economic Journal* database. The research sample covers the period from 2007 to 2015. Similar to Yuan *et al.* (2016), this paper further deletes financial firms and firms with insufficient financial data. Finally, the research sample contains 4,890 firm-year observations and represents 657 firms.

The means (standard deviations) of the crash risk measures, *NCSK* and *DUV*, are −0.4997 (0.7849) and −0.2677(0.3639), respectively, which are much higher than those reported by Yuan *et al.* (2016). D&O insurance coverage has a lagged average value 8.6659 and a lagged standard deviation of 9.5015. The lagged mean and lagged standard deviation of the change in trading volume are 0.0149 and 0.0485. The lagged mean (lagged standard deviation) of stock price bubbles is −0.0013 (0.0072). The firm size variable has an average value of 22.2726. The lagged average firm growth is 1.6003. The lagged average earnings management is 0.1028.

The correlation coefficients between all variables except crash risk measures and lagged crash risk measures are all lower than 0.8. The results indicate that the regression analysis does not have severe multicollinearity problems.

4. Empirical results

4.1 Discussion of endogenous problems and instrumental variables

Table I shows the test results whether D&O insurance coverage is endogenously associated with crash risk. The χ^2 values in Model 1 and Model 2 are all positive and statistically significant below the 5 percent level. As expected, the results show a significant endogenous relationship between D&O insurance and crash risk no matter measured with *NCSK* in Model 1 or measured with *DUV* in Model 2. Therefore, this study uses 2SLS regression analysis to test the relationship between D&O insurance coverage and crash risk.

Table II presents the test results whether the instrumental variables of crash risk are weak instruments in the 2SLS regression. The *F*-test values in Model 1 and Model 2 are both higher than 10 and statically significant at the 1 percent level. The results exhibit that the instrumental variables for crash risk are strong. Therefore, the regression coefficients of crash risk are estimated consistently in this study.

	Model 1	Model 2
χ^2	4.72**	7.90***
p-value	0.030	0.005

Table I. Endogeneity test results

Notes: This table presents the test results whether D&O insurance coverage is endogenously related to crash risk. Crash risk is measured with *NCSK* in Model 1 and measured with *DUV* in Model 2, respectively. **,***Significant at the 5 and 1 percent levels, respectively

	Model 1	Model 2
F-test	34.19***	34.21***
	F-test > 10	*F*-test > 10

Table II. Weak instrumental variable test results

Notes: This table presents the test results whether the instrumental variables are weak instruments in the 2SLS regression. Crash risk is measured with *NCSK* in Model 1 and measured with *DUV* in Model 2, respectively. ***Significant at the 1 percent level, respectively

The results of Sargan's (1958) test of over-identifying restrictions are exhibited in Table III. The test values in Model 1 and Model 2 all do not reach conventional statistically significant levels. The results indicate that the instrumental variables for crash risk are valid.

4.2 Effect of D&O insurance on crash risk

Table IV shows the estimates of Equation (5), which is the second-stage equation of the 2SLS regression. In Model 1, stock price crash risk is measured with *NCSK* and measured with *DUV* in Model 2. In both models, the predicted D&O insurance coverage ($LND\hat{O}M$) has a significant and negative coefficient. The coefficients show that D&O insurance coverage is significantly and negatively associated with stock price crash risk in Taiwanese

	Model 1	Model 2
χ^2	2.95	1.19
p-value	0.229	0.553

Notes: This table presents the results of the over-identification restriction tests. Crash risk is measured with *NCSK* in Model 1 and measured with *DUV* in Model 2, respectively

Table III.
Results of Sargan's test of over-identifying restrictions

	Model 1		Model 2	
Variables	Coefficient	*z*-value	Coefficient	*z*-value
Constant	−3.0878	−11.12***	−1.5305	−10.82***
LNDÔM	−0.0190	−2.07**	−0.0115	−2.44**
NCSK1	0.0566	3.86***		
DUV1			0.0624	4.07***
DTurn	−1.2042	−1.10	−0.3646	−0.67
RET	13.3183	2.59***	6.2242	2.43**
MTB	0.0153	3.09***	0.0084	3.50***
SIZE	0.1266	9.45***	0.0635	9.22***
SIGMAR	0.8975	1.16	0.0802	0.21
LEV	−0.1660	−1.47	−0.1188	−2.07**
ROA	−0.1929	−1.39	−0.0898	−1.32
ASACC	−0.0453	−0.78	−0.0090	−0.39
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
N	4,890		4,890	
R^2	0.0946		0.1039	

Notes: The table presents the 2SLS results of the effect of D&O insurance coverage on stock price crash risk. Dependent variables: *NCSK* and *DUV* are the crash risk measures of firm *i* in year t in Models 1 and 2, respectively. Independent variables: *LNDÔM* is the predicted *LNDOM* of Equation (5) of firm *i* in year *t*−1. *NCSK1* is the crash risk measure of firm *i* in year *t*−1. *DUV1* is the crash risk measure of firm *i* in year *t*−1. *DTurn* is the change in monthly share turnover of firm *i* in year *t*−1. *RET* is the average firm-specific weekly return of firm *i* in year *t*−1. *MTB* is the market-to-book-value ratio of firm *i* in year *t*−1. *SIZE* is the natural logarithm of the market value of equity of firm *i* in year *t*−1. *SIGMAR* is calculated as the standard deviation of the firm-specific weekly returns of firm *i* in year *t*−1. *LEV* is calculated as the total long-term debt to total asset ratio of firm *i* in year *t*−1. *ROA* is the return on assets of firm *i* in year *t*−1. *ABACC* is the absolute value of the abnormal accruals of firm *i* in year *t*−1. *Year Fixed Effect* is a set of year dummy variables. *Industry Fixed Effect* is a set of industrial dummy variables. This study applies the Arellano and Bond's (1991) approach to obtain robust standard errors and then computes the *z*-values. **,***Significant at the 5 and 1 percent levels, respectively

Table IV.
2SLS regression analysis of the effect of D&O insurance coverage on crash risk

market, no matter whether the risk is measured with *NCSK* or *DUV*. The evidence is consistent with that of Yuan *et al.* (2016) and shows that D&O insurance alleviates stock price crash risk in Taiwan. This study argues that the risk mitigating effect is because D&O insurance serves as an effective external monitoring mechanism and strengthens corporate governance in Taiwan (Holderness, 1990; Baker and Griffith, 2007).

As shown in Table IV, several control variables have a significant relationship with crash risk. The coefficients of one-year-ahead crash risk (*NCSK1* and *DUV1*) are both positive and statistically significant at the 1 percent level in Model 1 and Model 2. In contrast to the results of Yuan *et al.* (2016), higher one-year-ahead crash risk implies higher crash risk in Taiwan. Consistent with the findings of Chen *et al.* (2001), Harvey and Siddique (2000), Lee (2016) and Kim and Zhang (2016), the coefficients of the stock price bubble variable (*RET*) in Model 1 and Model 2 are significant and positive at the 1 percent level. The results indicate that larger the stock price bubbles imply greater future stock price crash risk.

The coefficients of firm growth (*MTB*) in Model 1 and Model 2 are significant and positive at the 1 percent level, respectively. Consistent with those of Harvey and Siddique (2000), Kim *et al.* (2014) and Lee (2016), the results show that glamour stocks are subject to high crash risk. In both Models, firm size (*SIZE*) has a positive coefficient and reaches significance at the 1 percent level. Supporting the arguments of Harvey and Siddique (2000), Chen *et al.* (2001) and Lee (2016), firm size is significantly associated with stock price crash risk.

4.3 Additional tests

Bae *et al.* (2006), Kim *et al.* (2014) and Andreou *et al.* (2016), argue that corporate governance mechanisms are significantly associated with firm-specific stock price crash risk. Moreover, Yuan *et al.* (2016) show that the effect of D&O insurance on stock price crash risk disappears when the quality of other corporate governance mechanisms is strong. However, corporate governance quality remain to be improved in Taiwan, particularly in the aspect of risk management (Lee and Chuang, 2007; Aebi *et al.*, 2012).

Under this scenario, it is unclear whether other corporate governance mechanisms are significantly associated with stock price crash risk and affect the effect of D&O insurance on stock price crash risk in Taiwan. As an additional test, this study further adds a corporate governance quality index constructed from other corporate governance mechanisms to the regressions to investigate the impact of D&O insurance on stock price crash risk[1].

The results of 2SLS including the corporate governance index are shown in Table V. The estimated coefficients of predicted D&O insurance coverage in Model 1 and Model 2 are −0.0191 and −0.0116, with *z*-values of −2.06 and −2.42, respectively. These coefficients are negative and statistically significant at the 5 percent level. The empirical results exhibit a significant and negative relationship between predicted D&O insurance coverage and crash risk for Taiwanese firms. In contrast to the finding of Yuan *et al.* (2016) in China, the results show that in Taiwan the effect of D&O insurance on stock price crash risk remain significant even when other corporate governance mechanisms are in place. Therefore, the present study provide stronger support to the argument that D&O insurance serves as an effective external monitoring mechanism, strengthens corporate governance and thus alleviates stock price cash risk (Holderness, 1990; Baker and Griffith, 2007; Yuan *et al.*, 2016).

Similar to the results in Table IV, most of the control variables in Model 1 and Model 2 of Table V are not statistically significant. However, higher one-year-ahead crash risk, larger stock market bubbles, greater firm growth and larger firm size are significantly and positively associated with higher future crash risk of Taiwanese firms.

The coefficients of the corporate governance variable (*CGIP*) in Model 1 and Model 2 are negative but not significant. These results show that other corporate governance mechanisms do not mitigate future stock price crash risk in Taiwan. The finding is

Variables	Model 1		Model 2	
	Coefficient	z-value	Coefficient	z-value
Constant	−3.0901	−11.08***	−1.5320	−10.79***
LNDÔM	−0.0191	−2.06**	−0.0116	−2.42**
NCSK1	0.0568	3.88***		
DUV1			0.0627	4.09***
DTurn	−1.2086	−1.10	−0.3689	−0.68
RET	13.3162	2.59***	6.2262	2.43**
MTB	0.0154	3.11***	0.0085	3.50***
SIZE	0.1270	9.25***	0.0638	9.03***
SIGMAR	0.9158	1.18	0.0971	0.25
LEV	−0.1652	−1.46	−0.1181	−2.05**
ROA	−0.1918	−1.38	−0.0887	−1.30
ASACC	−0.0447	−0.78	−0.0084	−0.37
CGIP	−0.0058	−0.32	−0.0054	−0.59
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
N	4,890		4,890	
R^2	0.0994		0.1036	

Notes: The table presents the 2SLS results of the effect of D&O insurance coverage on stock price crash risk. Dependent variables: *NCSK* and *DUV* are the crash risk measures of firm *i* in year t in Models 1 and 2, respectively. Independent variables: *LNDÔM* is the predicted *LNDOM* of Equation (5) of firm *i* in year *t*−1. *NCSK1* is the crash risk measure of firm *i* in year *t*−1. *DUV1* is the crash risk measure of firm *i* in year *t*−1. *DTurn* is the change in monthly share turnover of firm *i* in year *t*−1. *RET* is the average firm-specific weekly return of firm *i* in year *t*−1. *MTB* is the market-to-book-value ratio of firm *i* in year *t*−1. *SIZE* is the natural logarithm of the market value of equity of firm *i* in year *t*−1. *SIGMAR* is calculated as the standard deviation of the firm-specific weekly returns of firm *i* in year *t*−1. *LEV* is calculated as the total long-term debt to total asset ratio of firm *i* in year *t*−1. *ROA* is the return on assets of firm *i* in year *t*−1. *ABACC* is the absolute value of the abnormal accruals of firm *i* in year *t*−1. *CGIP* is the corporate governance index of the firm *i* in year *t*−1. *Year Fixed Effect* is a set of year dummy variables. *Industry Fixed Effect* is a set of industrial dummy variables. This study applies the Arellano and Bond's (1991) approach to obtain robust standard errors and then computes the *z*-values. **,***Significant at the 5 and 1 percent levels, respectively

Table V.
2SLS regression
analysis including
corporate governance

consistent with the advice that the quality of corporate governance mechanisms, particularly in the risk management aspect, requires improvement in Taiwan (Lee and Chuang, 2007; Aebi *et al.*, 2012).

5. Conclusion

The present study results show that D&O insurance coverage is significantly negatively related to the stock price crash risk of Taiwanese firms. Moreover, even controlling the quality of other corporate governance mechanisms, the empirical results still show that D&O insurance coverage has a pronounced effect in mitigating the risk of a stock price crash. Therefore, the findings of this study strongly support the argument of Holderness (1990) and Baker and Griffith (2007) that, in the perspective of corporate governance, D&O insurance serves as an effective external monitoring mechanism. This study also finds that one-year-ahead crash risk, stock price bubbles, firm growth and firm size have significant and positive associations with future stock price crash risk in Taiwan. The present study also reveals that the effect of other corporate governance mechanisms on future crash risk is not significant for Taiwanese firms.

The results of this study can benefit the managers and investors in terms of identifying stock price crash risk in Taiwan. The research results also support firms to purchase D&O insurance to attract and retain talented management and protect the directors and officers

from potential litigation risk. Finally, the research results support the relevant authorities in Asia emerging markets to encourage firms to purchase D&O insurance to protect investors and managers and thus maintain a sound investment environment.

Note

1. Following Chen *et al.* (2007), corporate governance ($CGIP_{i,t-1}$) is the corporate governance index of firm i in year $t-1$, as in the following equation: *Governance index* $P_{i,t-1} = CEO$ *duality indicator*$_{i,t-1} +$ *Board size indicator*$_{i,t-1} +$ *Managerial ownership indictor*$_{i,t-1} +$ *Block shareholders' indicator*$_{i,t-1}$. where,first, the *CEO duality indicator*$_{i,t-1}$ is equal to zero if the CEO and the chairman of the board of directors in a large firm i in year $t-1$ are the same person and is equal to one otherwise. In contrast, the *CEO duality indicator*$_{i,t-1}$ is equal to one if the CEO and the chairman of the board of directors in a small firm i in year $t-1$ are the same person and is equal to zero otherwise. Large firms are those whose firm value is above the average market value for all firms, and small firms are those whose firm value is below the average market value for all firms. Second, the *board size indicator*$_{i,t-1}$ is equal to one if the board size of firm i in year $t-1$ is larger than the statutory minimum number of directors and smaller than two standard deviations of average board size and is equal to zero otherwise. Third, the *managerial ownership indicator*$_{i,t-1}$ is equal to one if the managerial ownership ratio of firm i in year $t-1$ is greater than 10 percent and is equal to zero otherwise. Fourth, the *block shareholders' holding indicator*$_{i,t-1}$ is the ratio of the top ten shareholders of firm i in year $t-1$, which is equal to one if the ratio of major shareholders is larger than 25 percent and zero otherwise.

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