

Ownership Structure and Stock Price Crash Risk: Evidence from China

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This paper examines how corporate ownership concentration affects stock price crash risk in Chinese listed firms. Results show that ownership concentration is negatively associated with firm-specific crash risk and this negative relation is robust against difference-in-difference test. Further evidence demonstrates that the negative relation between ownership concentration and stock price crash risk is more pronounced in privately held firms than in state-owned firms.

Keywords: Ownership Concentration, Crash Risk, Privately Held Firms
JEL Classification Number: F23, F30, G15, G32, O32

INTRODUCTION

Forecasting future stock price crash risk has drawn substantial attention in both academia and practice, especially after the most recent financial crisis. Due to concerns on career development or compensation package, firm managers have the incentives to overstate financial performance and preserve an inflated stock price by strategically withholding bad news and accelerating the release of good news. Once the accumulation of bad news is beyond a certain threshold, the bubble of overvalued stock price will burst and a sudden stock price crash will occur (Hutton, Marcus, and Tehranian 2009; Jin and Myers 2006). To identify the determinants of crash risk, the current literature mainly focuses on various accounting mechanisms. Given the fact that the managerial opportunistic behavior is essentially caused by the separation of ownership and control, this study considers corporate ownership structure and attempts to investigate how ownership concentration impacts stock price crash risk in Chinese listed firms.

China offers an excellent opportunity to investigate the effect of ownership concentration on stock price crash risk. The ownership structure of Chinese firms is unique in that group and complex pyramidal ownership structure has been widely adopted to partially privatize state-owned enterprises (SOE) since early 1990s. As a result, nearly all Chinese listed firms have a dominant blockholder, among which more than two-thirds with government or government-related entity as a substantial blockholder. For example, Bai et al. (2004) show that, on average, the largest owner in publicly listed firms of China holds 44.8% of total shares. Given the highly concentrated ownership, we expect large shareholders play a crucial role in influencing managerial decisions.

The debate on the corporate ownership structure has been controversial. On the one hand, it has been argued that concentrated ownership has a positive impact on firm management. Large shareholders tend to monitor and discipline managers effectively. By virtue of their large stakes, large shareholders, are more willing to collect information and monitor firm management because they reap greater benefits than small investors from monitoring the organization (Shleifer and Vishny, 1986; 1997). They also tend to monitor and discipline managers to ensure that the firm's investment strategy is consistent with the objective of long-term value maximization, rather than meeting short-term earnings goals (Dobrzynski, 1993; Monks and Minow, 1995). Along the monitoring view of large shareholders, empirical studies document that large shareholders help promote corporate governance, improve information disclosure, and enhance firm value.

On the other hand, large shareholders have been criticized for expropriating minority shareholders. La Porta et al. (1999a) document high degrees of ownership concentration in firms from countries with relatively poor shareholder protection and argue that the conflict between large shareholders and minority shareholders is the primary corporate governance problem in such countries. Morck et al. (2000) and Bebchuk et al. (2000) discuss how controlling shareholders may pursue objectives that are at odds with those of minority shareholders. Controlling shareholders in China typically conduct outright theft, related party transactions (Jian and Wong, 2010), and inter-corporate loans (Jiang et al., 2010) to tunnel from their listed companies.

To describe the extent of a firm's ownership concentration, we construct four measures, the percentage of the three (or five) largest shareholders and the Herfindahl Index of the three (or five) largest shareholders. To measure crash risk for each individual firm, we follow the literature and compute the negative return skewness and down-to-up volatility based on weekly returns. Results show that ownership concentration is significantly negatively associated with firm-specific stock price crash risk, providing support for the monitoring view of large shareholders. This finding is robust not only to the different measures of ownership concentration and crash risk but also to alternative regression techniques.

We further examine how the association between ownership concentration and crash risk varies between privately held and state-owned firms. We construct an indicator variable to show whether a firm is privately held or state-owned. Results reveal that ownership concentration plays a stronger role in privately held firms than in their state-owned counterparts, indicating large shareholders are more effective in supervising firm management in privately held firms.

Our study contributes to the literature in several ways. First, our work advances the finance and economics literature on the importance of the fundamental agency problem between shareholders and firm management. Particularly, we focus on the extent of ownership concentration in Chinese listed firms and find that firms with more concentrated ownership experience lower stock price crash risk. Moreover, the negative relation between ownership concentration and crash risk is more pronounced in privately held firms than in state-owned firms.

Second, this study extends the burgeoning literature on stock price crash risk. Most existing studies have examined how various accounting characteristics, market structure variables, and institutional infrastructures affect stock price crashes. Only a few studies investigate the impact of ownership structure on stock crashes and their findings are mixed. For example, Andreou, Antoniou, Horton, and Louca (2013) provide evidence that crashes are positively associated with institutional ownership and directors' stock ownership. However, Callen and Fang (2013) find that stable institutional ownership help reduce the risk of future stock price crash. We examine the possible effect of corporate ownership concentration on crash risks.

The rest of this paper is organized as follows. First, we discuss the role of large shareholders and develop our hypotheses (Research Hypothesis). The second section (Research Design) describes the sample data and presents descriptive statistics. The third section (Empirical Results) examines the possible effect of ownership concentration on stock price crash risk. This section also analyzes how the relation between ownership concentration and crash risk varies between privately held and state-owned firms.

RESEARCH HYPOTHESIS

According to the extant literature, there could be two opposing views on the relationship between corporate ownership concentration and stock price crash risk. The supervising role played by large shareholders could align the interests of large shareholders and those of small shareholders and thus more concentrated ownership could lead to lower firm-specific crash risk. However, the entrenchment effect of large shareholders suggests that the existence of large shareholders could increase the crash risk facing the firm.

Shleifer and Vishny (1986,1997) argue that large shareholders play a monitoring role in corporate governance as they have incentives to collect information about the firm and review its investment decisions and operation activities, due to large shareholdings within the firm. Marcus and Terhanian (2008) find that large shareholders help keep firm managers from manipulating the share price. Besides, domestic studies find much evidence supporting this view. Grossman and Hart (1988) and Mitton (2002) find that, when the ownership structure is more concentrated, controlling shareholders' own interests and corporate performance are highly correlated and so is the interests of small investors. This is referred to as convergence effect. The evidence from the publicly listed firms of China suggests that, if there are multiple large shareholders within a firm, they will balance each other well, which helps refrain the controlling shareholders from tunneling and force the controlling shareholders to disclose more information (Bai, Liu, and Lu, 2005). As a result, this will improve disclosure quality and stock price crash risk.

Ha: There is a negative relation between the extent of ownership concentration and stock price crash risk.

On the other hand, Croce, Stewart, and Yermo (2011) argue that blockholders are short-sighted sometimes which could result in the rise of asset bubbles. Graves and Waddock (1990), Porter (1992) and Bushee (1998, 2001) suggest that if large shareholders are too concerned about short-term share price, they tend to urge firm management to beat the market, which has the potential to urge managers to pursue short-term profits instead of long-term development. Coffee (1991) and Manconi (2012) find that blockholders tend to sell their shares directly instead of performing their duties if it requires a large amount of funds and time to monitor the management. In addition to short-termism, large shareholders have been criticized to have the entrenchment effect. It refers to the situation where large shareholders have incentives to expropriate the interests of small investors and increase their own benefits. Under this situation, the information disclosure will be manipulated, which lead to greater crash risk.

Hb: There is a positive relation between the extent of ownership concentration and stock price crash risk.

RESEARCH DESIGN

Our primary data source is CSMAR and Datastream. We obtain firm financial characteristics from Worldscope and weekly return data from Datastream. Our sample includes companies listed on Shang Hai Stock Exchange and Shen Zhen Stock Exchange and our sample period spans from 2003 to 2008. We choose 2003 as the starting year as most firms began to disclose their ownership information in 2003. Following the literature, we exclude financial services companies and utilities. We also drop observations with the absolute value of weekly returns greater than 0.5 (i.e., 50%) because, to our knowledge, weekly stock returns larger than 0.5 are likely to be caused by non-adjusted stock splits in Datastream (See An, Li, and Yu, 2015). Our final sample consists of 10,001 firm-year observations. All variables are winsorized at 0.5%.

Crash Risk Measures

We consider two measures of stock price crash risk, i.e., the negative conditional return skewness (*Ncskew*) and down-to-up volatility (*Duvol*). To calculate the measures of firm-specific crash risk, we first estimate abnormal weekly returns for each firm-year. Particularly, the abnormal weekly return, $W_{i,t}$, is defined as the natural logarithm of one plus the residual return from an expanded market model regression (Jin and Myers, 2006):

$$r_{i,t} = \alpha_i + \beta_{1,i}r_{m,China,t} + \beta_{2,i}[r_{US,t} + EX_{China,t}] + \beta_{3,i}r_{m,China,t-1} + \beta_{4,i}[r_{US,t-1} + EX_{China,t-1}] + \beta_{5,i}r_{m,China,t-2} + \beta_{6,i}[r_{US,t-2} + EX_{China,t-2}] + \beta_{7,i}r_{m,China,t+1} + \beta_{8,i}[r_{US,t+1} + EX_{China,t+1}] + \beta_{9,i}r_{m,China,t+2} + \beta_{10,i}[r_{US,t+2} + EX_{China,t+2}] + \varepsilon_{i,t} \quad (1)$$

where $r_{i,t}$ is the stock return for firm i in week t , $r_{m,China,t}$ is the Chinese market return in week t , $r_{US,t}$ is the U.S. market return in week t to proxy for the global market return, and $EX_{China,t}$ is the change in exchange rate for the currency of RMB against the US dollar in week t . Two lead and two lag terms are included to correct for the non-synchronous trading for both local market return and U.S. market return (Dimson, 1979). The abnormal weekly return $W_{i,t}$ is measured by the natural logarithm of one plus the residual return from estimation of Eq. (1).

Following Chen et al. (2001) and Kim et al. (2011a, b), we use the negative skewness of the abnormal weekly returns (*Ncskew*) to measure crash risk. It is defined as the negative of the third moment of abnormal weekly returns over the standard deviation of abnormal weekly returns raised to the third power. Thus, for any stock i over any sample year t , we have

$$Ncskew_{i,t} = -[n(n-1)^{3/2}\Sigma w_{i,t}^3]/[(n-1)(n-2)(\Sigma w_{i,t}^2)^{3/2}] \quad (2)$$

where n is the number of observations on weekly returns during a particular sample year. The larger the *Ncskew*, the higher the crash risk.

Our second measure of crash risk, *Duvol*, is a measure of return asymmetries which does not involve third moments, and hence is less likely to be excessively influenced by extreme days (Chen et al., 2001). For each stock i over any sample year period, we separate all the weeks with abnormal returns $W_{i,t}$ below the annual mean ("down" weeks) from those with returns above the annual mean ("up" weeks), and compute the standard deviation for each of these subsamples separately. We then take the logarithm of the ratio of the standard deviation on the down weeks to the standard deviation on the up weeks. Thus we have

$$Duvol_{i,t} = \log \{ (n_u - 1) \Sigma_{down} R_{i,t}^2 / ((n_d - 1) \Sigma_{up} R_{i,t}^2) \} \quad (3)$$

where n_u and n_d are the number of up and down weeks, respectively. Similar to *Ncskew*, a higher value of *Duvol* corresponds to a stock with a greater likelihood of crash, i.e., having a more left-skewed distribution.

Ownership Concentration Measures

To describe firms' ownership structure, we consider four measures of ownership concentration, i.e., OWN3, OWN5, HHI3, and HHI5. OWN3 and OWN5 denote the percentage of the three largest shareholders within a firm and the percentage of the five largest shareholders, respectively. HHI3 and HHI5 are the Herfindahl-Hirschman index of the three or five largest shareholders, respectively. The higher the Herfindahl-Hirschman indices, the more concentrated the corporate ownership.

Descriptive Statistics

Appendix 2 reports the summary statistics of crash risk measures, ownership concentration measures, and the control variables used in later regression analysis. It shows that there is substantial variation in

crash risk measures. For example, *Ncskew* has a mean value of 0.176 and a standard deviation of 0.727. The ownership concentration variables indicate that the corporate ownership in China is quite concentrated. The sample average of OWN3 and OWN5 is 52.32% and 55.42% and that of HHI3 and HHI5 is 0.201 and 0.202.

Appendix 3 presents a Pearson correlation matrix for all the variables employed in our regression models. First of all, the two crash risk measures are highly positively correlated. The correlation coefficient between *Ncskew* and *Duvol* is 0.979. Second, the ownership concentration measures are highly positively correlated with each other as well. For example, OWN3 has a correlation coefficient of 0.972, 0.875, and 0.878 with OWN5, HHI3, and HHI5, respectively. Last, all the four ownership concentration measures are negatively correlated with crash risk measures. *Ncskew* has a correlation coefficient of -0.013, -0.020, -0.005, and -0.005 with OWN3, OWN5, HHI3, and HHI5, respectively. The same pattern holds for *Duvol*.

EMPIRICAL RESULTS

Ownership Concentration and Crash Risk

In this section, we perform a battery of multivariate tests for our prediction that corporate ownership concentration lowers stock price crash risk. We employ the following model specification to investigate the effect of ownership concentration on crash risk.

$$\text{CrashRisk}_{i,t} = \beta_0 + \beta_1 \text{Ownership}_{i,t-1} + \sum \beta_j * \text{ControlVars}_{i,t-1} + \varepsilon \quad (4)$$

In Eq. (4), *CrashRisk* is proxied by *Ncskew* or *Duvol* while *Ownership* is proxied by our ownership concentration measures, i.e., *Own3*, *Own5*, *HHI3*, and *HHI5*. Following Chen et al. (2001) and Hutton et al. (2009), we include a set of control variables that are perceived to be potential predictors of crash risk. The one-year lagged *Ncskew* is included to capture the potential persistence of the third moment of stock returns. The variable *Dturn* is the detrended stock trading volume, a proxy for investor heterogeneity or the difference of opinions among investors. Chen et al. (2001) document that firms with high stock turnovers are more likely to crash. *Ret* and *Sigma* are the average firm-specific weekly returns and the standard deviation of firm-specific stock returns over the past year, respectively. Chen et al. (2001) argue that past returns and past return volatility are positively associated with crashes in the future. *Analyst* is the number of financial analysts following a firm which serves as a variable to describe a firm's information environment. It has been suggested that opaque firms are more prone to future stock price crashes (Hutton et al., 2009). We also control for firm characteristics including firm size, measured by the logarithm of market valuation, market-to-book ratio, long-term debt ratio. Year-fixed effects are included in all the regressions and standard errors are clustered by firm.

We estimate Eq. (4) for each of our crash risk measures. The results are presented in Appendix 4. It shows that corporate ownership concentration is negatively associated stock price crash risk. In columns 1, 3, 5, and 7, when crash risk is proxied by *Ncskew* and ownership concentration is measured by OWN3, OWN5, HHI3, and HHI5, *Ownership* has significantly negative coefficients of -0.002 (t-statistic=-2.92), -0.003 (t-statistic=-3.41), -0.205 (t-statistic=-2.49), and -0.209 (t-statistic=-2.53), respectively. The results are very similar when crash risk is proxied by *Duvol*, as shown in columns 2, 4, 6, and 8. This finding indicates that firms with more concentrated ownership structure tend to have lower stock price crash risk, probably because large shareholders play a role in monitoring firm management. Therefore, the results provide support for H_a .

Endogeneity Problem

It is possible that the crash risk associated with a firm could potentially influences investors' behavior and thus leads to changes in the firm's ownership structure. To mitigate concerns about the reverse

causality problem, we have lagged our ownership structure variable and other control variables by one year.

To further account for the endogeneity issue, we perform difference-in-difference regressions. As shown in Appendix 5, the change in ownership concentration variables is negatively associated with the change in crash risk measures. Thus, the negative impact of ownership concentration on stock price crash risk has been confirmed.

Privately Held Firms vs. State-owned Enterprises

Sections 4.1 and 4.2 provide strong evidence that corporate ownership concentration has a negative effect on future stock price crashes. This section seeks to investigate how the negative relation between ownership concentration and crash risk differs between privately held firms and state-owned enterprises.

We construct a dummy variable, *Private*, to indicate if a firm is privately held or state-owned. Specifically, *Private* equals 1 if a sample firm is a private enterprise; otherwise, it equals 0. Then we interact ownership concentration variables with *Private* and examine their joint effects on future stock crashes. The model specification is as follows:

$$\text{Crashrisk}_{i,t} = \beta_0 + \beta_1 \text{Ownership}_{i,t-1} + \beta_2 \text{state}_i + \beta_3 \text{ownership}_{i,t-1} * \text{state}_i + \sum \beta_j * \text{Control Vars}_{i,t-1} + \varepsilon \quad (5)$$

The regression estimates of Eq. (5) are reported in Appendix 6. Our variable of interest is the interaction term, *Ownership-1*Private*, which captures how the impact of ownership concentration on crash risk varies with a firm's private ownership. Some interesting results emerged. First, ownership concentration has a negative effect on stock price crash risk in both privately held firms and state-owned firms. As it shows, *Ownership* per se has a negative coefficient across all the models. Second, ownership concentration has a stronger effect on crash risk in privately held firms than in state-owned firms. In columns 1 and 3, *Ownership*Private* has significantly negative coefficients of -0.027 (t-statistic=-2.28) and -0.028 (t=-2.03), respectively. The coefficients of *Ownership*Private* in other columns are negative as well, though they are marginally significant or non-significant. This suggests that, in privately held firms, concentrated ownership structure help reduce stock price crash risk to a larger extent than in state-owned enterprises. Third, it there is no significant difference in stock price crash risk between privately held firms and state-owned enterprises. The coefficient of the indicator variable *Private* per se is not statistically significant across all the models.

In sum, we conclude that there is a negative relationship between ownership concentration and stock price crash risk in both privately held firms and state-owned enterprises, However, large shareholders might play a more effective role to monitor managerial behaviors and reduce stock price crash risk in privately-held firms than in state-owned enterprises.

CONCLUSION

This paper contributes to the growing literature on the causes of stock price crash risk by examining the potential effect of corporate ownership concentration on crash risk in Chinese A-share market over the period of 2003-2008. Our analysis reveals that higher ownership concentration helps reduce stock price crash risk. The negative relation is robust to difference-in-difference tests. Our evidence is consistent with the argument that the existence of large shareholders improves corporate governance.

Having established the negative association between ownership concentration and stock prices crashes, we further examine how it varies with the nature of ownership, i.e., private vs. state-owned. Results show that the negative effect of ownership concentration is more pronounced in privately held firms, though the negative effect of ownership concentration holds for both types of firms.

These findings suggest that large shareholders play an important monitoring role in firm management. This provides significant implications for the ongoing restructure of state ownership in China, which aims to improve the operating efficiency and market performance of state-owned enterprises.

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APPENDIX 1

Definition of Variables

Variables	Acronym	Description
Dependent variables	Ncskew	Negative skewness of firm-specific abnormal weekly returns over the fiscal year
	Duvol	Natural logarithm of the ratio of standard deviation in the down weeks (firm-specific weekly return below annual mean) to the standard deviation in the up weeks (firm-specific weekly return above the annual mean)
Independent variables	OWN3	The proportion of top three shareholders, a proxy of ownership concentration
	OWN5	The proportion of top three shareholders a proxy of ownership concentration
	HHI3	Top three shareholders' herfindahl index, a proxy of ownership concentration
	HHI5	Top five shareholders' Herfindahl index, a proxy of ownership concentration
Control variables	Size	Company' size, which is represented by the logarithmic of company's total assets
	Ret	Specific week return of company stock
	VOL	Specific standard deviation of company stock's week return
	MB	Market to book value, namely the ratio of stock price and the net book value per share
	Leverage	Company's leverage, which is calculated by the ratio of all the debt book value and total assets
	Dturn	Detrended stock turnover ratio, a measure of investor heterogeneity. The greater the value, the greater the heterogeneity of investors.
	Analyst	Number of analysts

Appendix 2

Descriptive Statistics

This table provides descriptive statistics for the measures of crash risk, ownership structure, and other firm characteristics. All variables are winsorized at 1% and 99% levels. Their definitions are detailed in Appendix 1. The sample period is from 2003 to 2008.

Variable	N	Mean	Median	STD	Min	Q1	Q3	Max
Neskew	10,001	0.176	0.103	0.727	-5.344	-0.231	0.470	4.804
Duvol	10,001	0.081	0.070	0.336	-1.562	-0.141	0.283	1.719
OWN3	10,001	52.315	52.906	14.515	9.312	42.244	62.653	95.757
OWN5	10,001	55.415	56.100	14.032	9.612	45.825	65.225	96.059
HHI3	10,001	0.201	0.167	0.133	0.005	0.098	0.283	0.723
HHI5	10,001	0.202	0.167	0.132	0.006	0.100	0.284	0.723
Size	10,001	0.920	0.917	0.030	0.833	0.898	0.938	1.065
Sigma	10,001	0.413	0.383	0.146	0.171	0.307	0.493	1.427
Ret	10,001	0.157	-0.016	0.569	-1.276	-0.238	0.417	1.957
MB	10,001	0.910	0.815	0.681	-0.860	0.437	1.295	3.164
Leverage	10,001	0.053	0.016	0.080	0.000	0.000	0.072	0.415
Dturn	10,001	0.005	0.002	0.009	-0.060	0.000	0.008	0.036
Analyst	10,001	0.291	0.226	0.276	0.021	0.144	0.356	7.038

Appendix 3

Correlation Matrix

This table reports Pearson correlation coefficients of the measures of crash risk, ownership structure, and other firm characteristics. All variables are winsorized at 1% and 99% levels. Their definitions are detailed in Appendix 1. The sample period is from 2003 to 2008.

	Ncskew	Duivol	Size	Sigma	Ret	MB	Leverage	Dturm	Analyst	OWN3	OWN5	HHI3	
Duivol	0.979***	1											
Size	-0.164***	-0.174***	1										
Sigma	-0.061***	-0.061***	0.054***	1									
Ret	-0.221***	-0.232***	0.475***	0.480***	1								
MB	-0.15133	-0.16209	0.2832	0.29077	0.40132	1							
Leverage	-0.011	-0.011	0.162***	-0.065***	0.020**	-0.114***	1						
Dturm	-0.076***	-0.080***	-0.004	0.390***	0.367***	0.007	0.003	1					
Analyst	-0.016	-0.019*	-0.146***	0.061***	-0.025**	0.146***	-0.102***	-0.030***	1				
OWN3	-0.013	-0.009	0.138***	-0.201***	-0.134***	0.016	-0.006	-0.285***	-0.016	1			
OWN5	-0.020**	-0.016	0.133***	-0.198***	-0.134***	0.057***	-0.006	-0.307***	-0.007	0.972***	1		
HHI3	-0.005	-0.005	0.170***	-0.184***	-0.095***	-0.056***	0.012	-0.219***	-0.036***	0.875***	0.791***	1	
HHI5	-0.005	-0.005	0.170***	-0.186***	-0.097***	-0.054***	0.012	-0.223***	-0.036***	0.878***	0.799***	0.999***	1

Appendix 4

Effects of Ownership Concentration on Crash Risk

	OWN3		OWN5		HHI3		HHI5	
	Ncskew	Duval	Ncskew	Duval	Ncskew	Duval	Ncskew	Duval
Intercept _{t-1}	-0.69* (-1.75)	-0.128 (-0.71)	-0.689* (-1.76)	-0.128 (-0.71)	-0.75* (-1.84)	-0.162 (-0.87)	-0.754* (-1.85)	-0.163 (-0.88)
Ownership _{t-1}	-0.002*** (-2.92)	-0.001** (-2.8)	-0.003*** (-3.41)	-0.001*** (-3.29)	-0.205** (-2.49)	-0.095** (-2.45)	-0.209** (-2.53)	-0.097** (-2.48)
Ncskew _{t-1}	0.046*** (3.73)	0.016** (2.63)	0.046*** (3.73)	0.016** (2.64)	0.047*** (3.75)	0.016** (2.65)	0.047*** (3.75)	0.016** (2.65)
Size _{t-1}	0.929** (2.13)	0.217 (1.1)	0.966** (2.22)	0.232 (1.18)	0.91** (2.05)	0.218 (1.09)	0.915** (2.06)	0.22 (1.1)
Sigma _{t-1}	0.331*** (4.13)	0.158*** (4.23)	0.329*** (4.11)	0.158*** (4.21)	0.328*** (4.09)	0.157*** (4.18)	0.328*** (4.09)	0.157*** (4.18)
Ret _{t-1}	-0.32*** (-12.96)	-0.162*** (-14.13)	-0.322*** (-13.00)	-0.162*** (-14.17)	-0.317*** (-12.9)	-0.16*** (-14.06)	-0.317*** (-12.9)	-0.16*** (-14.06)
MB _{t-1}	-0.006 (-0.34)	-0.002 (-0.23)	-0.003 (-0.16)	-0.001 (-0.06)	-0.01 (-0.55)	-0.004 (-0.44)	-0.01 (-0.55)	-0.004 (-0.44)
Leverage _{t-1}	0.04 (0.33)	0.001 (0.02)	0.047 (0.38)	0.004 (0.07)	0.038 (0.31)	0.000 (0.00)	0.038 (0.31)	0.000 (0.00)
Dturn _{t-1}	-0.674 (-0.56)	-0.021 (-0.04)	-0.899 (-0.75)	-0.118 (-0.2)	-0.337 (-0.28)	0.114 (0.19)	-0.347 (-0.29)	0.11 (0.19)
Analyst _{t-1}	-0.07 (-2.04)	-0.028 (-1.82)	-0.069 (-2)	-0.028 (-1.78)	-0.071 (-2.09)	-0.028 (-1.85)	-0.071 (-2.09)	-0.028 (-1.85)
Observation	10001	10001	10001	10001	10001	10001	10001	10001
Adjusted R ²	0.104	0.125	0.105	0.125	0.104	0.124	0.104	0.124

Appendix 4 presents the effects of firm ownership concentration on stock price crash risk. The dependent variable crash risk measures, Ncskew and Duval. The independent variable, ownership, is proxied by ownership concentration measures, Own3, Own5, HHI3 and HHI5, respectively. All variables are winsorized at 1% and 99% levels. Their definitions are detailed in the Appendix. All regressions include unreported industry- and year-fixed effects. T-statistics shown in parentheses are adjusted for firm-level clustered standard errors. The sample period is from 2003 to 2008. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Appendix 5

Difference-in-Difference Tests

This table presents the impact of the change in firm ownership concentration on the change in stock price crash risk. The dependent variable is computed as the change in crash risk measures, Ncskew and Duvol. The independent variable, ownership, is defined as the change in the ownership concentration measures, Own3, Own5, HHI3 and HHI5. All variables are winsorized at 1% and 99% levels. Their definitions are detailed in the Appendix. All regressions include unreported industry- and year-fixed effects. T-statistics shown in parentheses are adjusted for firm-level clustered standard errors. The sample period is from 2003 to 2008. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

	OWN3		OWN5		HHI3		HHI5	
	Δ Dnckew	Δ Dduvol	Δ Dnckew	Δ Dduvol	Δ Dnckew	Δ Dduvol	Δ Dnckew	Δ Dduvol
Δ Intercept	-0.894** (-2.29)	0.088 (0.9)	-0.904** (-2.32)	0.084 (0.85)	-0.821** (-2.1)	0.124 (1.27)	-0.822** (-2.11)	0.123 (1.26)
Δ Ownership	-0.018*** (-6.92)	-0.009*** (-7.2)	-0.018*** (-7.64)	-0.009*** (-7.75)	-1.742*** (-5.92)	0.921*** (6.96)	-1.761*** (-5.95)	-0.932*** (-7.01)
Δ Ncskew	1.047*** (84.23)	0.189*** (46.22)	1.046*** (83.96)	0.189*** (46.01)	1.047*** (84.43)	0.189*** (46.23)	1.047*** (84.4)	0.189*** (46.19)
Δ Size	0.944** (2.27)	-0.234** (-2.28)	0.95** (2.28)	-0.231** (-2.26)	0.887** (2.13)	0.264** (2.58)	0.887** (2.13)	-0.264** (-2.57)
Δ Sigma	0.463*** (5.46)	-0.085*** (-3.11)	0.465*** (5.49)	-0.084*** (-3.07)	0.458*** (5.39)	0.086*** (3.14)	0.458*** (5.4)	-0.086*** (-3.13)
Δ Ret	-0.298*** (-11.57)	0.176*** (18.64)	-0.294*** (-11.46)	0.177*** (18.74)	-0.308*** (-11.95)	0.171*** (18.58)	-0.307*** (-11.93)	0.172*** (18.59)
Δ MB	-0.029 (-1.62)	0.004 (0.93)	-0.03* (-1.68)	0.004 (0.82)	-0.029 (-1.58)	0.005 (1.00)	-0.029 (-1.58)	0.005 (0.99)
Δ Leverage	0.05 (0.4)	0.01 (0.32)	0.054 (0.43)	0.012 (0.38)	0.039 (0.31)	0.004 (0.12)	0.038 (0.31)	0.004 (0.12)
Δ Dturn	-0.667 (-0.57)	0.088 (0.24)	-0.806 (-0.69)	0.021 (0.06)	-0.451 (-0.39)	0.18 (0.5)	-0.461 (-0.39)	0.175 (0.48)
Δ Analyst	-0.075** (-2.05)	-0.019* (-2)	-0.075** (-2.06)	-0.019* (-2.02)	-0.077** (-2.08)	0.02* (2.05)	-0.077** (-2.08)	-0.02* (-2.05)
Observation	9124	9124	9124	9124	9124	9124	9124	9124
Adjusted R ²	0.598	0.297	0.6	0.297	0.597	0.296	0.597	0.296

Appendix 5

Private Firms vs. State-Owned Enterprises

This table presents the effects of firm ownership concentration on on stock price crash for state-owned and non-state-owned enterprises. The dependent variable is crash risk measures, Ncskew and Duvol. The independent variable, Ownership, is proxied by ownership concentration measures, Own3, Own5, HHI3 and HHI5, respectively. All variables are winsorized at 1% and 99% levels. Their definitions are detailed in Appendix 1. All regressions include unreported industry- and year-fixed effects. T-statistics shown in parentheses are adjusted for firm-level clustered standard errors. The sample period is from 2003 to 2008. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

	OWN3		OWN5		HHI3		HHI5	
	Ncskew	Duvol	Ncskew	Duvol	Ncskew	Duvol	Ncskew	Duvol
Intercept _{t-1}	-0.684*	-0.125	-0.685*	-0.126	-0.747*	-0.161	-0.75*	-0.162
	(-1.74)	(-0.70)	(-1.75)	(-0.70)	(-1.84)	(-0.87)	(-1.84)	(-0.87)
Ownership _{t-1}	-0.002***	-0.001**	-0.003***	-0.001**	-0.204***	-0.095**	-0.209**	-0.096**
	(-2.91)	(-2.79)	(-3.40)	(-3.27)	(-2.49)	(-2.44)	(-2.52)	(-2.47)
Private _{t-1}	1.379*	0.815*	1.479	0.872*	-0.116	0.035	-0.116	0.035
	(1.82)	(1.78)	(1.54)	(1.65)	(-0.16)	(-0.1)	(-0.16)	(-0.1)
Ownership*Private _{t-1}	-0.027**	-0.015*	-0.028**	-0.016*	-0.083	-0.423	-0.083	-0.422
	(-2.28)	(-1.88)	(-2.03)	(-1.85)	(-0.04)	(-0.41)	(-0.04)	(-0.41)
Ncskew _{t-1}	0.047***	0.016**	0.047***	0.016**	0.047***	0.016**	0.047***	0.016**
	(3.74)	(2.64)	(3.74)	(2.65)	(3.75)	(2.65)	(3.75)	(2.65)
Size _{t-1}	0.923**	0.214	0.961**	0.23	0.907**	0.217	0.912**	0.219
	(-2.12)	(-1.09)	(-2.21)	(-1.17)	(-2.05)	(-1.08)	(-2.06)	(-1.09)
Sigma _{t-1}	0.329***	0.158***	0.327***	0.157***	0.327***	0.157***	0.327***	0.157***
	(-4.11)	(-4.21)	(-4.09)	(-4.19)	(-4.07)	(-4.17)	(-4.07)	(-4.17)
Ret _{t-1}	-0.32***	-0.162***	-0.321***	-0.162***	-0.317***	-0.16***	-0.317***	-0.16***
	(-12.95)	(-14.13)	(-12.99)	(-14.16)	(-12.89)	(-14.04)	(-12.89)	(-14.04)
MB _{t-1}	-0.006	-0.002	-0.003	0.000	-0.01	-0.003	-0.01	-0.003
	(-0.33)	(-0.22)	(-0.16)	(-0.05)	(-0.55)	(-0.44)	(-0.55)	(-0.44)
Leverage _{t-1}	0.041	0.002	0.047	0.004	0.037	0.000	0.038	0.000
	(-0.33)	(-0.03)	(-0.39)	(-0.08)	(-0.31)	(0.00)	(-0.31)	(0.00)
Dturn _{t-1}	-0.674	-0.021	-0.9	-0.118	-0.34	0.113	-0.35	0.109
	(-0.56)	(-0.03)	(-0.75)	(-0.20)	(-0.29)	(-0.19)	(-0.29)	(-0.18)
Analyst _{t-1}	-0.07**	-0.028*	-0.069**	-0.028*	-0.071**	-0.028*	-0.071**	-0.028*
	(-2.06)	(-1.83)	(-2.02)	(-1.79)	(-2.10)	(-1.86)	(-2.10)	(-1.86)
Observation	10,001	10,001	10,001	10,001	10,001	10,001	10,001	10,001
Adjusted R ²	0.104	0.125	0.105	0.125	0.104	0.124	0.104	0.124