

## Management Background Characteristics and Stock Price Crash Risk\*

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Taking A-share listed companies in the Shanghai and Shenzhen stock markets from 2011 to 2015 as samples, this study examines the relationship between the management background characteristics and stock price crash risk. There was found to be a significant negative correlation between the age of the Chairman and the stock price crash risk. With the increase of the Chairman's age, the stock price crash risk was significantly reduced, but education level and gender were not found to significantly impact stock price crash risk. Further examination of the impact mechanism revealed that corporate investment behavior and internal control activities played a "bridge role" in the impact of Chairman's age on stock price crash risk. In addition, the "substitution effect" between Chairman's age and accounting conservatism was also found to be a factor in the relationship with stock price crash risk. On one hand, this study deepens the research on the influencing factors of stock price crash risk, and on the other hand, it sheds light on the economic consequences of the management background characteristics in enterprise activities.

Keywords: Management Background Characteristics, Stock Price Crash Risk, Accounting Conservatism, Investment Efficiency, Internal Control

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## I. Introduction

Stock price crashes are an important phenomenon in capital market. This extreme event will not only wipe out billions of dollars of investors' wealth, dampen investors' enthusiasm, disturb the stability of financial markets, and even endanger the development of the real economy. Although China's stock market has rapidly developed for more than 20 years, compared with the mature capital market in the West, sharp rises and falls in the stock market are more acute. Specifically, since the global financial crisis in 2007-2008, stock price crashes have become the focus of investors, regulators, and scholars. It is not only of theoretical value, but also of great practical significance to explore the factors influencing stock price crash risk and explain this "financial anomaly" (Pan et al., 2011).

Previous studies have ascribed stock price collapse to information management behaviors of internal managers. That is, the management hoards bad news for a long time due to self-interest concerns; when the negative information cannot be hidden, managers release this into the external market, causing a huge impact and eventually leading to the collapse of stock prices (Jin and Myers, 2006; Kim et al., 2011). It shows that internal managers are the key factor in causing stock price crash risk. From the perspective of the agency problem and information asymmetry, the existing literature mainly studies the impact of market trading mechanism, internal and external corporate governance mechanism, corporate social responsibility, the association of government and enterprise, and other factors on stock price crash risk (Jiang et al., 2018; Kim et al., 2014; Hu and Wang, 2018). There are only a few studies that focus on the relationship between enterprise managers and stock price crash risk (Kim et al., 2016; Li and Liu, 2012; Jiang et al., 2018). However, whether the agency problem or information asymmetry, their roots lie in the different corporate behaviors under managers' decision-making, which will inevitably be affected by managers' background characteristics. Therefore, when we study future stock price crash risk, not considering the background characteristics of managers may affect

the validity of the conclusions. Will the personal background characteristics of managers, such as age, education, professional background, and employment experience have an impact on stock price crash risk? What type of impact will this have? What is the specific path and mechanism of this impact? These questions need to be answered, which is the main point of this study.

This study takes A-share listed companies on the Shanghai Stock Exchange and Shenzhen Stock Exchange from 2011 to 2015 as the research object and systematically tests the impact of top executives' background characteristics, such as age, education, and gender, on the stock price crash risk. The results revealed there is a significant negative correlation between top executives' age and future stock price crash risk. With the increase of top executives' age, crash risk is significantly reduced, but we do not find that education level and gender have a significant impact on crash risk. Further examination tested the impact mechanism of how top executives' age affects stock price crash risk. We found the investment behavior and internal control activities of enterprises play a "bridge role." In addition, the "substitution effect" between the increase of top executives' age and accounting conservatism also provides a specific explanation for this mechanism.

This study contributes to related research in the following aspects. First, we expand and deepen the previous analytical framework on stock price crash risk and extend the research perspective to the background characteristics of actors. We investigate the influence of top executives' background characteristics on stock price crash risk. Second, from the study of the impact mechanism of the top executives' physiological characteristics (age) on stock price crash risk, we establish a complete path of "human-behavior-economic consequences," and deepen the theoretical understanding of stock price crash risk.

The remainder of the paper is organized as follows. Section 2 is a literature review and theoretical analysis. Section 3 includes research design and model establishment, setting up specific variables and outlining the measurement model. Section 4 mainly covers descriptive statistics, which are used to conduct a

quantitative investigation of individual stock slump, top executives' background characteristics, and other enterprise characteristics. Empirical and robustness tests and results are reported in section 5. Section 6 tests and analyzes the influence mechanism of top executives' background characteristics on stock price crash risk. Concluding remarks and implications are presented in section 7.

## II. Literature review and theoretical analysis

Compared with research on stock price crash risk at the market level, there is a lack of research on the specific formation mechanism of stock price crash risk at the individual level and research in this field is just emerging in academia (Ye et al., 2015). The research on Chinese stock markets is relatively scarce at present (Xu et al., 2012). The study of the formation mechanism of stock price crashes was mostly based on the external factors of companies, such as the trading mechanism of financial markets. The latest research results indicate that the crashes of individual stocks may not only be affected by the generation process of exogenous random information, but may also be caused by deliberate management by insiders of internal specific information flow of companies entering external capital market. Jin and Myers (2006) found that information management behaviors, which contain managers' rent-seeking activities in an opaque enterprise environment, and deliberately concealing the negative internal news of company are the main reason for increasing stock price crash risk are. The authors then put forward the "bad news hoarding theory." Specifically, due to their personal reputation, salary return, career development, and other self-interest concerns, managers often strategically delay or conceal release of bad news to the external environment, while they release positive news in a timely manner. The asymmetry between disclosure of bad and good news keeps negative information accumulating in company, but this will ultimately be disclosed. When the total amount of accumulated bad news exceeds the maximum capacity internal management can hoard, this negative information will be exposed

intensively, which will have a significant impact on the market and lead to stock price crash.

To explore and test the influencing factors of stock price crash risk, recent studies are mostly based on the "bad news hoarding" hypothesis and focus on many internal and external factors and various stakeholders that may encourage or inhibit corporate managers' behaviors of hiding bad information. Many studies have verified the aforementioned theory. The existing literature indicates the following factors will promote or encourage managers to hoard information and increase stock price crash risk. For example, self-interest motive of managers to maintain their authority and salary (Khan and Watts, 2009), opaque corporate financial statements (Hutton et al., 2009), corporate tax avoidance (Kim et al., 2011b), top executives' options incentive (Kim et al., 2011a), and management's extra allowance (Xu et al., 2014). These factors will help to restrain managers' asymmetric information disclosure behaviors so as to reduce stock price crash risk. A good internal control system (Zhou et al., 2015), disclosure of internal control information (Ye et al., 2015), prudent accounting policies (Kim and Zhang, 2016), increasing the shareholding ratio of major shareholders (Wang et al., 2015; Tan et al., 2019), reporting and supervision from the media (Luo and Du, 2014), auditor industry expertise (Habib and Hasan, 2016), investor protection (Zhang and Wang, 2018), strong labor union organization (Chen et al., 2019), and so on will help restrain such behaviors.

The "bad news hoarding theory" and the aforementioned research show that the self-interest motive and rent-seeking behavior of management are the "behind the scenes" and "the initiator" of a company's stock price crash. Furthermore, the internal manager is the "source" and key factor in stock price crash risk. It is worth noting that, besides discussing the impact of executives' options incentives (Kim et al., 2011a), extra allowance (Xu et al., 2014), ranking (Jiang et al., 2018), executive's reduction (Sun et al., 2017), and other factors on crash risk, the existing literature has begun to focus on the influence internal managers' characteristics exert on stock crashes. Kim et al. (2016) found that overconfident executives may

mistakenly invest in projects with negative net present value (NPV), and "don't take bad news" in the implementation of the project, which eventually leads to stock price crash risk. Using the data of China's A-share listed companies, Li and Liu (2012) tested the relationship between female executives and stock price crash risk. They argued that given the fact that female CEOs have higher moral sense and higher level of risk aversion than men, they can significantly reduce the risk of stock price crash. Li and Zeng (2019) verified that female CFOs are more prudent and they can therefore significantly reduce the risk of stock price crash.

In recent years, with the deepening application of behavioral economics and demography in management, the heterogeneity of managers has attracted the attention of academia in various fields. The important role of the background characteristics of executives in production, management activities, and corporate performance of companies they lead has been increasingly emphasized in the literature. Previous research has found the following important results. Women managers tend to choose more conservative corporate strategies (Peng and Wei, 2007). With the increase of age, managers tend to choose less risky and more conservative projects in which to invest (Vroom and Pahl, 1971). A significant correlation has also been found among the education level of company executives, the average age of the managerial team, and over-investment behaviors (Jiang et al., 2009). The background characteristics of executives have a significant impact on the quality of internal control (Chi et al., 2014). There is a significant correlation between the nature of the executives and the choice of investment strategy (Huang and Kisgen, 2013). The executive team's average age, educational background, and heterogeneity are significantly correlated with accounting conservatism and investment efficiency (Han et al., 2014). Furthermore, based on the "upper echelon theory" (Hambrick and Mason, 1984), these studies explain the impact of the background characteristics of top executives. According to this theory, due to the complexity of internal and external environments, managers cannot have a comprehensive understanding of all aspects of their environment. The

existing cognitive structure and values of managers therefore determine their explanatory power regarding relevant information, and then determine managers' decision-making and the behavior of enterprises. Meanwhile, although the cognitive ability and values of managers are difficult to observe and quantify, population background characteristics (e.g., gender, age, education background, professional background, etc.) closely related to personal cognition can be objectively measured. Therefore, we can observe and test the influence that background characteristics of top managers exert on their behavioral decision-making and various activities of enterprise.

As an extreme event reflecting the collapse of the company's market performance, in theory, the stock price crash caused by top executives' rent-seeking behavior for self-interest and information hiding behavior is closely related to the company's executives (Jin and Myers, 2006; Hutton et al., 2009; Wang et al., 2015). At the same time, based on the "upper echelon theory," executives' cognition and value judgment guide their behaviors and decision-making and can be objectively observed from the aspect of executives' background characteristics. That is, the background characteristics of top managers reflect their cognition and value judgment, which will affect the specific behavioral choice and decision-making and may then affect stock price crash risk.

Therefore, based on the above analysis, we formulate the following hypothesis: The background characteristics of top executives will have a significant impact on stock price crash risk.

In the relevant literature, Huang and Sheng (2013) used the event study method and found that in the event of a change of top executives, their background characteristics have a significant impact on stock price response. The characteristics of top executives have significant information content and value relevance, which provide direct evidence that the characteristics of managers will cause the stock price response in the trading market. However, the problem of which background characteristics will impact on extreme tail events of capital markets, that is stock price crash risk has not been fully explained. In addition, Li and Liu (2012) tested the relationship

between gender of CEOs and the risk of stock price crash. However few studies examine the relationship between top executives' background characteristics and stock price crash risk. The nature of the relationship among the aforementioned factors still needs to be tested and demonstrated. In addition, the specific path by which background characteristics of top executives influence stock price crash risk of the company, and which aspects are reflected in the enterprise activities need to be further observed and discussed.

Based on the above discussion, this study examines the relationship between top executives' background characteristics and stock price crash risk, tests the possible impact mechanism, and suggests a reasonable explanation.

### III. Research design and model establishment

#### 1. Variable setting

##### (1) Explained variable - stock price crash risk

Referring to the previous relevant literature (Xu et al., 2012; Li and Liu, 2012; Wang et al., 2015; Ye et al., 2015; Dai and Yue, 2015), we construct the following two indicators to measure stock price crash risk.

First, to calculate stock yields adjusted by market, we use weekly returns data of stock  $i$  and eliminate the influence of market factors on individual stock returns using formula (1).

$$\gamma_{i,t} = \alpha + \beta_1 \gamma_{M,t-2} + \beta_2 \gamma_{M,t-1} + \beta_3 \gamma_{M,t} + \beta_4 \gamma_{M,t+1} + \beta_5 \gamma_{M,t+2} + \varepsilon_{i,t} \quad (1)$$

Where  $\gamma_{i,t}$  is the yield of stock  $i$  in week  $t$  and  $\gamma_{M,t}$  is the average yield weighted by the value of the stock market containing stock  $i$  in week  $t$ . In formula (1), we add lagged and excess terms to adjust the impact of non-synchronous trading of stock (Dimson, 1979). Specifically,  $W_{i,t} = \ln(1 + \varepsilon_{i,t})$ , where we define the weekly special yield of the company and residual  $\varepsilon_{i,t}$  refers to the part of individual stock yield that cannot be explained by fluctuation of market yield.

Second, we construct two measurements of stock price crash risk.

The first measurement is the negative coefficient of skewness of returns, which is recorded as  $NCSKEW$ .

Formula (2) shows the method of calculating the index, where  $n$  is the number of trading weeks of a stock during a fiscal year.  $NCSKEW_{i,t}$  is the negative skewness of the return of stock  $i$  in the year  $t$ , which represents the tendency of stock price crash. The larger this index is, the greater the stock price crash risk.

$$NCSKEW_{i,t} = -\frac{[n(n-1)^{\frac{3}{2}} \sum w_{i,t}^3]}{[(n-1)(n-2)(\sum w_{i,t}^2)^{\frac{3}{2}}]} \quad (2)$$

The second measurement is the ratio of the downside and upside volatility, which is recorded as  $DUVOL$ . Formula (3) shows the specific calculation method of this measurement. We define upside as the firm-specific weekly returns being above its annual mean, and downside as those below its annual mean. Thus,  $n_u$  and  $n_d$  represent the number of weeks when the firm-specific weekly returns of stock  $i$  is greater or lower than its annual mean in a fiscal year, respectively. The larger  $DUVOL_{i,t}$ , the more inclined the return distribution is to the left and the higher stock price crash risk will be.

$$DUVOL_{i,t} = \log \left\{ \frac{[(n_u - 1) \sum_{Down} w_{i,t}^2]}{[n_d - 1) \sum_{Up} w_{i,t}^2]} \right\} \quad (3)$$

##### (2) Explanatory variables - background characteristics of top executives

Following previous research (Zhang et al., 2011; Huang and Sheng, 2013; Chi et al., 2014), and considering the availability of data, we mainly examine the background characteristics of top executives from three aspects: gender, age, and educational background. At present, there is no unified standard for the definition of executives in the academic community, and specific literature often defines it according to the specific needs of research (Chi et al., 2014). Given the actual situation of China's corporate governance, this study defines executives as the Chairman of the board of directors. The reason is that the Chairman has a significant influence and is responsible for the formulation of major strategic direction and the decision-making regarding major issues in Chinese enterprises. In some companies, the Chairman is often "personally" responsible for the specific operation and management of the company, becoming the "top leader" of company, and even forming the

situation in which "only the leader talks" (Zhang and Zhang, 2016). Therefore, the Chairman usually has greater authority, is the top management, and the actual decision-maker (Kato and long, 2006).

**(3) Control variables**

In terms of control variables, combining our research and referring to existing literature (Pan et al., 2011; Li and Liu, 2012; Xu et al., 2012; Ye et al., 2015; Han et al., 2014; Chi et al., 2014), we control for the influence of following factors: Turnover, Maghold, Lev, ROA, Yreturn, Sigma, Size, Top 1, Dual, Indpt, Opaque, and MB. In addition to these factors, we control the year and industry of the sample.

The specific definitions of variables are presented

in Table 1.

**2. Model setting**

Based on previous literature and specific needs of our study, this study mainly uses the following model to test the relationship between top executives' background characteristics and stock price crash risk.

$$Crash_{t+1} = \alpha + \beta_1 Background + \beta_c Controls + \varepsilon \quad (4)$$

According to the relationship set by the model (Wang et al., 2015), *Crash* is an index of stock price collapse risk that lags one period, including *NCSKEW* and *DUVOL*. *Background* is the Chairman's background characteristics in period *t*, including age, degree of education, and gender. *Controls* is a series of control variables, including Turnover, Maghold, Lev,

**Table 1 Definition and measurement of main variables**

Variable	Definition and description
<b>Explained variable</b>	
NCSKEW	Negative coefficient of skewness of returns (NCSKEW) measures the tendency of stock price to plummet. The larger NCSKEW is, the greater stock price crash risk is. Please refer to the text and formula (2) for the specific algorithm.
DUVOL	DUVOL is the ratio of fluctuation of stock returns. This indicator measures the degree of the left inclination of return distribution. The greater the DUVOL is, the greater stock price crash risk is. Please refer to the text and formula (3) for the specific algorithm.
<b>Explanatory variable</b>	
Age	Age of Chairman.
Degree	Degree of Chairman. Secondary school's degree and below is 1; college's degree is 2; undergraduate's degree is 3; master's degree is 4 and doctor's degree is 5.
Gender	Gender of Chairman. Male is 1, and female is 0.
<b>Control variable</b>	
Turnover	The difference between stock turnover rate of current year and that of previous year divided by turnover rate of current year.
Maghold	Total management shareholding
Lev	Total liabilities / total assets of company
ROA	Return on total assets
Yreturn	Annual individual stock return considering reinvestment of cash dividend
Sigma	Volatility of stock return means annual standard deviation of weekly special return.
Size	Natural logarithm of total assets of company
Top 1	Shareholding ratio of the first largest shareholder
Dual	If the Chairman and CEO of the company are combined, 1 will be taken, otherwise 0.
Indpt	Proportion of independent directors in the board of directors
MB	Market value of shareholders' equity divided by book value
Opaque	Referring to study of Pan et al. (2011), Opaque is measured by the sum of absolute value of the previous three periods of controllable accrual profits, and the controllable accrual profits are estimated by using the modified Jones model (Dechow et al., 1995)

ROA, Yreturn, Sigma, Size, Top 1, Dual, Indpt, Opaque, and MB.  $\varepsilon$  is the error item.

### 3. Data and descriptive statistics

#### (1) Data and processing method

The initial sample includes all A-share listed companies on the Shanghai Stock Exchange and Shenzhen Stock Exchange from 2011 to 2015. Referring to previous relevant research (Xu et al., 2012; Wang et al., 2015; Jiang and Xu, 2015), we screen the initial samples according to following standards: (1) We eliminate financial companies because there are significant differences between the statement structure of such companies and that of other industries. (2) We eliminate the firm-year observations whose weekly return records are less than 30 in one year, which is to ensure the reliability of calculation of indicators of stock price collapse risk. (3) We eliminate companies listed in Growth Enterprises Market as, due to the loose listing conditions and short time to market in this sector, abnormal fluctuations easily occur; (4) We exclude observations with missing values. After the above processing, we obtained 6816 firm-year observations, including 1232 in 2011, 1335 in 2012, 1345 in 2013, 1414 in 2014, and 1490 in 2015. The data used in this study is mainly covered by the China Stock Market and Accounting Research (CSMAR) database. Data of individual stock trading comes from the Wind Financial Database (Wind), and missing data on top executives' background is collected and sorted manually according to annual company reports.

#### (2) Statistics of Chairman's background characteristics

Tables 2 and 3 report statistics and distribution on Chairmen's background characteristics. In terms of age, the age range from 50 to 60 (excluding the minimum value and including the maximum value in each range) accounts for the highest proportion. Specifically, this range accounts for 49.9% of the 6816 observations, and has an increasing trend annually, from 41.9% in 2011 to 57.5% in 2015, a 15.6% increase in five years. In terms of time trend, the proportion of Chairman over 50 years old is increasing every year, while the proportion of those less than 50

years old is declining. In terms of the distribution of the Chairmen's educational background, we find that most Chairmen hold a master's degree, which accounts for 51.6% of 6816 observations. In terms of time trend, the proportion of each degree is relatively stable, and there is no obvious change over the period. The gender distribution is reported in Table 3. The proportion of males remains above 95% and that of females is between 4% and 5%. In terms of time trend, although the proportion of females is low, it shows a trend of slow growth year by year.

To comprehensively reflect age and education, we divide the age into groups according to 5-year intervals. Finally, we divide Chairman from 25 to 80 years old into 11 groups (each group excludes the minimum value and includes the maximum value). We count the frequency and cumulative frequency of each group of samples and accumulate the average value of education of each group. The results are reported in Figure 1. Looking at Figure 1, we can see that up to the fifth group (45-50 years old), the educational background has a negative correlation with age, which means the older the Chairman, the lower the average educational background, these groups account for 87.2% of the sample. This feature also reflects the reality to some extent; with the improvement of education level and progress of social knowledge level, the labor market requires higher education level for new entrants. Furthermore, opportunities and resources to receive high-level education are more available and the cost is lower, which makes the education level of younger managers higher. In contrast, due to the existence of objective factors such as social environment and resource constraints, older managers have no chance to obtain higher education. In other words, in the period when these groups grew into entrepreneurs and managers, higher education was not necessary. Generally, part of the samples show negative correlation between educational background and age, and this phenomenon has a real social basis.

**Distribution of Chairmen's age**

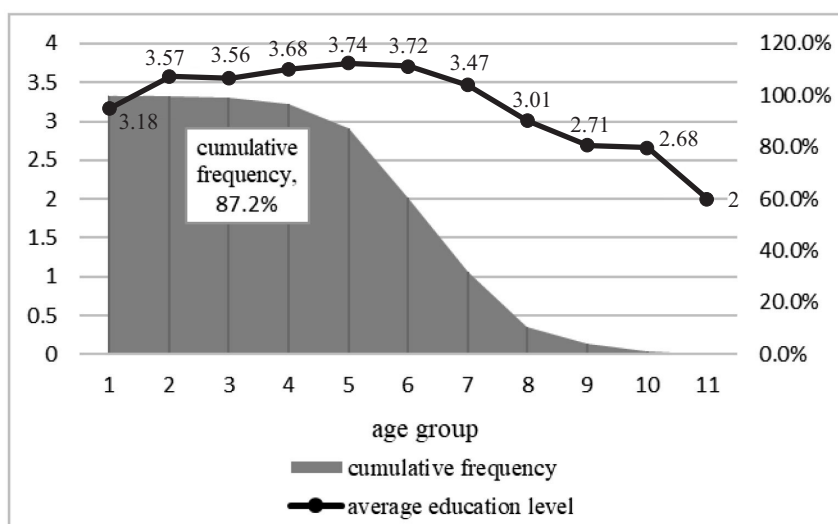
Year	20-30		30-40		40-50		50-60		60-80	
	N	%	N	%	N	%	N	%	N	%
2011	6	0.49	48	3.90	549	44.60	516	41.90	113	9.17
2012	6	0.45	41	3.07	564	42.20	593	44.40	131	9.81
2013	1	0.07	38	2.83	506	37.60	665	49.40	135	10.00
2014	2	0.14	40	2.83	442	31.30	770	54.50	160	11.30
2015	2	0.13	48	3.22	396	26.60	857	57.50	187	12.60
In total	17	0.25	215	3.15	2457	36.00	3401	49.90	726	10.70

**Distribution of Chairmen's education**

Year	high school and below		college		undergraduate		master		doctor	
	N	%	N	%	N	%	N	%	N	%
2011	26	2.11	109	8.85	343	27.80	634	51.50	120	9.74
2012	33	2.47	114	8.54	356	26.70	698	52.30	134	10.00
2013	30	2.23	110	8.18	366	27.20	709	52.70	130	9.67
2014	34	2.40	130	9.19	396	28.00	724	51.20	130	9.19
2015	44	2.95	136	9.13	412	27.70	749	50.30	149	10.00
In total	167	2.45	599	8.79	1873	27.50	3514	51.60	663	9.73

**Table 3 Distribution of Chairmen's gender and time trend**

Year	Male	%	Female	%
2011	1180	95.8	52	4.22
2012	1278	95.7	57	4.27
2013	1287	95.7	58	4.31
2014	1349	95.4	65	4.60
2015	1418	95.2	72	4.83
In total	6512	95.5	304	4.46



**Figure 1 Distribution of Chairmen's age and education**



### (3) Descriptive statistics of individual stock crash risk

Our study defines individual stock crash risk referring to Pan et al. (2011), and Luo and Du (2014).

$$W_{i,t} \leq \text{Average}(W_{i,t}) - 3.09\sigma_{i,t} \quad (5)$$

As is shown in formula (5),  $\text{Average}(W_{i,t})$  is the annual mean of weekly special yield of stock  $i$ ;  $\sigma_{i,t}$  is the standard deviation of weekly special yield of stock  $i$ . In the standard normal distribution, 3.09 standard deviations correspond to the probability interval of 0.1%. If weekly special returns of a certain week meet the above formula, the week is defined as a crash week, and the number of crash weeks in a financial year is the number of times that individual stocks have experienced crashes in that year.

Table 4 reports the detailed statistics of frequency of individual stock crashes in 2011-2015. Taken together, most samples (86.16%) did not experience a crash during the study period. The proportion of individual stocks that experienced a crash in one year is 13.60%. The number of stocks that experienced two

crashes in one year is only 16, accounting for 0.23%.

### (4) Correlation analysis

The Pearson correlation coefficients of the main variables are reported in Table 5. The correlation coefficient between NCSKEW and DUVOL is about 0.93, which is significant at the 1% level, indicating that the two indexes have good consistency. The correlation coefficient between top executives' age and educational background is -0.23, which is significant at the 1% level. This result confirms the findings regarding the previous descriptive statistics of Chairman's age and educational background to some extent. In addition, the correlation coefficients of other explanatory variables are not large, which indicates that there is no obvious multicollinearity problem in this study.

We divide samples into five groups according age and educational background. The average distribution of each group of NCSKEW and DUVOL is shown in

**Table 4 Descriptive statistics of stock price crash risk**

the number of sharp falls in a year	the number of observations	proportion	cumulative proportion
0	5873	86.16%	86.16%
1	927	13.60%	99.77%
2	16	0.23%	100%
In total	6816	100.00%	

**Table 5 The Pearson correlation coefficient of the main variables**

	NCSKEW	DULVOL	Age	Degree	Gender	Top1	Dual	MagHold	Lev
NCSKEW	1.000								
DUVOL	0.92***	1.000							
Age	-0.020	-0.013	1.000						
Degree	0.018	0.024**	-0.23***	1.000					
Gender	0.006	0.005	0.07***	0.025**	1.000				
Top1	-0.012	0.004	0.06***	0.077***	0.008	1.000			
Dual	0.017	0.003	-0.09***	-0.03**	-0.004	-0.10***	1.000		
MagHold	-0.03***	-0.05***	-0.013	-0.13***	-0.002	-0.11***	0.19***	1.000	
Lev	0.006	-0.004	-0.07***	0.05***	0.011	0.04***	-0.04***	-0.14***	1.000
ROA	0.03***	0.04***	0.06***	-0.03**	-0.03**	0.05***	0.01	0.06***	-0.25***
Yreturn	0.04***	0.006	0.03**	-0.03***	-0.015	-0.03**	0.06***	0.14***	-0.07***
Sigma	-0.27***	-0.37***	-0.05***	-0.03**	-0.015	-0.05***	0.06***	0.09***	0.00
Size	0.004	0.023*	0.12***	0.15***	0.018	0.32***	-0.11***	-0.15***	0.18***
Indpt	-0.001	-0.010	-0.03**	0.03**	0.005	0.04***	0.09***	0.06**	0.01
Turnover	-0.001	-0.019	0.03**	-0.002	-0.010	-0.08***	0.02**	0.03**	-0.015
Opaque	-0.011	-0.017	-0.011	-0.05***	-0.06***	0.05***	0.01	-0.01	0.04***
MB	0.004	-0.004	-0.04***	0.00	-0.004	-0.02	0.00	0.00	0.03***

Continued table 5 The Pearson correlation coefficient of the main variables

	ROA	Yreturn	Sigma	Size	Indpt	Turnover	Opaque	MB
ROA	1.000							
Yreturn	0.03**	1.000						
Sigma	-0.09***	0.28***	1.000					
Size	0.05***	-0.03***	-0.209***	1.000				
Indpt	-0.01	0.03**	0.012	0.049***	1.000			
Turnover	-0.01	0.29***	0.101***	0.044***	-0.022*	1.000		
Opaque	0.00	0.011	0.060***	-0.002	0.004	0.001	1.000	
MB	0.00	0.06***	0.059***	-0.135***	-0.003	-0.001	0.008	1.000

Note: \*, \*\*and\*\*\* indicate significance at the levels of 10%, 5%, and 1%, respectively.

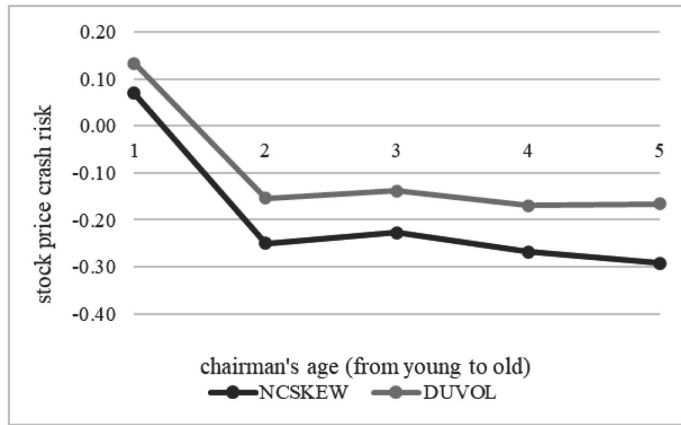


Figure 2 Age of Chairman and stock price crash risk

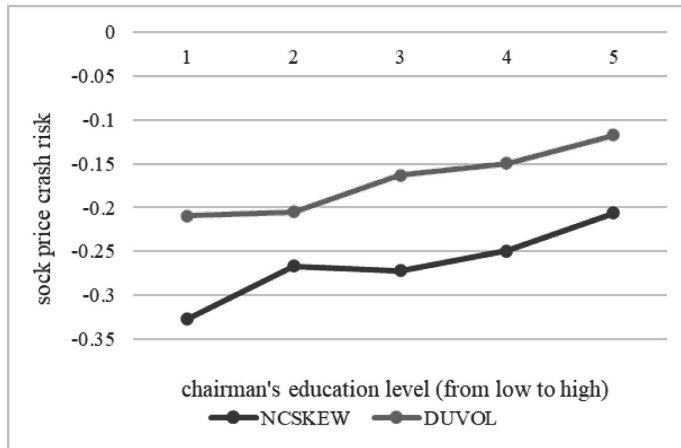


Figure 3 Chairman's education level and stock price crash risk

Figures 2 and 3, respectively. We can see from following figures that Chairman's age has a negative correlation with overall stock price crash risk. With the increase of the age of the Chairman, stock price crash risk decreases while education of has a positive correlation with stock price crash risk on the whole.

Stock price crash risk increases with education level. These results prove that there is a correlation between the background characteristics of the Chairman and stock price crash risk.

**Table 6 Basic descriptive statistics of main variables**

stats	N	min	mean	max	p50	sd
NCSKEW	6816	-5.434	-0.255	4.563	-0.248	1.072
DUVOL	6816	-5.062	-0.157	3.913	-0.187	0.853
Age	6816	26	52.53	79	52	6.798
Degree	6816	1	3.573	5	4	0.873
Gender	6816	0	0.955	1	1	0.206
Top1	6816	0.29	35.21	89.99	33.18	15.53
Dual	6816	0	0.188	1	0	0.39
MagHold	6816	0	5.055	83	0.00717	12.8
Lev	6816	0.00708	0.505	13.4	0.501	0.321
ROA	6816	-1.988	0.0308	4.837	0.0278	0.0941
Yreturn	6816	-0.686	0.226	7.355	0.125	0.558
Sigma	6816	0.0109	0.053	0.196	0.0481	0.022
Size	6816	15.73	22.26	28.51	22.1	1.359
Indpt	6816	0.182	0.371	0.8	0.333	0.0558
Turnover	6816	-46.48	-0.185	0.949	0.0708	1.163
Opaque	6816	0.00667	0.299	61.74	0.232	0.814
MB	6816	-201.7	4.494	1646	2.538	25.33

### (5) Basic descriptive statistics of the main variables

Table 6 reports the number of samples, minimum, mean, maximum, median, and standard deviation for each variable. The mean of NCSKEW and DUVOL are -0.26 and -0.16, respectively, which are close to values reported by Xu et al. (2012) and Wang et al. (2015). The standard deviations of NCSKEW and DUVOL are 1.07 and 0.85, respectively, which means that there is a large difference in stock price crash risk in the study samples. The mean of Chairmen's age is 53; the minimum is 26 and the maximum is 79. The minimum educational background is 1, which is high school level and below, and the maximum is 5 (doctoral degree). The distribution of other variables is within a reasonable range.

## IV. Empirical analysis

### 1. Background characteristics of top executives and stock price crash risk

First, we test the relationship between background characteristics of top executives and stock price crash risk using formula (4). The results are reported in Table 7.

We find that the regression coefficient of age is negative at the 5% level for each test, which indicates that stock price crash risk is significantly reduced with an increase of the age of the Chairman. This

result may be related to the change in top managers' risk preference as age increases. The older top managers are, the stronger their risk consciousness and the more conservative their behavior. Therefore, they are inclined to make low-risk decisions (Carlsson and Karlsson, 1970; Vroom and Pahl, 1971; Jiang et al., 2009; Chi et al., 2014). Older top managers are more prudent in their business management activities. Top executives' age has been found to have a significant impact on the quality of internal control (Chi et al., 2014), accounting conservatism (Zhang et al., 2011), and investment behavior (Jiang et al., 2009). Meanwhile, there is a significant negative relationship among the quality of internal control, accounting conservatism, investment efficiency, and stock price crash risk (Zhou et al., 2015; Jiang and Xu, 2015; Kim and Zhang, 2016), which also provides a specific explanation regarding how top executives' background characteristics affect stock price crash risk.

We test the characteristics of top executives' education. In the independent test, we found that the degree regression coefficient is significantly positive at the 1% level. However, when we put all the characteristic variables (age, degree, and gender) into the model, we found that the impact of education on stock price crash risk is not significant. In addition, we found no significant results in the subsequent robustness test. We believe that the results of the

independent test of educational background are caused by the existence of a significant negative relationship between educational background and age in most samples, that is, the educational background of the Chairman is affected by age to some extent. The result of the positive correlation between educational background and stock price collapse risk is likely to be because the Chairmen's age has a negative significant impact on stock price collapse risk. Therefore, combined with the results and analysis of multiple tests, this study confirms that there is no significant

correlation between the Chairman's level of education and stock price crash risk.

In addition, we do not find a significant relationship between gender and stock price crash risk. This result is not consistent with the findings of Li and Liu (2012), which may be caused by the large differences between the two studies in terms of the definition of executives and the research period.

In conclusion, after controlling other factors, we test top executives' age, education, gender, and stock price crash risk. We found that there was a signifi-

**Table 7 Background characteristics of top executives and stock price crash risk**

	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Age	-0.005*** (-2.739)	-0.003** (-2.517)					-0.004** (-2.393)	-0.003** (-2.091)
Degree			0.024* (1.735)	0.021* (1.909)			0.015 (1.064)	0.015 (1.315)
Gender					0.009 (0.150)	-0.009 (-0.193)	0.018 (0.308)	-0.003 (-0.061)
Top1	-0.000 (-0.055)	0.001 (0.793)	-0.000 (-0.151)	0.000 (0.697)	-0.000 (-0.111)	0.000 (0.742)	-0.000 (-0.086)	0.000 (0.754)
Dual	0.059* (1.850)	0.038 (1.548)	0.066** (2.084)	0.043* (1.759)	0.067** (2.099)	0.043* (1.776)	0.059* (1.863)	0.038 (1.566)
MagHold	-0.003*** (-3.317)	-0.003*** (-4.244)	-0.003*** (-3.120)	-0.003*** (-4.028)	-0.003*** (-3.297)	-0.003*** (-4.227)	-0.003*** (-3.194)	-0.003*** (-4.093)
Lev	0.111*** (2.727)	0.053* (1.681)	0.117*** (2.880)	0.057* (1.817)	0.118*** (2.895)	0.057* (1.839)	0.111*** (2.727)	0.053* (1.689)
ROA	-0.027 (-0.203)	-0.052 (-0.504)	-0.034 (-0.256)	-0.056 (-0.544)	-0.040 (-0.296)	-0.062 (-0.599)	-0.024 (-0.176)	-0.050 (-0.483)
Yreturn	0.368*** (13.471)	0.293*** (13.954)	0.368*** (13.491)	0.293*** (13.977)	0.368*** (13.472)	0.293*** (13.955)	0.368*** (13.481)	0.293*** (13.967)
Sigma	-22.64*** (-30.192)	-20.93*** (-36.331)	-22.56*** (-30.112)	-20.88*** (-36.271)	-22.55*** (-30.082)	-20.87*** (-36.239)	-22.64*** (-30.190)	-20.93*** (-36.333)
Size	-0.057*** (-5.354)	-0.045*** (-5.493)	-0.062*** (-5.809)	-0.049*** (-5.945)	-0.060*** (-5.656)	-0.047*** (-5.771)	-0.059*** (-5.449)	-0.047*** (-5.620)
Indpt	0.125 (0.573)	-0.009 (-0.051)	0.133 (0.607)	-0.005 (-0.027)	0.141 (0.647)	0.003 (0.018)	0.121 (0.552)	-0.012 (-0.073)
Turnover	0.000 (0.016)	-0.003 (-0.305)	0.000 (0.020)	-0.003 (-0.303)	0.000 (0.029)	-0.003 (-0.294)	0.000 (0.013)	-0.003 (-0.310)
Opaque	0.000 (0.023)	-0.001 (-0.091)	0.002 (0.110)	0.000 (0.005)	0.001 (0.037)	-0.001 (-0.095)	0.001 (0.091)	-0.000 (-0.029)
MB	0.000 (0.527)	0.000 (0.355)	0.000 (0.560)	0.000 (0.380)	0.000 (0.592)	0.000 (0.414)	0.000 (0.514)	0.000 (0.338)
Year	Y	Y	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y	Y	Y
_cons	2.554*** (9.467)	2.277*** (10.983)	2.310*** (8.886)	2.100*** (10.512)	2.339*** (8.834)	2.139*** (10.514)	2.495*** (9.000)	2.237*** (10.504)
N	6816	6816	6816	6816	6816	6816	6816	6816
Adj-R <sup>2</sup>	0.1503	0.2087	0.1498	0.2084	0.1494	0.2080	0.1502	0.2087
F	37.536	55.471	37.375	55.367	37.268	55.229	35.423	52.348

Note: \*, \*\*and\*\*\* indicate significance at the levels of 10%, 5%, and 1%, respectively.

cant negative correlation between top executives' age and future stock price crash risk, but there is no evidence to indicate significant impact of education and gender on such risk. This result is consistent with the conclusion of Li et al.(2015) that there are significant differences in terms of age of top executives in listed companies, but there is a lack of obvious difference in education background.

## 2. Further analysis

Previous theoretical analysis has shown that internal managers strategically conceal bad news, which leads to the accumulation of negative information. Finally,

the centralized release of bad news leads to stock price crash, in which executives play an important role. In addition, information asymmetry and opaqueness "contribute to" stock price crash risk because it is very difficult for management to hide negative information in companies with high information transparency. On the contrary, in companies with a high degree of information asymmetry, company insiders have lots of private information about business activities and it is therefore easier for management to engage in rent-seeking behaviors and they are more likely to hide negative information (Wang et al., 2015). Therefore, in companies with low transparency

**Table 8 Further analysis: Information transparency**

	Lower Information transparency		Higher Information transparency	
	NCSKEW	DUVOL	NCSKEW	DUVOL
Age	-0.005** (-2.036)	-0.004* (-1.809)	-0.004 (-1.520)	-0.003 (-1.459)
Top1	-0.000 (-0.079)	0.000 (0.133)	-0.000 (-0.123)	0.001 (0.916)
Dual	0.061 (1.351)	0.031 (0.904)	0.042 (0.934)	0.033 (0.946)
MagHold	-0.004*** (-2.665)	-0.003*** (-3.029)	-0.003* (-1.955)	-0.003*** (-2.885)
Lev	0.076* (1.677)	0.031 (0.892)	0.229** (2.193)	0.129 (1.627)
ROA	0.012 (0.082)	0.021 (0.181)	-0.205 (-0.657)	-0.351 (-1.477)
Yreturn	0.385*** (9.428)	0.297*** (9.418)	0.361*** (9.815)	0.298*** (10.648)
Sigma	-22.417*** (-20.767)	-20.859*** (-24.976)	-23.069*** (-21.961)	-21.254*** (-26.542)
Size	-0.050*** (-3.263)	-0.034*** (-2.878)	-0.059*** (-3.524)	-0.052*** (-4.089)
Indpt	0.401 (1.269)	0.209 (0.855)	-0.145 (-0.476)	-0.202 (-0.871)
Turnover	-0.002 (-0.151)	-0.004 (-0.296)	0.002 (0.136)	-0.001 (-0.079)
Opaque	-0.015 (-0.968)	-0.013 (-1.044)	-0.019 (-0.070)	-0.211 (-1.015)
MB	0.000 (0.197)	0.000 (0.205)	0.001 (0.804)	0.000 (0.403)
Year	Y	Y	Y	Y
Industry	Y	Y	Y	Y
_cons	2.605*** (6.634)	2.158*** (7.103)	2.337*** (5.965)	2.297*** (7.691)
N	3388	3388	3428	3428
Adj-R <sup>2</sup>	0.1482	0.2025	0.1568	0.2214
F	19.420	27.875	20.313	30.535

Note: \*, \*\*and\*\*\* indicate significance at the levels of 10%, 5%, and 1%, respectively.

and a high degree of information asymmetry, the inhibiting effect of top executives' age on future stock price crash risk will be more significant, which is also tested in our study.

Following Hutton et al. (2009) and Pan et al. (2011), we add up the absolute value of controllable accruals in the first three periods to measure information transparency. Specifically, we estimate controllable accrued profits using the modified Jones model, which classifies this according to fiscal year and industry (Dechow et al., 1995). The information transparency is recorded as "Opaque." The larger the value for "Opaque," the lower the information transparency. Then, we divide all research samples into low and high information transparency groups based on whether values of "Opaque" of samples are higher than the median of fiscal years and industries.

The results are reported in Table 8. We can see that the regression coefficient of age is significantly negative in the group with low information transparency, while it is negative in the group with high information transparency. However, this regression coefficient is not significant. This result indicates that when the transparency of information is low, the age of the Chairman has a more significant effect on stock price collapse risk, which confirms the above analysis.

In order to ensure the reliability of the above conclusions, we conducted the following robustness tests.

(1) Change the method of measuring stock price crash risk. Further, referring to existing literature (Pan et al., 2011; Jiang and Xu, 2015; Luo and Du, 2014), we use the following indicators to measure crash risk: the dummy variables of stock price crash risk, the frequency of individual stock crash, the difference between the number of individual stock crash weeks and surge weeks, and the difference between the frequency of sharp individual stock price rises and falls. The research conclusion remains the same as the above results. Specifically, the dummy variable of stock price crash risk refers to whether a stock has had a crash week in at least one fiscal year. If stock experienced a crash week at least once in a fiscal year, the dummy variable of this observation is 1, otherwise 0. The frequency of individual stock crash

is equal to the number of crash weeks in a year divided by the number of trading weeks in a year; the frequency of individual stock crash is equal to the number of surge weeks in a year divided by the number of trading weeks in a year. The definition of crash week is in formula (5). The definition of inflation week is opposite to that of crash week, as shown in formula (6). If the specific weekly yield of a week meets this formula, it is defined as an inflation week.

$$W_{i,t} \geq Average(W_{i,t}) + 3.08\sigma_{i,t} \quad (6)$$

(2) To conduct the aforementioned tests, we use all A-share listed companies on the Shanghai Stock Exchange and Shenzhen Stock Exchange, including the growth enterprise market, as samples. Moreover, the results are basically unchanged.

(3) To eliminate the influence of extreme values on the results, the continuous variables in this study were winsorized at 1% and 99% percentiles. Then we carry out the aforementioned tests and the results remained stable.

## V. Analysis of impact mechanism

The results of previous tests show that stock price crash risk will be significantly inhibited with the increase of top executives' age, but the specific mechanism is not clear. Previous studies show that the older top executives are, the higher the quality of internal control (Chi et al., 2014), the better the accounting conservatism (Zhang et al., 2011), and the more cautious the investment behavior (Jiang et al., 2009). Moreover, there is a significant negative relationship among the internal control quality, accounting conservatism, investment efficiency, and stock price crash risk (Zhou et al., 2015; Jiang and Xu, 2015), but there is a lack of research on the relationship between background characteristics of top executives and stock price crash risk. Further testing and analysis is needed to prove how the age of top executives affects stock price crash risk and what factors are involved. Next, based on the existing research results, this study puts forward two hypotheses of "substitution effect" and "bridge role" from the aspects of accounting conservatism, internal control quality, and investment efficiency, which provide a possible explanation for

influence mechanism of top executives' age on stock price crash risk. The "substitution effect" refers to the role played by background characteristics of top executives and the effects of accounting conservatism, internal control quality, or investment efficiency are mutually substituted in the process of controlling stock price crash risk. Under this hypothesis, when the accounting conservatism of the company is low, the quality of internal control is poor, or the investment efficiency is low, we expect the inhibition effect of top executives' age increase exerts on stock price crash risk to be more significant. The "bridge role" refers to the background characteristics of top executives that affect stock price crash risk by acting on accounting conservatism, internal control quality, and investment efficiency. This hypothesis emphasizes the intermediate role of accounting conservatism, internal control, and investment behavior in the impact of top executives on stock price crash risk. Therefore, we expect that when the company has high accounting conservatism, good internal control quality, and high investment efficiency, the age of executives has a more significant effect on inhibiting stock price crash risk. The impact of top executives' age on stock price crash risk may have both a "substitution effect" and "bridge role." Further testing is necessary to provide evidence for which hypothesis is more suitable in enterprises.

Based on Han et al. (2014), we use the conservatism index method proposed by Khan and Watts (2009) to calculate the company's annual accounting conservatism score, and divide the samples high and low conservatism groups according to whether the score index is greater than the year and the industry median. Referring to Jiang et al. (2009), Zhang et al. (2011), Han et al. (2014) and Jiang and Xu (2015), we use Richardson's (2006) model to estimate the investment efficiency of enterprises (Inveff), and divide the samples into low and high investment efficiency groups according to whether the Inveff index is greater than the year and the industry median. For the internal control of enterprises, we use the internal control research data of the CSMAR database. We use whether there are defects in the internal control of the enterprise as an alternative indicator of the

quality of internal control. The samples are divided into low- and high-quality groups according to whether there are defects in the internal control. We carry out groups test from the perspectives of robustness, investment efficiency, and internal control quality. The results are reported in Table 9.

The regression results indicate that in the group with low accounting conservatism, the increase in top executives' age can significantly reduce stock price crash risk, while in the group with high accounting conservatism, the test results are not significant, which is consistent with the expectation of a "substitution effect." That is, the impact of managers' age and accounting conservatism on crash risk are substitutable to some extent. The test of investment efficiency reveals that in the group with high investment efficiency, the increase in top executives' age can significantly reduce stock price collapse risk, while in the group with low investment efficiency, the impact is not significant. The test results support the "bridge role" hypothesis. That is, from the perspective of investment behavior, the impact of top executives' age on stock price collapse risk may act as a critical path. With the increase of top executives' age, the managers' investment behavior may become more cautious (Jiang et al., 2009). The scale of enterprise investment may decrease, and negative information not reflected in the stock price brought by investment projects in a timely manner decreases (Jiang and Xu, 2015). Thus, the risk of price crash is reduced. The test of internal control quality shows that in the group without internal control defects and with high internal control quality, the increase of top executives' age can significantly reduce the risk of stock price collapse. However, the relationship between top executives' age and stock price collapse risk in the group with low internal control quality is not significant, which also conforms to the "bridge role" hypothesis; the older the top executives are, the stronger their risk awareness. They are more likely to choose stricter risk control measures in the process of internal control implementation and the quality of the company's internal control will be higher (Chi et al., 2014). Accordingly, the risk of the company's internal operation will be lower (Ye et al., 2015), and the risk of the company's

**Table 9 Test of mechanism of impact of top executives' age and crash risk**

Groups test by accounting conservatism				
	Lower group accounting conservatism		Higher groupaccounting conservatism	
	NCSKEW	DUVOL	NCSKEW	DUVOL
Age	-0.005** (-2.211)	-0.005*** (-2.815)	-0.004 (-1.464)	-0.001 (-0.496)
Controls	Y	Y	Y	Y
N	3478	3478	3338	3338
Adj-R <sup>2</sup>	0.1606	0.2204	0.1493	0.2103
F	21.160	30.786	19.302	28.766
Groups test by investment efficiency				
	Lower group accounting conservatism		Higher groupaccounting conservatism	
	NCSKEW	DUVOL	NCSKEW	DUVOL
Age	-0.003 (-1.406)	-0.002 (-1.131)	-0.006** (-2.256)	-0.005** (-2.192)
Controls	Y	Y	Y	Y
N	3492	3492	3324	3324
Adj-R <sup>2</sup>	0.1739	0.2234	0.1345	0.2022
F	23.965	32.381	16.650	26.516
Groups test by quality of internal control				
	Group with internal control defects		Group without internal control defect	
	NCSKEW	DUVOL	NCSKEW	DUVOL
Age	0.003 (0.608)	0.002 (0.516)	-0.006** (-2.313)	-0.004* (-1.950)
Controls	Y	Y	Y	Y
N	1275	1275	3422	3422
Adj-R <sup>2</sup>	0.1348	0.1962	0.1611	0.2334
F	7.614	11.364	22.187	34.592

Note: \*, \*\*and\*\*\* indicate significance at the levels of 10%, 5%, and 1%, respectively.

stock price collapse in the market will also be lower.

In conclusion, the above tests show that the impact of top executives' age on stock price crash risk can be reflected in the investment behavior and internal control activities of enterprises. In addition, the substitution of top executives' age and accounting conservatism also explains the negative correlation between age and stock price crash risk. The above findings provide evidence for the impact of top executives' age on stock price crash risk from the perspective of specific corporate activities, and further confirm the reasonability of the theoretical analysis.

Regression results of control variables are not shown in paper due to limitations of space.

## VI. Conclusion and implications

We took A-share listed companies in the Shanghai Stock Exchange and Shenzhen Stock Exchange from

2011 to 2015 as the research object, and systematically tested the impact of top executives' background characteristics on stock price crash risk from the aspects of age, education, and gender. We find that there is a significant negative correlation between top executives' age and stock price crash risk. With the increase of top executives' age, stock price crash risk is significantly reduced, but education and gender were not found to have a significant impact on stock price crash risk. In addition, in the further test, in the companies with low transparency and high degree of information asymmetry, the increase of top executives' age has a more significant effect on stock price crash risk. The test of the impact mechanism reveals that the investment behavior and internal control activities have a "transfer effect" on impact of top executives' age on stock price crash risk. In addition, the "substitution effect" between the increase of age and accounting conservatism also provides a specific



explanation for the mechanism of top executives' age affecting stock price crash risk.

This research has important theoretical and practical significance. First, this study confirms the significant impact of the background characteristics of top executives on stock price crash risk, extends the research on collapse risk to the characteristics of managers, and expands and deepens the research on the factors influencing stock price crash risk from the perspective of the internal managers of the company. Second, the results reveal that the background characteristics of managers are important factors affecting business activities and market performance. In the field of company research, we should pay attention to the impact of manager heterogeneity, observe and understand the enterprise behavior from the perspective of "people," and improve the level of internal governance.

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