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Article

Large shareholders' tunneling and stock price crash risk

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Large shareholders' tunneling and stock price crash risk

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ABSTRACT

Tunnelling by large shareholders is a problem representative of ownership concentration. Large shareholders may interfere with a firm's information disclosure to support their tunnelling behaviour, causing a high stock price crash risk. Using listed companies in China from 2001 to 2019 as a sample, we find that more severe tunnelling can lead to a higher risk of stock price crashes. Moreover, we investigate potential factors such as internal control, operational performance, and split-share reforms, that may affect the aforementioned relationship. A high level of internal control and good operational performance will weaken the relationship, and the relationship is stronger before split-share reforms. The findings of this study contribute to a better understanding of the relationship given China's institutional background and better investor protection.

KEYWORDS

Tunnelling; stock price crash risk; internal control; operational performance; Split-share reforms

1. Introduction

An important function of the capital market is to collect and redistribute idle funds held by investors to improve market efficiency. As more investors are attracted, it is likely that more funds will be gathered, which will enable the development of the capital market and even the overall economy. To achieve this goal, both high returns and appropriate control are required. In China, the stock price shock caused by the global financial crisis in 2008 and the 'stock disaster' in 2015 deterred investors from entering the stock market, and adversely affected the development of the stock market. Therefore, it is prudent to examine the risk of a stock price crash from theoretical and practical perspectives to seek countermeasures to curb this risk.

To date, researchers have extensively explored stock price crash risk (Chen et al., 2001; Hutton et al., 2009; Kim et al., 2011a, 2011b; Piotroski et al., 2015; Kim & Zhang, 2016; Chen & Zhang, 2009; Xu et al., 2012; Quan et al., 2015; Chu & Fang, 2016; You et al., 2022). However, compared with research in other fields, these studies are still in the early stages. Taking large shareholders' tunnelling as a starting point, this study explores the mechanism of stock price crash risk given China's institutional background. The study examines

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whether large shareholder tunnelling causes a future stock price crash risk. Furthermore, the study analyzes whether the above relationship is different under different levels of internal control, operational performance, and before and after the split-share reforms. These questions are empirically tested using data on China's A-share listed companies from 2001 to 2019. The results show that the more serious the tunnelling behaviour, the greater the stock price crash risk, and that a high level of internal control and good operational performance can ease this effect. In addition, the effect was more obvious before the split-share reforms. The study findings indicate the adverse impact of large shareholders' tunnelling on the stock market and highlight the positive role of internal control and split-share reforms in mitigating stock price crash risk.

The purpose and significance of the study are as follows. First, it is necessary to consider the stock price crash risk in China. The different institutional backgrounds result in the factors leading to stock price crash risk differing between China and Western countries. The ownership is relatively diluted in Western countries. Consequently, conflicts of interest between management and shareholders are often seen as the main problem in corporate governance, which is also a factor affecting the stock price crash risk (Kim et al., 2011a); However, in China, ownership is quite concentrated, so the conflict of interests between large shareholders and minority shareholders is the leading problem. In this case, the behaviour of large shareholders, viz., tunnelling, may be responsible for the stock price crash risk. Thus, large shareholder tunnelling becomes a practical starting point for research on stock price crash risk in China. Second, the differentiated and developing institutional environment in China provides an ideal scenario for deepening the research on stock price crash risk. This is because, statically, the legal environment, financial development, and corporate governance in China, where transitional and emerging economies occur, are relatively weak (Allen et al., 2005), and the stock market fluctuates relatively violently. Therefore, research on stock price crash risk is extremely important.[1] Dynamically, China has experienced split-share reforms during which the legal environment, financial development, and corporate governance developed. Such a weak and dynamic environment not only provides enlightenment for the development of China's capital market but also makes it possible to compare different institutional environments and changes in the institutional environment. The paper may provide more detailed support for the transnational discovery of K.H. Bae et al. (2006). Finally, in further exploration considering different conditions (internal control level, operational performance, and the event of split-share reforms), with the major shareholders' ability or motivation to hide bad news, the heterogeneous impact of large shareholders' tunnelling on the stock price crash risk is illustrated. This enhances the logic and enriches the content of the paper.[2]

The remainder of this paper is organised as follows. Section 2 presents the literature review, theoretical analysis, and hypothesis development. Section 3 presents the research design and descriptive statistics. Section 4 presents the empirical results and analysis, and Section 5 concludes the paper.

[1]The Shanghai stock index rose as high as 97% in 2007 and fell 65% in 2008, ranking the first in the global stock market. The A-share market fell by 35% in the 18 trading days from June 12 to 9 July 2015. Within a few days, the so-called phenomenon of '1000 shares falling limit, 1000 shares rising limit and 1000 shares suspension' was experienced.

[2]In our study of the relationship between large shareholders' tunnelling and the stock price crash risk, the large shareholders' ability to hide bad news is shown in the comparison between companies with high internal controls and low internal controls, and the large shareholders' motivation to hide bad news is shown in the comparison between companies with good operational performance and bad operational performance.

2. Literature review, theoretical analysis, and hypothesis development

2.1. Literature review

Stock price crash risk is an emerging research topic in the finance field. Chen et al. (2001) conducted an early empirical study using a large sample size. They attempted to predict a company's future stock price crash risk based on the characteristics of its stock trading. They found that stocks with higher trading volumes and higher returns tend to have a higher risk of subsequent crashes. They proposed two ways of measuring stock price crash risk for the first time, which have been widely used in subsequent research. Following this, Jin and Myers (2006) pioneered the explanation of the causes of stock price crash risk from the perspective of conflicts between shareholders and managers. They pointed out that shareholders or managers, for self-interest, would hide bad news, thus leading to the accumulation of risks. Once the accumulated bad news exceeds a critical value, it is released in a concentrated manner, causing stock prices to crash. K. H. Bae et al. (2006) believed that compared with developed capital markets, listed companies in emerging capital markets have lower governance levels, so they were more likely to have stock price crash events, and their cross-country research results support this inference. Hutton et al. (2009) focused more directly on the relationship between the degree of a company's information opacity and the stock price crash risk, using the cumulative earnings management margin as a substitution variable for the degree of information opacity. They found that the higher the level of information opacity, the higher is the risk of a company's future share price crash. Kim et al. (2011a) compared the impact of chief financial officers (CFOs) and chief executive officers (CEOs) on the stock price crash risk, and the results showed that CFOs have a more significant impact on the stock price crash risk. The greater the sensitivity of the CFO's stock options to the stock price, the higher the company's future stock price crash risk, whereas the CEO's influence is relatively small. Kim et al. (2011b) believed that large-scale tax evasion by companies is often accompanied by information concealment. They found that companies with a higher degree of tax evasion had a higher risk of future stock price crash. Kim and Zhang (2016) used accounting conservatism to explain stock price crash risk. They found that the level of accounting conservatism has a predictive effect on future stock price crash risk. The higher the accounting conservatism level, the lower is the stock price crash risk.

Domestic large-sample empirical research on stock price crash risk was first conducted by Chen and Zhang (2009). Research from 1997 to 2008 showed that the more the heterogeneous beliefs of corporate investors, the greater the risk of future stock price crashes. Li et al. (2011) posited that the specificity of relational assets increases the market's interpretation cost of transaction behaviour. Therefore, stocks with more relation-based transactions exhibit higher stock price synchronicity and crash risk. Subsequent research on stock price crash risk has further expanded the perspective of a company's ownership structure, board structure, management, analysts, institutional investors, local governments, and so on (Liang et al., 2020; X. R. Li & Liu, 2012; Wang et al., 2015; Xu et al., 2012; You et al., 2022). Wang et al. (2015) found that with an increase in the shareholding ratio of a company's largest shareholder, the future stock price crash risk decreases significantly, supporting the 'supervision effect' of the large shareholder. Liang

et al. (2020) showed that board faultlines could increase the behaviour of managers' hiding bad news and tax avoidance, thereby increasing the risk of stock price crash. Li and Liu (2012) found that the gender characteristics of CEOs would affect the stock price crash risk, and that female CEOs could significantly reduce the stock price crash risk.

Chen et al. (2018) showed that the administrative hierarchy mechanism of state-owned enterprises in China suppresses stock price crash risk. Yang et al. (2020) found that transactional institutional investors would increase the company's future stock price crash risk, while stable institutional investors would reduce it. You et al. (2022) showed that when the government has an aggressive governance style, the stock price crash risk of local companies would be higher. In addition, Quan et al. (2015) revealed that corporate social responsibility has a significant impact on a company's stock price crash risk. Chu and Fang (2016) found that the newly implemented margin financing and securities lending arrangements worsened the stock price crash risk in China.

There is considerable research on capital appropriation and 'tunneling' than that on the stock price crash risk in China. Most studies show that tunnelling is detrimental to company value, especially for minority shareholders (K. Bae et al., 2002; Bertrand et al., 2002; Johnson et al., 2000). As China is a typical sample that has concentrated shareholding companies and weak investor protection (Allen et al., 2005), the problem of large shareholders' tunnelling is more serious, and the related research, insightful. Studies have found that tunnelling is affected by the nature of the property rights of listed companies (Jian & Wong, 2010; Jiang et al., 2010), separation of control rights and cash flow rights (Jiang et al., 2010), shareholding ratio of the largest shareholder (Li et al., 2004), corporate governance level (Gao & Zhang, 2009), supervision of independent directors (Ye et al., 2007), and the degree of regional marketisation (Jian & Wong, 2010) among others. Tunnelling also leads to a series of consequences, such as poor performance (Jiang et al., 2010), greater possibility of being issued qualified audit opinions (Jiang et al., 2010), lower investment efficiency (Liu & Lu, 2007), higher earnings management levels (Gao & Zhang, 2009; Lei & Liu, 2007), lower management compensation and lower sensitivity of performance-based compensation (Wang & Xiao, 2011), higher executive compensation stickiness (Zhang et al., 2019), and higher frequency of management replacement (Liang & Chen, 2015).

Although there is ample research on tunnelling by large shareholders, few studies have directly explored its impact on the stock price crash risk. In addition, there are many ideal conditions to conduct this research in China, such as the institutional background of shareholding concentration and split-share reforms and easy access to tunnelling data.

2.2. Theoretical analysis and hypothesis development

Research based on the theory of information asymmetry shows that stock price crash risk is caused by a company's shareholders or executives failing to disclose 'bad news' in a timely manner due to their self-interest, resulting in insufficient information for investors. With the gradual accumulation of 'bad news', after reaching a certain threshold, the cost of continuing to hide 'bad news' is too high. At one point, all 'bad news' will be released, causing a stock price crash event (Jin & Myers,

2006; Kim et al., 2011a, 2011b). Following this logic, this study believes that a company's future stock price crash risk will increase with the intensification of the tunnelling by large shareholders.

At first, tunnelling will directly decrease a company's information disclosure quality and increase its future stock price crash risk. On the one hand, large shareholders have an incentive to delay and hide the disclosure of the 'bad news' by tunnelling. Tunnelling is essentially the transfer of resources from minority to large shareholders. Therefore, it is 'good news' for large shareholders or their other companies, but 'bad news' for minority shareholders. If the large shareholders keep the funds for a long time, it will be equivalent to directly reducing the rights and interests of the minority shareholders, and may lead to a company loss (Xue & Wang, 2004). Even if the large shareholders keep the funds for several years and return them afterwards, it will still indirectly damage the rights and interests of the minority shareholders. Furthermore, tunnelling is often of a no- or low-interest nature, which causes the company to lose the funding from capital borrowing. In addition, large shareholders have an incentive to delay and hide the disclosure of other 'bad news' about the company. Tunnelling is for large shareholders' own profit. Naturally, they do not want to arouse vigilance from regulators, intermediaries, and minority shareholders. If the company's financial situation deteriorates sharply, the possibility of their tunnelling behaviour being exposed and investigated will increase. Jiang et al. (2010) showed that the more serious the tunnelling, the more likely the company will be given special treatment (ST) and be issued a modified audit opinion. Therefore, when tunnelling deteriorates a company's financial situation, other 'bad news' (such as cancellation of large orders and potential legal proceedings) are expected to be delayed or hidden from disclosure. Lei and Liu (2007) and Gao and Zhang (2009) showed that the more serious the tunnelling, the higher the level of earnings management. This is because, when using earnings management to manipulate profits, there is no incentive to disclose 'bad news' in a timely manner. If it must be disclosed, the financial impact of the 'bad news' will also need to be masked through earnings management, which is costlier and not necessarily achievable. Therefore, irrespective of the tunnelling information itself or other related 'bad news', tunnelling will deteriorate a company's information disclosure quality, thereby increasing its future stock price crash risk.

Second, tunnelling may also indirectly reduce a company's information disclosure quality by affecting its business activities and increasing its future stock price crash risk. Severe tunnelling behaviour will deteriorate the company's liquidity and reduce the financial resources to improve operations. The resultant deterioration of the financial situation will trigger the company to take measures such as laying off staff, selling assets, and reducing investment (Ofek, 1993; Opler & Titman, 1994). In China, where credit resources are scarce, tunnelling will greatly limit the company's future development, bringing it disadvantage in competition with its peers. In addition, Wang and Xiao (2011) showed that the more serious the tunnelling, the lower the level and sensitivity of management's performance-based compensation, while Liang and Chen (2015) found that the more serious the tunnelling behaviour, the more frequent the management change. The series of impacts will undoubtedly reduce the value of the company and damage the rights and interests of the minority shareholders. Once such information is

disclosed, it will inevitably lead to verification and strong opposition from minority shareholders.[3] Thus, from the perspective of the impact on business activities, tunnelling by large shareholders will also lead to the deterioration of the company's information disclosure and increase its future stock price crash risk.

In general, tunnelling can directly or indirectly increase a company's incentive to delay and hide 'bad news' disclosure.[4] However, this is unsustainable, and once the threshold is reached, it may lead to a stock price crash. Thus, the more serious the tunnelling behaviour, the greater the company's future stock price crash risk. Accordingly, the research hypothesis of this study is proposed as follows:

Hypothesis: The more serious the tunnelling behaviour of large shareholders, the greater the company's future stock price crash risk.

3. Research design and descriptive statistics

3.1. Model design

Referring to Kim et al. (2011a, 2011b), Xu et al. (2012), and Quan et al. (2015), we construct the following multiple regression model (1) to test the research hypothesis.

$$Ncskew_t(Duvol_t) = \alpha_0 + \alpha_1 Tun_{t-1} + \sum Control + \sum Year + \sum Industry + \varepsilon_t \quad (1)$$

The main variables are defined as follows:

3.1.1. Explained variable: stock price crash risk

At present, there are three principal approaches to measure stock price crash risk in China and abroad. (J. Chen et al., 2001; Hutton et al., 2009; Kim et al., 2011a; X. R. Li & Liu, 2012; Wang et al., 2015; Xu et al., 2012). In consideration of space and consistent with Xu et al. (2012) and Quan et al. (2015), the regression results of the first two methods are presented in the body of the paper, and the results of the third method are briefly explained in the robustness test.

To compute stock price crash risk, the priority is to compute the unique weekly rate of return of stock j in week t ($W_{j,t}$). $W_{j,t}$ = Log (1+ $\varepsilon_{j,t}$), and $\varepsilon_{j,t}$ is the regression residual of model (2). In model (2), $r_{j,t}$ denotes the rate of return of stock j in week t, *and* $r_{m,t}$ denotes the rate of return of the overall stock market in week t. Additionally, we add the weekly rate of return of the overall stock markets lagged by two periods and two periods ahead to control for the effect of asynchronous stock trading. Consistent with Kim et al. (2011b), t must be greater than or equal to 26. Model (2) is as follows:

$$r_{j,t} = a + b_{1j}r_{m,t-2} + b_{2j}r_{m,t-1} + b_{3j}r_{m,t} + b_{4j}r_{m,t+1} + b_{5j}r_{m,t+2} + \varepsilon_{j,t} \quad (2)$$

[3]Although the information of tunnelling will appear in the company's annual report, such information may not be disclosed as soon as it occurs, and the disclosure of information may not be complete, such as including information on the object of occupation, relationship between the two parties and actual use. It takes some time for this information to be delivered to the investors, and the investors may interpret it differently.

[4]Although both direct information impact and indirect operating impact exist, the occurrence of the indirect impact is more affected by other corporate governance and financial forces, so it is believed that the direct impact of tunnelling on the stock price crash risk may be dominant.

Next, we examine the stock price crash risk. The first approach to estimating crash risk (*Ncskew*) is given by Equation (3):

$$Ncskew_{j,t} = -[n(n-1)^{3/2}\sum W^3{}_{j,t}]/[(n-1)(n-2)(\sum W^2{}_{j,t})^{3/2}] \quad (3)$$

where n denotes the number of weeks stock j *is* traded per year.

The second approach to estimating crash risk (*Duvol*) is given by Equation (4):

$$Duvol_{j,t} = Log\left\{\left[(n_u-1)\sum\nolimits_d W_{j,t}2\right]/\left[(n_d-1)\sum\nolimits_u W_{j,t}2\right]\right\} \quad (4)$$

where n_u and n_d denote the number of weeks over which stock j has risen and fallen in a year, respectively; $\sum_d W_{j,t}{}^2$ equals the square sum of the unique weekly rate of return of stock j in weeks when it fell, and $\sum_u W_{j,t}{}^2$ is the square sum of the unique weekly rate of return of stock j in weeks when it rose.

If the management does not hide the 'bad news', the probability and magnitude of rise or fall in $W_{j,t}$ should be approximately equal. However, if the management discloses the 'good news' promptly and hides the 'bad news' until it accumulates to the extent that it cannot be hidden at all, then the probability of an increase in $W_{j,t}$ will be greater than that of a fall in $W_{j,t}$. However, the very concentrated disclosure of 'bad news' will lead to a decrease in $W_{j,t}$ far outweighing the increase in $W_{j,t}$. Therefore, the larger the values of *Ncskew* and *Duvol*, the greater the skewness of the distribution of stock return and the more the left deviation, which implies an increased stock price crash risk.

3.1.2. Explanatory variables: tunnelling of large shareholders

Jiang et al. (2010) and Wang and Xiao (2011) believed that other receivables are the principal instrument for large shareholders to achieve their tunnelling ambitions; therefore, this study employs the other receivables to total assets ratio (*Tun*) to estimate the tunnelling of large shareholders. Variable *Tun* takes the value of the previous period in the regression model.

3.1.3. Control variables

Following previous research (Hutton et al., 2009; Kim et al., 2011a, 2011b; Xu et al., 2012), we choose several control variables: *Dturn* refers to the mean of a stock's weekly return rate, *Ncskew* refers to the skewness of the stock's unique weekly return rate, *Sigma* refers to the standard deviation of the stock's weekly return rate, *and Wret* is the annual mean of the unique stock weekly return rate. *Size* is defined as the natural logarithm of total assets; *MB* is defined as the market-to-book ratio; *Lev* is defined as the total liabilities to total assets ratio; *Roa* is defined as the net profit to total assets ratio at the beginning of the year; *Accm* measures the degree of information opacity, which is defined as the sum of the absolute value of earnings management in the previous three years.[5] Following Wang et al. (2015), we add *Sh*, the shareholding ratio of the largest shareholder.

In addition, other governance characteristics of the company are also controlled for. *Sh2_5* denotes the shareholding ratio of the second to fifth largest shareholders; *Msh1* denotes the sum of the shareholding ratios of the board members; *Msh2* denotes the sum of the shareholding ratios of the management members; and *Dual is* a dummy variable that takes the value of 1 if the chairman of the board and CEO are the same person, and 0

[5]Calculated according to the adjusted Jones model, refer to Dechow et al. (1995).

otherwise. *Big4* is also a dummy variable that takes the value of 1 if the company hires four major audit firms to audit, and 0 otherwise. *Index* is an indicator of the marketisation of a company's location. All the variables above take the value of the previous period in the regression model.

If the research hypothesis holds, the coefficient of Tun_{t-1}, which is α_1 should be significantly positive.

3.2. Sample selection

Our initial sample includes Chinese A-share listed companies from 1999 to 2019, with a total of 42,236 observations. To ensure the stability and comparability of the conclusion, we further narrow the number of observations contained in the dataset. We exclude 5,891 observations on companies that were listed for less than two years, 1,370 observations of financial companies, and 11,006 observations with missing values for *Accm*. Finally, 23,969 observations over the period 2001–2009 are included in the empirical analysis. The data on split-share reforms are sourced from WIND, and the remaining data are collected from the CSMAR and CCER databases.

3.3. Descriptive statistics

Table 1 presents the descriptive statistics of the main variables used in this study.[6] Although a series of regulations have been issued in recent years for the governance of large shareholders' tunnelling,[7] the results show that the tunnelling problem is still severe.

Table 1. Descriptive statistics of main variables.

Variable	Obs	Mean	Lower quartile	Median	Upper quartile	SD
Ncskew	23,969	−0.358	−0.770	−0.337	0.063	0.743
Duvol	23,969	−0.252	−0.578	−0.267	0.061	0.495
Tun	23,969	0.030	0.004	0.011	0.030	0.052
Dturn	23,969	0.096	0.042	0.075	0.133	0.069
$Ncskew_{t-1}$	23,969	−0.338	−0.745	−0.321	0.080	0.748
Sigma	23,969	0.045	0.032	0.042	0.054	0.018
Wret	23,969	−0.001	−0.001	−0.001	−0.001	0.001
Size	23,969	22.042	21.115	21.884	22.801	1.323
MB	23,969	3.734	1.662	2.604	4.276	3.938
Lev	23,969	0.493	0.347	0.501	0.642	0.198
Roa	23,969	0.044	0.009	0.035	0.074	0.077
Accm	23,969	0.192	0.095	0.154	0.246	0.139
Sh	23,969	0.357	0.234	0.333	0.470	0.157
Sh2_5	23,969	0.154	0.060	0.132	0.230	0.112
Msh1	23,969	0.039	0.000	0.000	0.001	0.146
Msh2	23,969	0.020	0.000	0.000	0.000	0.120
Dual	23,969	0.148	0.000	0.000	0.000	0.355
Big4	23,969	0.070	0.000	0.000	0.000	0.255
Index	23,969	8.631	7.230	8.930	10.420	2.167

[6]The unreported Pearson correlation table reveals that the correlation coefficient of the two measurement of stock price crash risk ($Ncskew_t$,$Duvol_t$) is 0.88, indicating that the two approaches are consistent. The correlation coefficient between stock price crash risk ($Ncskew_t$,$Duvol_t$) and tunnelling (Tun_{t-1}) is positive and significant.

[7]In 2003, the China Securities Regulatory Commission issued the 'Notice on Several Issues Concerning Regulating Fund Exchanges between Listed Companies and Related Parties and Listed Companies' External Guarantees' to regulate the issue of tunnelling by large shareholders.

The mean and upper quartiles of Tun_{t-1} are both 3.0%, which indicates that, large shareholders tunnel a huge amount of money in some companies. In the full sample, the average market-to-book ratio is 3.734, the average financial leverage is 49.93%, and the average shareholding ratio of the largest shareholder is 35.7%. The descriptive statistics of the other variables are consistent with those reported in previous research.

4. Empirical results and analysis

4.1. Tunnelling and stock price crash risk

To test this hypothesis, we conduct an OLS regression on Model (1) and control for the fixed effects of industry and year. The regressions are clustered at the company level and robust *t*-values are reported. Table 2 presents the results of the main regression. The explained variable of columns (1) and (3) is $Ncskew_t$, and that of columns (2) and (4) is $Duvol_t$. Columns (1) and (2) report the regression results that include only control variables. The results are as follows: The coefficient of $Ncskew_{t-1}$,$Sigma_{t-1}$,MB_{t-1} is significantly positive, consistent with Kim et al. (2011a, 2011b); the coefficient of $Dturn_{t-1}$ is significantly negative, consistent with Li et al. (2011); the coefficient of Sh_{t-1} is significantly negative,[8] consistent with Wang et al. (2015). The explanatory power of the model is similar to those of Kim et al. (2011b) and Xu et al. (2012). Columns (3) and (4) report the regression results with Tun_{t-1}. The coefficient of Tun_{t-1} is positive and statistically significant at the 1% level. The results show that based on the consideration of other variables, as tunnelling becomes more serious, the company is at a greater risk of a stock price crash in the future, which supports the hypothesis.[9] It is also noteworthy that $Accm_{t-1}$ has no significant effect, consistent with Xu et al. (2012). This indicates that the estimation of information transparency based on the earnings management range cannot fully explain the stock price crash risk; the extent of tunnelling provides incremental information for predicting a crash.[10] The results in Table 2 support our hypothesis.

4.2. Alternative hypothesis testing: tunnelling, liquidity shortage, and stock price crash risk

According to the theory of information asymmetry, stock price crash risk originates from conflicts between shareholders and managers under information asymmetry. However, recent studies believe that not only information asymmetry but also a liquidity shortage

[8]The coefficient of Roa_{t-1} is positive. We consult relevant domestic studies and find that the coefficient of Roa_{t-1} in previous research has both negative and positive correlation. If we exclude Roa_{t-1} from the model, the result remains the same.

[9]This paper finds that the shareholding ratio of the largest shareholder (Sh_{t-1}) is significantly negative, while tunnelling (Tun_{t-1}) is significantly positive. These two are not contradictory. Wang et al. (2015) suggest that the increase of the shareholding ratio of large shareholders will tighten the supervision of the management, reduce the motivation of tunnelling, and improve tunnelling ability. It can be found that after controlling tunnelling, the coefficient of Sh_{t-1} is significantly negative, which means after removing tunnelling (besides capital occupation, there are other ways of tunnelling), the pure supervision can decrease stock price crash risk.

[10]Whether $Ncskew_{t-1}$,$Sigma_{t-1}$,$Wret_{t-1}$ are controlled or not, $Accm_{t-1}$ has no significant effect, and the coefficient of Tun_{t-1} is always positive and statistically significant at 1% level. So it is resonable to infer that in China, tunnelling may be a more fundamental explanation of stock price crash risk. In western countries, the conflict between shareholders and management is the dominant agency problem, and a typical manifestation of the opportunistic motivation of management is earnings management. However, in China, the reasons of information opacity are more diverse, including the tunnelling behaviour of large shareholders and the opportunistic behaviour of the management. It is likely that a single $Accm_{t-1}$ cannot measure the company's transparency comprehensively.

Table 2. Tunnelling and stock price crash risk.

	(1)	(2)	(3)	(4)
Dep. Var =	$Ncskew_t$	$Duvol_t$	$Ncskew_t$	$Duvol_t$
Tun_{t-1}			**0.287*** **	**0.224*** **
			(2.66)	**(3.02)**
$Dturn_{t-1}$	−0.514***	−0.303***	−0.503***	−0.295***
	(−4.80)	(−4.20)	(−4.70)	(−4.08)
$Ncskew_{t-1}$	0.034***	0.025***	0.034***	0.025***
	(5.16)	(5.90)	(5.08)	(5.81)
$Sigma_{t-1}$	3.190**	1.152	3.154**	1.125
	(2.57)	(1.43)	(2.54)	(1.40)
$Wret_{t-1}$	37.709*	13.406	37.416*	13.177
	(1.77)	(0.97)	(1.75)	(0.95)
$Size_{t-1}$	0.030***	0.019***	0.032***	0.020***
	(5.27)	(4.98)	(5.51)	(5.27)
MB_{t-1}	0.017***	0.011***	0.016***	0.011***
	(10.38)	(10.10)	(10.15)	(9.86)
Lev_{t-1}	−0.052	−0.028	−0.061*	−0.035
	(−1.60)	(−1.31)	(−1.87)	(−1.62)
Roa_{t-1}	0.358***	0.225***	0.388***	0.249***
	(5.02)	(4.69)	(5.39)	(5.14)
$Accm_{t-1}$	0.084**	0.049*	0.077*	0.043*
	(2.10)	(1.89)	(1.90)	(1.65)
Sh_{t-1}	−0.106***	−0.081***	−0.102***	−0.077***
	(−2.82)	(−3.19)	(−2.71)	(−3.06)
$Sh2_5_{t-1}$	0.109**	0.067*	0.106**	0.065*
	(2.12)	(1.96)	(2.08)	(1.91)
$Msh1_{t-1}$	0.177**	0.137***	0.178**	0.138***
	(2.28)	(2.72)	(2.29)	(2.74)
$Msh2_{t-1}$	−0.162*	−0.123**	−0.162*	−0.123**
	(−1.89)	(−2.20)	(−1.89)	(−2.19)
$Dual_{t-1}$	0.050***	0.034***	0.050***	0.034***
	(3.30)	(3.38)	(3.29)	(3.37)
$Big4_{t-1}$	−0.009	−0.005	−0.008	−0.005
	(−0.44)	(−0.40)	(−0.42)	(−0.39)
$Index_{t-1}$	−0.006**	−0.004**	−0.006**	−0.003**
	(−2.29)	(−2.19)	(−2.11)	(−1.98)
Constant	−1.040***	−0.649***	−1.084***	−0.684***
	(−8.02)	(−7.58)	(−8.28)	(−7.88)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs#	23,969	23,969	23,969	23,969
Adj-R^2	0.041	0.048	0.042	0.049
F	24.17	27.15	23.67	26.59

Note: ***, ** and * mean significant at the level of 1%, 5% and 10% (two-tailed) respectively, the same below.

leads to a stock price crash risk. Yuan (2005) and Huang and Wang (2009) theoretically discussed the relationship between a liquidity shortage and stock price crash risk, while Dai and Yue (2015) and Gu et al. (2015) provided empirical evidence in the Chinese context. Gu et al. (2015) found that a monetary deflation policy at the macro level and redemption pressure of open funds at the micro level would lead to a higher stock price crash risk. They pointed out that an excessive distribution of cash dividends would reduce the cash resources available to a company and was an easy way to promote a centralised release of accumulated bad news, which is more likely to lead to a stock price crash risk. Jiang et al. (2010) and other studies believe that tunnelling would reduce the cash resources available to a company and reduce its liquidity. Therefore, is reduced liquidity an intermediate channel of tunnelling affecting the stock price crash risk?

To test this alternative hypothesis, following Dai and Yue (2015), we control for the state of the monetary policy and define the variable *Mp*. *Mp* is a dummy variable for monetary deflation policy. If the years are 2004, 2006, 2010, 2011, 2017 and 2018, *Mp* equals 1, and 0 otherwise.[11] Following Gu et al. (2015), we control for the cash dividend per share and define the variable *Div*. Based on Model (1), we add the monetary policy status (Mp_t) and cash dividend per share (Div_{t-1}) to the regression analysis.[12] Table 3 presents the results of the main regression. The explained variable in column (1) is $Ncskew_t$, and the explanatory variable in column (2) is $Duvol_t$. The coefficient of Mp_t is significantly positive at the 1% level. This means that when the monetary policy is deflationary, a company's future stock price crash risk is higher. The coefficient of Div_{t-1} is significantly positive at the 1% level. This means that the more cash dividends a company pays, the higher future stock price crash risk it faces. These results are consistent with Dai and Yue (2015) and Gu et al. (2015), supporting that liquidity is a driver of the stock price crash risk. After controlling for the above variables, the coefficient of Tun_{t-1} is significantly positive at the 1% level. Furthermore, columns (3) and (4) add two control variables related to liquidity at the company level: the cash holding level (*Cash*) and current ratio (*Rcurrent*). Of these, *Cash* is measured as the proportion of cash held by the company at the end of the year to total assets; *Rcurrent* is measured as the proportion of current assets of the company at the end of the year to current liabilities. When these two control variables are further increased, we observe that the sign and significance of Tun_{t-1} coefficient remain unchanged. The results in Table 3 show that, considering the liquidity inside and outside a company, the previous findings on tunnelling and stock price crash risk still hold true.

4.3. Further exploration

4.3.1. Tunnelling, internal control and stock price crash risk

The previous analysis points out that large shareholders have incentives to delay and hide the disclosure of a company's direct and indirect 'bad news'. However, whether this motivation can be truly realised is limited by many factors such as a company's internal control level. Doyle et al. (2007), and Fang and Jin (2011) found that the higher a company's internal control level, the higher the quality of information disclosure. With an improvement in a company's internal control level, it will become more difficult for large shareholders to delay and hide 'bad news' for self-interest. Even if there is 'bad news', it will be released in time, rather than gradually accumulated, and the connection between tunnelling and the stock price crash risk will be weakened. When a company's internal control level is low, with the same level of tunnelling, the large shareholders may find it easier to delay and hide the 'bad news'. In this situation, the relationship between tunnelling and the stock price crash risk will be stronger.

To test this inference, we first define the variable *Highic* to distinguish the internal control level. *Highic* is a dummy variable. If a company's internal control index exceeds the industry median, *Highic* equals 1 (the higher the internal control level, the higher the

[11]Refer to Rao and Jiang (2013) to check the monetary policy from 2013 to 2015. The monetary policies implemented in these three years are not monetary deflation policies. In addition, Rao and Jiang (2013) defined 2007 as a year of monetary deflation. If defined in this way, the results remain stable.

[12]Dai and Yue (2015) controlled the monetary policy status of the current year rather than the previous year.

Table 3. Tunnelling, liquidity shortage and stock price crash risk.

	(1)	(2)	(3)	(4)
Dep. Var =	$Ncskew_t$	$Duvol_t$	$Ncskew_t$	$Duvol_t$
Tun_{t-1}	**0.313*** **	**0.243*** **	**0.317*** **	**0.243*** **
	(2.92)	**(3.31)**	**(2.93)**	**(3.29)**
Mp_t	**0.172*** **	**0.127*** **	**0.173*** **	**0.127*** **
	(10.73)	**(12.60)**	**(10.74)**	**(12.55)**
Div_{t-1}	**0.336*** **	**0.256*** **	**0.336*** **	**0.256*** **
	(8.23)	**(8.99)**	**(8.13)**	**(8.82)**
$Cash_{t-1}$			**−0.021**	**−0.007**
			(−0.40)	**(−0.19)**
$Rcurrent_{t-1}$			**−0.005**	**−0.001**
			(−1.10)	**(−0.37)**
$Dturn_{t-1}$	−0.445***	−0.251***	−0.451***	−0.253***
	(−4.17)	(−3.49)	(−4.22)	(−3.52)
$Ncskew_{t-1}$	0.035***	0.026***	0.035***	0.026***
	(5.25)	(6.00)	(5.26)	(6.01)
$Sigma_{t-1}$	4.731***	2.288***	4.755***	2.272***
	(3.80)	(2.85)	(3.81)	(2.82)
$Wret_{t-1}$	48.475**	21.251	48.780**	20.987
	(2.28)	(1.55)	(2.29)	(1.53)
$Size_{t-1}$	0.015***	0.008**	0.015***	0.008*
	(2.60)	(1.98)	(2.59)	(1.93)
MB_{t-1}	0.013***	0.009***	0.014***	0.009***
	(8.26)	(7.82)	(8.33)	(7.82)
Lev_{t-1}	−0.012	0.002	−0.042	−0.005
	(−0.37)	(0.08)	(−1.03)	(−0.17)
Roa_{t-1}	0.183**	0.092*	0.182**	0.091*
	(2.38)	(1.77)	(2.34)	(1.73)
$Accm_{t-1}$	0.081**	0.047*	0.087**	0.047*
	(2.03)	(1.81)	(2.15)	(1.82)
Sh_{t-1}	−0.083**	−0.063**	−0.081**	−0.061**
	(−2.22)	(−2.53)	(−2.17)	(−2.42)
$Sh2_5_{t-1}$	0.104**	0.063*	0.104**	0.066*
	(2.05)	(1.86)	(2.05)	(1.93)
$Msh1_{t-1}$	0.157**	0.122**	0.160**	0.123**
	(2.04)	(2.46)	(2.07)	(2.47)
$Msh2_{t-1}$	−0.140*	−0.107**	−0.143*	−0.108**
	(−1.70)	(−2.01)	(−1.73)	(−2.03)
$Dual_{t-1}$	0.044***	0.030***	0.045***	0.031***
	(2.97)	(3.03)	(3.04)	(3.12)
$Big4_{t-1}$	−0.009	−0.005	−0.007	−0.004
	(−0.43)	(−0.41)	(−0.36)	(−0.28)
$Index_{t-1}$	−0.007***	−0.005***	−0.007***	−0.005***
	(−2.78)	(−2.75)	(−2.76)	(−2.74)
Constant	−0.865***	−0.517***	−0.844***	−0.510***
	(−6.53)	(−5.92)	(−6.32)	(−5.76)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs#	23,969	23,969	23,870	23,870
Adj-R^2	0.049	0.058	0.049	0.058
F	27.59	31.36	26.51	30.10

internal control index), and 0 otherwise. Based on Model (1), we add the internal control level ($Highic_{t-1}$) and its cross-section term with tunnelling (Tun_{t-1}*$Highic_{t-1}$) to the regression analysis. If the inference that internal control supervision weakens the impact of tunnelling by large shareholders on future stock price crash risk is tenable, then the coefficient of Tun_{t-1}*$Highic_{t-1}$ should be significantly negative. In the opposite scenario, the coefficient of Tun_{t-1}*$Highic_{t-1}$ should be significantly positive. The regression results

Table 4. Tunnelling, internal control and stock price crash risk.

	(1)	(2)
Dep. Var =	$Ncskew_t$	$Duvol_t$
Tun_{t-1}	0.350***	0.273***
	(2.90)	(3.32)
Tun_{t-1}*$Highic_{t-1}$	**−0.374***	**−0.295***
	(−1.74)	**(−1.95)**
$Highic_{t-1}$	−0.019	−0.016**
	(−1.58)	(−2.01)
Constant	−1.120***	−0.714***
	(−8.49)	(−8.17)
Control	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Obs#	23,969	23,969
Adj-R^2	0.042	0.049
F	22.72	25.59

are presented in Table 4.[13] The explained variable in column (1) is $Ncskew_t$ and the explained variable in column (2) is *Duvol*. The coefficient of *Tunt-1* is significantly positive at the 10% level, while the coefficient of Tun_{t-1}*$Highic_{t-1}$ is significantly negative at the 10% level. This shows that tunnelling increases a company's future stock price crash risk, but a high level of internal control weakens this relationship. Results in Table 4 show the impact of tunnelling on future stock price crash risk from the perspective of hidden ability differences.

4.3.2. Tunnelling, operational performance, and stock price crash risk

Previous analyses believe that large shareholders have an incentive to delay and hide the disclosure of 'bad news' to avoid the vigilance and attention of regulators, intermediaries, and minority shareholders. However, the level of this conflict is different under different performance conditions of the company. When a company's performance is poor, the external response to the tunnelling by large shareholders may be very strong. The motivation of these shareholders to delay and hide the disclosure of tunnelling and other 'bad news' is greater in this case, and the relationship between tunnelling and the stock price crash risk is also strengthened. In contrast, when a company's performance is good, the external resistance and attention to tunnelling by large shareholders are relatively weak, and the relationship between tunnelling and the stock price crash risk is also weakened.

To this end, the variables *Highroa* and *Noloss* are first defined to distinguish performance statuses. *Highroa* is a dummy variable; if the company's profit level is higher than the lower quartile of the industry, it equals 1, and 0 otherwise. *Noloss* is a dummy variable; if the company's profit is greater than zero, it equals 1, and 0 otherwise. Next, based on m = Model (1), we add performance variables (*Highroa, Noloss*) and their cross-section term with tunnelling (*Tun*Highroa, Tun*Noloss*) to the regression analysis. If the previous inference is true, the coefficients of *Tun*Highroa* and *Tun*Noloss* should be significantly negative. The regression results are presented in Table 5. The explained variable in columns (1) and (3) is $Ncskew_t$, and the explained variable in columns (2) and (4) is

[13]Due to space limitations, the results of control variables in subsequent tables are not reported.

Table 5. Tunnelling, operation performance and stock price crash risk.

	(1)	(2)	(3)	(4)
Dep. Var =	$Ncskew_t$	$Duvol_t$	$Ncskew_t$	$Duvol_t$
Tun_{t-1}	0.485***	0.388***	0.549***	0.460***
	(3.51)	(4.16)	(3.64)	(4.48)
Tun_{t-1}*$Highroa_{t-1}$	**−0.420****	**−0.349*****		
	(−2.31)	**(−2.81)**		
$Highroa_{t-1}$	0.021	0.017		
	(1.32)	(1.60)		
Tun_{t-1}*$Noloss_{t-1}$			**−0.495*****	**−0.443*****
			(−2.74)	**(−3.54)**
$Noloss_{t-1}$			−0.010	−0.007
			(−0.52)	(−0.52)
Constant	−1.080***	−0.680***	−1.056***	−0.661***
	(−8.22)	(−7.80)	(−8.01)	(−7.54)
Control	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs#	23,969	23,969	23,969	23,969
Adj-R^2	0.042	0.049	0.042	0.049
F	22.85	25.70	23.11	26.27

$Duvol_t$. It can be found that the coefficient of Tun_{t-1} is always positive, while the coefficient of Tun_{t-1}*$Highroa_{t-1}$ and Tun_{t-1}*$Noloss_{t-1}$ is significantly negative at a 1% or 5% level. This shows that the interaction between tunnelling and poor operational performance strengthens the stock price crash risk. If the company's performance is good, even if there is more tunnelling, it does not necessarily bring a higher stock price crash risk; however, if the company's performance is poor, the more the tunnelling, the higher the stock price crash risk. The results in Table 5 reveal the impact of tunnelling on future stock price crash risk from the perspective of hidden motivation differences.[14]

4.3.3. Tunnelling, split-share reforms and stock price crash risk

The split-share reform, which started in 2005, is a major event in China's stock market reforms. It reduces the shareholding ratio of large shareholders, standardises corporate governance, and alleviates tunnelling by large shareholders.[15] Therefore, it is expected that the stock price crash risk caused by tunnelling will be weakened after the split-share reform.

Therefore, a virtual variable *Change* is defined, that takes a value of 0 before the split-share reforms and 1 after the split-share reforms. Model (1) is regressed by adding $Change_{t-1}$ and its cross-section term with tunnelling (Tun_{t-1}*$Change_{t-1}$). The results show that the coefficient of Tun_{t-1} is significantly positive, whereas the coefficient of Tun_{t-1} *$Change_{t-1}$ is significantly negative at a 1% or 5% level. Thus, tunnelling leads to a higher stock price crash risk, but the split-share reform weakens this connection. The unreported subsample test (by the split-sample test of Model (1) before and after the split-share

[14]This finding also suggests that tunnelling may cause greater harm to investors when the macro situation is poor. When the macro situation is poor, the systematic exogenous impact may lead to lower company profits. At this point, companies have a stronger incentive to hide all kinds of bad news.

[15]The mean value of *Tun* in the years before the split-share reforms is 0.077, while the mean value for the years after the split-share reforms is 0.023. In fact, it is difficult for us to distinguish between reasonable other receivables and tunnelling. After the split-share reforms, although other receivables have not been reduced to zero, we speculate that the tunnelling for self-interest purposes may be decreased.

Table 6. Tunnelling, split-share reforms and stock price crash risk.

	(1)	(2)
Dep. Var =	$Ncskew_t$	$Duvol_t$
Tun_{t-1}	0.565***	0.369***
	(3.49)	(3.30)
Tun_{t-1}*$Change_{t-1}$	**−0.608*** **	**−0.304** **
	(−3.03)	**(−2.16)**
$Change_{t-1}$	−0.047	−0.019
	(−1.53)	(−0.92)
Constant	−1.124***	−0.706***
	(−8.54)	(−8.11)
Control	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Obs#	23,922	23,922
Adj-R^2	0.042	0.049
F	23.01	25.58

reform) shows that after the split-share reform, the coefficient of Tun_{t-1} is positive but not significant. The results in Table 6 show the significant impact of the split-share reform on the relationship between tunnelling and the stock price crash risk.

4.4. Robustness test

4.4.1. Endogeneity issues

Although the above empirical results show that there is a positive correlation between tunnelling and the stock price crash risk, we cannot conclude that tunnelling is the cause of a stock price crash risk. For example, in a company with poor performance or governance, the situation of large shareholders infringing the interests of minority shareholders appears to be more serious, and causes a higher stock price crash risk, which further fosters large shareholders' encroachment. To address the above potential issues of omitted variables and reverse causality, we make efforts in the following three aspects.

(1) Test for variable tunnelling and stock price crash risk.

We further divide tunnelling (Tun_{t-1}) into tunnelling two periods prior (Tun_{t-2}) and variable tunnelling ($\Delta Tun = Tun_{t-1} - Tun_{t-2}$) to repeat the main regression. Columns (1) and (2) of Table 7 show the regression results, where the explained variable in column (1) is $Ncskew_t$, and that in column (2) is $Duvol_t$. The results show that the coefficient of Tun_{t-2} is always positive and significant at a 1% or 5% level and that of ΔTun is always positive and significant at the 1% level. Given the fact that tunnelling two periods prior can influence the stock price crash risk, variable tunnelling can also influence it, which strengthen the inference of their causal relationship.

Table 7. Endogeneity issues.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var =	$Ncskew_t$	$Duvol_t$	$Ncskew_t$	$Duvol_t$	$Ncskew_t$	$Duvol_t$
Tun_{t-2}	**0.259****	**0.210*****				
	(2.37)	**(2.79)**				
ΔTun	**0.387*****	**0.273*****				
	(3.02)	**(3.18)**				
Tun_{t-1}			**0.287*****	**0.224*****	**1.324*****	**0.804****
			(2.66)	**(3.02)**	**(2.66)**	**(2.44)**
Constant	−1.073***	−0.678***	−1.084***	−0.684***	−1.244***	−0.774***
	(−8.16)	(−7.80)	(−8.28)	(−7.88)	(−8.15)	(−7.58)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Obs#	23,969	23,969	23,969	23,969	23,969	23,969
Adj-R^2/R^2	0.042	0.049	-	-	0.040	0.048
F/ Chi	23.46	26.10	1136.26	1276.24	1120.17	1268.60

(2) Test for controlling fixed effects of company

The company fixed effects model can address the problem of omitted variables that do not change over time. We add the company fixed effects and repeat the main regression. Columns (3) and (4) of Table 7 present the regression results. The results show that the coefficient of Tun_{t-1} is positive and significant at the 1% level.

(3) Instrumental variable tests

According to previous research, year-industry mean is a commonly used instrumental variable. The demand and supervision for tunnelling in the same industry will be similar in the same year; however, the tunnelling of other companies in the industry does not have a direct impact on one company's future stock price crash risk. Therefore, we use the year-industry mean of tunnelling as an instrumental variable (excluding the company itself) and repeat the main regression. Columns (5) and (6) of Table 7 show the regression results, with the coefficient of Tun_{t-1} always positive and significant at a 1% or 5% level.

4.4.2. Other robustness tests

We also conduct some tests that are unreported. (1) We use the third approach to estimating the stock price crash risk (Crash). We define dummy variables *Crash1, Crash2*, and *Crash3*. If the unique weekly return rate ($W_{j,t}$) of stock *j* in week *t* is 2.25 (2, 1.65) standard deviations below the mean of its distribution, *Crash1* (*Crash2, Crash3*) equals 1, and 0 otherwise (Chen & Zhang, 2009). (2) Li et al. (2004) and Zhu et al. (2010) suggest that there is not only large shareholders' capital occupation behaviour but also large shareholders' capital transfer behaviour. We use the net amount to estimate tunnelling and define it as the ratio of the difference between other receivables and other payables to total assets. (3) We control for the square of the share proportion of the largest shareholder. (4) We use the median tunnelling at the industry level and repeat the regression. (5) To avoid the effect of tunnelling fluctuation, we use the mean of tunnelling in *t-2, t-1*, and *t* to regress. (6) We measure the market return rate as market return rate weighted by

current market value or total market value in model (2). (7) We adopt the Shenzhen Stock Exchange scoring system to measure information transparency (Y. L. Li & Tan, 2019). (8) In the performance test, we drop Roa_{t-1} or control for earnings management and the interaction term of earnings management and tunnelling. (9) Considering the systemic impact of the 2008 global financial crisis on stock prices, we drop 2008 and repeat the regression. (10) To avoid the influence of transfer of control caused by mergers and acquisitions on the conclusion, we delete observations in which the ratio of M&A amount to the total assets at the beginning of the period is higher than 10%, and perform the regression again. (11) The correlation analysis shows that stock return characteristics ($Dturn_{t-1}$,$Sigma_{t-1}$, *and* $Wret_{t-1}$) are highly correlated; hence, we exclude them one by one, and repeat the regression. All the above tests coincide with the former conclusion.

5. Conclusions

Large shareholders' tunnelling is a problem representative of ownership concentration. To successfully occupy funds, and thus achieve self-interest, large shareholders are motivated to interfere with information disclosure, resulting in a higher stock price crash risk. Therefore, it is insightful to explore the relationship between large shareholders' tunnelling and the stock price crash risk to protect the interests of minority investors and contribute to a stable development of the overall financial market. Using listed companies in China from 2001 to 2019 as the sample, the paper presents an empirical study on the problems above. The results show that more severe tunnelling can lead to a higher stock price crash risk. Additionally, high levels of internal control and good operational performance can weaken this relationship. Finally, the split-share reforms not only limit large shareholders' tunnelling to a certain extent, but also weaken their impact on the stock price crash risk. The results remain stable in a variety of robustness tests.

The findings of this study have theoretical and practical implications. First, this study finds that unlike Western countries, China's institutional background, ownership concentration, and large shareholders' tunnelling may significantly affect the stock price crash risk. This adds new explanatory factors to the theory of a company's stock price crash risk and expands on the previous stock price crash risk theory, which mainly focuses on conflicts of interest between management and shareholders. Second, this study finds that tunnelling and stock price crash risk are affected by a company's internal control level, operational performance, and split-share reforms. This enables us to gain a deeper understanding of the logical mechanism of the effect of tunnelling on the stock price crash risk. Specifically, under different operational performance and different internal control levels, the difference in the effect can be seen along two different paths: the motivation and ability of large shareholders to hide bad news. Third, the data show that even after the split-share reforms, the tunnelling of some companies is high,[16] which indicates that supervision and disclosure of tunnelling still require attention. Under the current financial reporting structure, the disclosure of tunnelling, which manifests as other accounts receivable, is in the form of a table summary. However, some companies do not provide a detailed description of the process of its formation, which needs more

[16]Taking 2015 as an example, the average value of tunnelling is 0.018, the median is 0.008, and the 90% quantile is 0.042.

supplement. In addition, in the case of tunnelling events showing major changes in other accounts receivable, the company shall provide relevant information to investors and make announcements at their own initiative. Fourth, in order to save supervision costs, companies with unsatisfactory internal control and operational performance and those in the poor macro economy (systemic shocks leading to widespread performance failures) should be imposed with strict supervision.

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