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Article

Internal control effectiveness and stock price crash

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Abstract: This study focuses on the problems of imperfect internal control effectiveness, insufficient information transparency, and plummeting stock prices. The study selects the data of non-financial main board listed companies in China's Shanghai and Shenzhen A-shares from 2012 to 2021 as a sample, and adopts an empirical research methodology, which reveals that the effectiveness of internal control is negatively related to the trend of share price crash, and efficient internal control is positively related to the transparency of corporate information environment. The findings suggest the impact of internal control on the risk of stock price crash at the individual stock level and provide empirical support for listed companies to manage their risks. This study has practical value in guiding listed companies to strengthen internal control, improve information transparency, mitigate the risk of stock price crashes, and provide a decision-making basis for the healthy and stable development of the capital market.

Keywords: internal control effectiveness; information transparency; share price crash risk
JEL Classification: M4; G3; G34

1. Introduction

1.1. Statement of problem and significance of the study

Currently, the Chinese capital market is developing rapidly. There are a large number of listed companies. However, the Chinese securities market is still at an immature stage, failing to match the efficient operation of the economy and provide adequate protection for investors. The annual turnover rate of Chinese Shanghai and Shenzhen stock markets is twice that of developed countries, and the strong volatility of the Chinese stock market is accompanied by frequent ups and downs.

Internal control plays an important role in reducing information asymmetry (Henk, 2020). On the one hand, it increases the cost of management's opportunistic behavior and controls the risk of intentional misstatement through the implementation of supervision over all aspects of production, operation, and reporting; on the other hand, it reduces the possibility of unintentional misstatement through the standardization of processes, ensures the reliability of the information provided by the enterprise, and strengthens the accuracy of investors' understanding of the information. Thus, it improves the information transmission efficiency between the two. The effective operation of internal controls can limit the accumulation of bad news at multiple points, thereby reducing the likelihood of a company experiencing a future stock price collapse.

This study achieves important results at both the theoretical and practical levels. On the theoretical side, by examining the effectiveness of internal controls of listed

companies, it extends the scope of research on internal control effectiveness to the risk of stock price collapse, deepens the study of its economic consequences, and provides a new theoretical perspective for understanding the role of internal controls in the capital market. On the practical side, this study reveals the impact of disclosure of internal control deficiencies on the risk of stock price collapse, which has practical guiding value for listed companies to correctly understand internal control, control the risk of stock price collapse, and provide decision support for the healthy and stable development of the capital market.

2. Literature review

2.1. Effectiveness of internal controls

The COSO framework suggests that the premise of internal control evaluation is whether the five elements of internal control are present and functioning well, while Ngangbam (2023) suggests that the overall evaluation of internal control should be formed by considering the extent to which a single element is contributing to the functioning of the whole system, evaluating the single element individually, and integrating the results of the evaluations of all the elements. which in turn results in an overall evaluation of internal control. The goal-oriented view suggests that the core criterion for evaluating internal control should ultimately focus on whether internal control helps the firm achieve a specific purpose (Dolghi and Petreanu, 2021).

The effectiveness of internal controls is the degree of assurance provided by the internal control system in achieving the control objectives. It is considered ineffective when the planning and activities of the enterprise's internal control system support the enterprise's advancement in the course of achieving the control objectives, i.e., internal control helps the enterprise to achieve the control objectives (Tumimomor et al., 2022). internal control is considered effective when it helps the firm achieve its control objectives (Seyam and Copper, 2020). From a 'quantitative' perspective, the effectiveness of a firm's internal controls is generally in a linear dynamic of degree (Washington, 2018). There is a continuum between lower and higher levels of internal control effectiveness, both of which can theoretically be taken by individual firms.

The COSO framework points out that the existence of gaps in internal control will weaken the firm's ability to accomplish its objectives, and whether it ensures that the firm achieves its objectives is a measure of the effectiveness of internal control (Liu et al., 2017). In other words, the effectiveness of internal control can be reflected by the existence of internal control deficiencies within the firm. In fact, internal control deficiencies include material weaknesses, significant deficiencies, and general deficiencies, and the different levels of deficiencies also map the degree of harm to the firm's ability to accomplish its objectives (Sari and Darmastuti, 2023). Both material and significant deficiencies result in challenges to the feasibility of the firm's ability to accomplish its goals, while general deficiencies do not add resistance to the firm's ability to accomplish its goals (Schneider, 2020). Current research oriented toward the Chinese market context has more often adopted the Dibble internal control index as a continuous quantitative indicator of internal

control effectiveness (Chen and Zhou, 2013). The index relies on the Chinese internal control normative system, takes five control objectives as the first level indicators, subdivided into quantifiable sub-indicators, assigns weights to the sub-indicators through a combination of subjective and objective methods, and scores the total, and then adjusts them with internal control deficiencies as the corrective indicators to finally obtain the internal control index.

2.2. Risk of stock crashes

The theoretical analysis and hypothesis of stock price crash risk (SPCR) is the probability that a company may experience a stock price crash in the future. A stock price crash is a specific phenomenon that is usually described as a rapid and significant drop in stock prices due to some reason that causes investors to concentrate on selling their stocks (Blocher and Zhang, 2016). Jin and Myersl (2006) express this phenomenon as "negative extremes in a stock-specific return distribution".

Hao and Wang (2018) examined the crash risk of the Chinese stock market, with a special focus on the relationship between the effects of Corporate social responsibility, internal controls, and stock price crash risk. Kim et al. (2019) focused on the relationship between the quality of internal controls and the risk of stock price crashes, emphasizing the importance of internal controls in reducing the risk of crashes. Francis et al. (2017) examined the impact of management's risk incentives on a firm's exchange rate sensitivity and analyzed the sources of firm risk from the perspective of managerial behavior. Hu and Kleinman (2023) focusing on the relationship between internal control quality and audit analysts' forecast accuracy and dispersion, reveals the impact of internal control on information quality.

2.3. Economic consequences of internal control

Earlier studies such as Kinney and McDaniel (1989) and Bell and Carcello (2000) have found that effectively functioning internal control is inversely related to the risk of financial misstatement. After the implementation of Sarbanes-Oxley, more studies have provided supporting evidence for the function of internal controls from the perspective of financial reporting quality. Doyle et al. (2007) empirically found that material weaknesses are negatively correlated with the ability to convert accruals into cash flows using data from 2002–2005 and that this correlation exists only with material weaknesses at the firm level, and not at the account level. It may be that managers actively circumvent internal control oversight by whitewashing statements. Chan et al. (2008) empirically concludes that firms with internal control deficiencies tend to report adjusted accounting figures. Ashbaugh-Skaife et al. (2008) examine the impact of internal control on the quality of internal control disclosures. Internal control deficiencies were found to reduce the quality of internal control disclosures through unintentional misstatements and intentional overstatements. Firms that report deficiencies have poorer surplus quality and firms that correct deficiencies have better surplus quality. Internal control effectiveness and surplus quality show consistent changes over time. The study emphasizes the critical impact of internal control on the reliability of financial reporting. Goh and Li (2011), on the

other hand, find that the existence and modification of internal control deficiencies can negatively and positively affect the conservatism of firms' accounting policies.

Rice et al. (2015) suggest that there is still a blind spot in the current internal control regulation and that the existing regulatory mechanisms do not achieve effective monitoring of internal control disclosure. They found that firms with deficiencies but no disclosure were not penalized. Feng et al. (2015) directly examined the impact of internal control on firms' operating results. They found that firms with ineffective internal control had lower inventory turnover and were more likely to make provision for inventory decline and that after the deficiencies were repaired the inventory turnover increased accordingly, along with an increase in operating cash flow. D'Mello et al. (2017) found that internal control affects the internal resource allocation of a company, and companies with ineffective internal control have lower internal resource transfer efficiency.

2.4. Importance of stock price crash risk and related impact factors

The references including Bali et al. (2014), Chabi-Yo et al. (2018), Long et al. (2019), etc., are academic papers that examine the relationship between tail risk, collapse risk, and the pricing of stock returns in international markets. These papers collectively contribute to the understanding of how extreme events and market collapses are priced in different financial markets, shedding light on the behavior of investors and the impact of risk factors on asset pricing. The findings from these studies emphasize the importance of considering tail and collapse risks in the context of global financial markets and their implications for investment strategies.

In addition to this, Piotroski (2015) found that compared to Western developed countries, the Chinese stock market is shorter in time and has some institutional flaws, and thus faces a higher risk of stock price crashes. Hutton et al. (2009) studied the listed companies in the United States and found that when the information transparency of the company is low, the company managers are more likely to violate the rules, and at the same time, it is difficult for external investors to make an effective judgment on the real situation of the company, so the company is more likely to have a stock price crash. Kim et al. (2012) argued that the disclosure of CSR information can produce a "communication effect", which not only can enhance corporate social responsibility but also can enhance corporate social responsibility. Kim et al. (2012) argue that CSR information disclosure can have a "communication effect", which not only enhances corporate reputation but also provides non-financial information to the outside world, which helps investors to make decisions and thus reduces the risk of stock price collapse.

2.5. Research hypothesis

This study aims to validate the existence and causality of internal control effectiveness on stock price plunge risk and reveal its influence mechanism and path of action in order to comprehensively describe the association between internal control effectiveness and stock price plunge risk. Based on relevant literature studies and related theories, the following hypotheses and conceptual research framework are proposed:

H1: The higher the effectiveness of internal control, the higher the transparency of information.

H2: The lower the information transparency, the higher the risk of stock price rash.

H3: Effective internal controls reduce the risk of stock price collapse by increasing information transparency.

The relevant conceptual framework is shown in **Figure 1**.

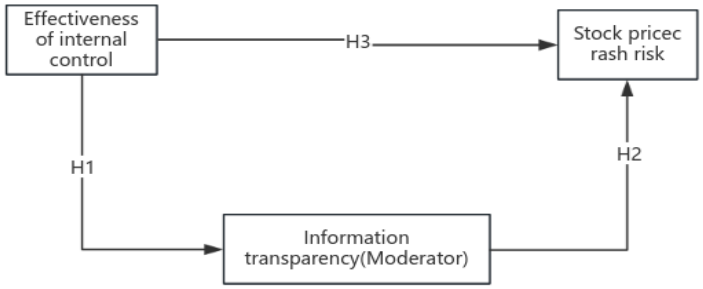

Figure 1. Conceptual framework.

Source: Construction of this study.

3. Methodology

3.1. Date and sample

In this paper, the listed companies on the main board of Shanghai and Shenzhen A-shares from 2012 to 2021 are selected as the research sample. The following rules are followed to process the initial sample:

1) For the purpose of calculating the measure of stock price plunge trend, referring to Jin and Myers (2006), if the number of weeks in a year in which a company's stock is involved in buying and selling activities is less than thirty, it is considered to be insufficiently active in trading, and the method of calculating the indicator does not effectively reflect the volatility of the stock price so that this portion of the sample has to be excluded.

2) Discard samples for which the necessary data are not available.

3) Banking and insurance companies cannot be effectively compared with other industries due to the specificity of their financial indicators, so they cannot be included in the sample either.

There are 12,937 observations as shown in **Table 1** Distribution of share price crashes of listed companies over the years. The number of share price crashes of listed companies is 1012, accounting for 7.82% of the total ratio.

Table 1. Distribution of stock prices of listed companies to crash.

Year	Total number of companies	Number of companies that crashed	Percentage of companies that crashed
2013	1452	78	5.37%
2014	1443	58	4.02%
2015	1434	87	6.07%
2016	1445	64	4.43%
2017	1429	168	11.76%

Table 1. (*Continued*).

Year	Total number of companies	Number of companies that crashed	Percentage of companies that crashed
2018	1463	216	14.76%
2019	1440	115	7.99%
2020	1404	101	7.19%
2021	1427	125	8.76%
Total number	12,937	1012	7.82%

3.2. Variables definition

3.2.1. Dependent variable

Stock price crash risk is the probability of an unforeseen sharp decline in the stock market index or individual stock prices over a short period of time. The stock price crash risk studied in this paper mainly focuses on the probability of the phenomenon of a large drop in the price of individual stocks. In order to maintain consistency with existing studies and improve the comparability of results, drawing on the methodology of Chen et al. (2001), this paper uses the negative stock return skewness coefficient (Ncskew) and the stock up/down volatility ratio (Duvol) to measure the likelihood of an extreme negative distribution of stock prices. The specific calculations of the two indicators are as follows.

First, the weekly return of the stock issued by firm is calculated according to the equation.

$$R_{i,s} = \psi_i + \delta_{1s}R_{m,s-2} + \delta_{2s}R_{m,s-1} + \delta_{3s}R_{m,s} + \delta_{4s}R_{m,s+1} + \delta_{5s}R_{m,s+2} + \varepsilon_{i,s} \quad (1)$$

where $R_{i,s}$ is the individual stock payoff of $stock_i$ in weeks; $R_{m,s}$ is the market payoff of the market in $week_s$. The model includes both the lead and lag terms of the market payoff; the residuals $_e$, derived from the estimation, represent the stock-specific payoffs after removing the effect of the market trend. Due to the narrow range of values of the residuals, and in order to improve the convenience of the subsequent calculations, $W_{i,s} = 1n(1 + \varepsilon_i,)$ is defined as the weekly payoffs of the stocks.

Then, the negative return skewness coefficient (Ncskew) is calculated according to Equation (2). Where n is the count of weeks of trading activity in which $stock_i$ participated in $year_t$. Ncskew is positively correlated with the downward trend of the stock price, with larger values representing a greater likelihood of a rapid downward phenomenon in the stock price.

$$\text{Ncskewi, t} = \frac{-n(n-1)^{3/2}\sum W_{i,s}^3}{(n-1)(n-2)\left(\sum W_{i,s}^2\right)^{3/2}} \quad (2)$$

Next, the stock upward and downward volatility ratios (Duvol) are calculated based on Equation (3). First, the annual average return for all trading weeks of each stock is calculated, and then each week of each stock is differentiated into above-average and below-average weeks based on the annual average return. N is the number of weeks in which the weekly return of $stock_i$ is above the annual average return, and n is the number of weeks in which the weekly return of $stock_i$ is below the annual average return. Duvol is positively correlated with the risk of a stock crash, and the larger the value of Duvol, the greater the possibility that the stock will undergo a rapid downward phenomenon is more likely.

$$\text{Duvol}_{i,t} = \ln\left[\frac{(n_u-1)\sum_{down} W_{i,s}^2}{(n_d-1)\sum_{up} W_{i,s}^2}\right] \quad (3)$$

3.2.2. Independent variable

The quality of internal control is the effectiveness of internal control, the better the construction of the enterprise's internal control system, the more obvious the implementation process and effect, the higher the quality of internal control. This paper adopts the DIB internal control index to measure internal control quality. The data needed for the index construction process come from listed companies' internal control annual reports, evaluation reports, as well as audit and attestation reports. Therefore, the DIB internal control index of listed companies in China is used to measure the explanatory variables of this paper. Since the value of the index ranges from 0 to 1000, the logarithm of the index after adding 1 is used for analysis for the convenience of research. ICeffectivenesst = ln (DIB internal control index + 1).

3.2.3. Mediation variables

In this paper, we take relevant proxy variables to quantify information transparency and maintain consistency with the existing literature by using the level of accrued surplus management as a mapping of information transparency (Angela Liu et al., 2022). The specific calculations of the three types of models are as follows.

$$\frac{TA_{i,t}}{A_{i,t-1}} = \alpha_1\left[\frac{1}{A_{i,t-1}}\right] + \alpha_2\left[\frac{\Delta REV_{i,t}}{A_{i,t-1}}\right] + \alpha_3\left[\frac{PPE_{i,t}}{A_{i,t-1}}\right] + \varepsilon_{i,t} \quad (4)$$

$TA_{i,t}$ is the total accrued profit in year $_t$, i.e., the portion of the firm's net profit that is not converted into cash flow; $A_{i,t-1}$ is the total assets in year$_{t-1}$; $\Delta REV_{i,t}$ is the change in operating revenues in year$_t$ and year$_{t-1}$; and $PPE_{i,t}$ is the net fixed asset in year$_t$. All sample observations are grouped by year and industry, and then Equation (4) is estimated using the samples from each group, and the residuals obtained reflect the size of manipulated accrued profits.

The specific setup of the Modified Jones model is as follows.

$$\frac{TA_{i,t}}{A_{i,t-1}} = \alpha_1\left[\frac{1}{A_{i,t-1}}\right] + \alpha_2\left[\frac{\Delta REV_{i,t}-\Delta REC_{i,t}}{A_{i,t-1}}\right] + \alpha_3\left[\frac{PPE_{i,t}}{A_{i,t-1}}\right] + \varepsilon_{i,t} \quad (5)$$

where $\Delta REC_{i,t}$ is the incremental accounts receivable and the rest of the variables are set consistent with the basic Jones model. The regression residuals of Equation (5) reflect the size of manipulated accrued profits.

The specific settings of the Jones model for intangibles are as follows.

$$\frac{TA_{i,t}}{A_{i,t-1}} = \alpha_1\left[\frac{1}{A_{i,t-1}}\right] + \alpha_2\left[\frac{\Delta REV_{i,t}-\Delta REC_{i,t}}{A_{i,t-1}}\right] + \alpha_3\left[\frac{PPE_{i,t}}{A_{i,t-1}}\right] + \alpha_4\left[\frac{IA_{i,t}}{A_{i,t-1}}\right] + \varepsilon_{i,t} \quad (6)$$

where $IA_{i,t}$ are intangible assets and the other variables are set consistent with the Modified Jones model. The regression residuals of Equation (6) are the manipulated accrued profits calculated by the Jones model for intangible assets.

Equations (4), (5), and (6) estimate manipulative accrued profits and then take the absolute value to get the level of accrued surplus management. The larger the value of the level of accrued surplus management, the lower the transparency of information.

3.2.4. Control variables

Based on previous literature (Chen et al., 2001; Hutton et al, 2009), we also selected the following control variables:

(1) Average monthly excess turnover rate (Turnovert-1). Calculated as the difference between the average monthly turnover rate of stocks in year t-1 minus the average monthly turnover rate of the previous year, it is used to measure the heterogeneity of investor beliefs and can reflect the degree of stock liquidity.

(2) Weekly return volatility (Sigmatt-1). The higher the volatility of an individual stock's return, the higher the likelihood of stock price collapse will be, so this variable is added in this paper to control the effect of the volatility of an individual stock's return on the risk of its stock price collapse.

(3) Average weekly return (Rett-1). When the cumulative payoff of individual stock *i* is high, it is prone to be overvalued by the market and creates a bubble, which makes it more prone to crash.

(4) Firm size (Sizet-1). Firms of different sizes have different volumes and complexities of business, and the motivation and difficulty with which management is able to extract private profits, so this variable is added in this paper to control for the effect of firm size on the risk of stock price collapse of individual stock i.

(5) Book-to-market ratio (BMt-1). This variable is added in this paper to control the effect of a firm's growth on the risk of stock price collapse.

(6) Gearing ratio (Levt-1). When a firm operates with a high percentage of debt, it will make potential investors think that this firm is poorly run. In order to avoid this bad impression, the management may take advantage of the convenience of the position to manipulate the financial information, which will have an impact on the stock price collapse of individual stock i. For this reason, this paper controls for gearing ratio.

(7) Return on total assets (Roat-1). Firms with high profitability generally do not have incentives to hide bad news, so this variable is controlled in this paper.

The definitions of the variables in this paper are explained in **Table 2**.

Table 2. Variable definitions.

Variable symbol	Variable definition
FNcskew	The lagged one-period negative stock return bias coefficient, according to Equation (2) in this paper
FDuvol	The lagged period stock up/down volatility ratio, according to model (3) in this paper
ICeffectivenesst	ln (DIB internal control index + 1)
Transparencyt	The level of accrued earnings management is used to measure information opacity.Calculated from Equations (4), (5), and (6) from this paper
DTurnt	The difference between the average monthly turnover rate of company $_{i}$ stock in year $_{t-1}$ and year $_{t-2}$
Sigmat	The standard deviation of the weekly yield of individual shares of company i in year $_{t-1}$
Rett	The annual average of the weekly returns of each stock of company i in year $_{t-1}$ is multiplied by 100
Sizet	The natural log of company it's total assets at the end of year $_{t-1}$
BMt	Total book assets of company $_{i}$ in year $_{t-1}$/total stock market value
LEVt	Total liabilities/total assets of Company $_{i}$ in year $_{t-1}$
ROAt	Net profit/total assets in year $_{t-1}$ of company $_{i}$

3.3. Model

Based on the above theoretical analyses, to test H1, H2, and H3, and to examine whether the effectiveness of internal control acts through the path of information

transparency on the trend of stock price plunge, this paper adopts the mediation effect step-by-step method to test whether the information transparency is the pathway linking the two. The testing process is decomposed into four steps.

1) To test whether the effect of internal control effectiveness on the trend of stock price plunge is significant. Build the model as follows:

$$Crash_{i+1} = \lambda_0 + \lambda_1 ICeffectiveness_t + \lambda_2 Transparency_t + \Sigma\lambda Controls_t + FE + \varepsilon \quad (7)$$

2) To test whether the effect of internal control effectiveness on information transparency is significant. The modeling is built as follows:

$$Transparency_t = \beta_0 + \beta_1 ICeffectiveness_t + \Sigma\beta Controls_t + FE + \varepsilon \quad (8)$$

3) To test whether the effect of information transparency on the risk of stock price collapse is significant. The modelling is as follows:

$$Crash_{i+1} = \gamma_0 + \gamma_1 Transparency_t + \Sigma_\gamma Controls_t + FE + \varepsilon \quad (9)$$

4) To test whether information transparency plays a mediating effect in the relationship between the effectiveness of internal control and the risk of stock price collapse. The model is developed as follows:

$$Crash_{i+1} = \lambda_0 + \lambda_1 ICeffectiveness_t + \lambda_2 Transparency_t + \Sigma\lambda Controls_t + FE + \varepsilon \quad (10)$$

4. Results

4.1. Descriptive statistics

The descriptive statistical analysis shown in **Table 3** shows that the mean values of FNcskew and FDuvol are 1.861 and 0.527, the minimum values are 1.304 and -1.835, the maximum values are 3.268 and 6.121, and the standard deviations are 0.224 and 0.625, indicating that there are large differences in the distribution of negative extremes of the share prices of different companies in different periods. The mean value of Transparency is 0.010, and the standard deviation is 0.113, indicating that there are large differences in the effectiveness of internal control in different companies in different periods, and the mean value of ICeffectiveness is 660.570, and the standard deviation is 138.681, indicating that there are huge differences in the quality of internal control in different companies. In addition, the control variables are significantly different among different companies, which indirectly indicates the necessity of including these variables in the model.

Table 3. Descriptive statistics.

Variable	Sample Size	Mean	Median	Min	Max	Sd
FNcskew	11069	1.861	1.828	1.304	3.268	0.224
FDuvol	11069	0.527	0.509	−1.835	6.121	0.625
Transparency	12937	0.010	0.014	−2.603	3.304	0.113
ICeffectivenness	12937	633.546	660.570	0.000	941.310	138.681
DTurn	12937	0.256	0.185	−19.934	24.016	3.006
Sigma	12937	1.081	1.086	−2.089	3.668	0.443
Ret	12937	0.165	0.063	−0.760	7.355	0.514
Size	12937	22.763	22.586	17.971	28.636	1.341
BM	12937	0.666	0.670	0.013	1.559	0.267
LEV	12937	0.472	0.472	0.008	1.957	0.202
ROA	12937	0.031	0.030	−1.395	0.526	0.070

4.2. Regression results

Table 4 reports the Pearson correlation coefficients between the main variables. The correlation coefficient between FNcskew and FDuvol in **Tables 4–7** is 0.260, which is significant at the 1% level, indicating that the higher the effectiveness of internal control, the higher the information transparency of the company, which initially verifies H1. Transparency is significantly and negatively correlated with both FNcskew and FDuvol at a 1% level, which indicates that the trend of the stock price crash of the company with high information transparency is weaker, initially validating H2. ICeffectiv~s is significantly negatively correlated with both FNcskew and FDuvol at the 1% level, indicating that the trend of plummeting is weaker for companies with higher internal control effectiveness, initially providing support for H3. The correlations between the other variables are all less than 0.8, indicating that there is no multicollinearity problem between the other variables.

Table 4. Pairwise correlations analysis.

	FNcskew	**FDuvol**	**Transp~y**	**ICeffe~s**	**DTurn**	**Sigma**	**Ret**
FNcskew	1						
FDuvol	0.260***	1					
Transparency	−0.013***	−0.023**	1				
ICeffectiv~s	−0.055***	−0.033***	0.157***	1			
DTurn	0.119***	0.039***	−0.054***	−0.020**	1		
Sigma	0.001	0.028***	−0.015*	0.014	0.054***	1	
Ret	0.163***	0.023**	−0.008	0.068***	0.441***	−0.033***	1
Size	−0.045***	−0.054***	0.253***	0.188***	−0.037***	−0.113***	−0.070***
BM	−0.060***	0.007	0.145***	0.030***	−0.094***	−0.121***	−0.349***
LEV	0.060***	0.021**	−0.004	−0.101***	0.012	−0.011	−0.045***
ROA	−0.087***	−0.078***	0.351***	0.370***	−0.029***	−0.061***	0.149***

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

As shown in **Table 5**, the difference test between crashed and non-crashed firms, the sample firms in this paper are divided into two groups, firms that experienced a crash and firms that did not experience a crash, according to the stock crash identification algorithm, and the difference test is performed on the Ncskew and Duvol of the firms in the two groups. The mean (median) of Ncskew of the collapsed companies is 1.860 (1.834), which is significantly higher than that of Ncskew of the non-collapsed companies which is 1.661 (1.828), and the *t*-value (*z*-value) of the test of difference in means (difference in medians) is 0.121 (0.935), which is significant at 1% level; and the mean (median) of Duvol of the collapsed companies is 0.507 (0.499), which is significantly higher than the mean (median) of Duvol of non-crash companies 0.429 (0.410), and the *t*-value (*z*-value) of the test for difference in means (difference in medians) is 0.113 (0.393), which is significant at the 1% level. It can be seen that the risk of share price crash for crashed companies is significantly higher than that of non-crashed companies even if different indicators are used to measure the trend of share price crash, implying that it is reasonable to reflect the trend of share price crash with Ncskew and Duvol.

Table 5. Tests for differences between collapsed and non-collapsed firms.

	Company that collapsed (N = 1012)		**Non-collapsed companies (N = 11925)**		**Homogeneity Test**	**Median Test**
	Mean	Median	Mean	Median	T-value	Z-value
Ncskew	1.860	1.834	1.661	1.828	0.121	0.935***
Duvol	0.507	0.499	0.429	0.410	0.113	0.393***

As shown in **Table 6**, the risk of stock price collapse is measured by FNcskew, and according to the stepwise method of Baron and Kenny (1986), the first step of the test of whether the effectiveness of internal control significantly affects the risk of stock price collapse, the results show that the correlation coefficient of ICeffectiveness is −1.04, which is significant at the 1% level. It can be carried out to show that the higher the effectiveness of internal control the lower the risk of stock price crash of the company. The second step is to test whether the effectiveness of internal control significantly affects the transparency of information, and the results, as shown in column (2), show that the correlation coefficient of ICeffectivenness is 1.94, which is significant at the 1% level. It indicates that the higher the internal control effectiveness the higher the information transparency of the company and H1 is supported. The third step tests whether information transparency significantly affects the trend of stock price plunge, and the results are shown in column (3), the correlation coefficient of Transparency is −0.078, which is significant at the 1% level. It indicates that the trend of stock price plunge is weaker for companies with higher information transparency and H2 is supported. The fourth step tests whether information transparency plays a mediating effect in the relationship between internal control effectiveness and stock price crash risk, and the results are shown in column (4), the correlation coefficient of ICeffectiveness is −1.23, which is significant at a 1% level. It indicates that effective internal control can reduce the tendency of stock price crashes by improving information transparency, and H3 is supported.

Table 6. The main effects regression results.

	(1)	**(2)**	**(3)**	**(4)**
Variables	**F.Ncskew**	**Transparency**	**F.Ncskew**	**F.Ncskew**
ICeffectivenness	−1.040*** (−3.35)	1.940*** (3.83)		−1.230*** (−3.29)
Transparency			−0.078*** (−3.87)	−0.077*** (−3.82)
Ncskew	0.141*** (15.06)	0.002 (0.44)	0.141*** (15.06)	0.141*** (15.05)
DTurn	0.002*** (2.62)	−0.001** (−2.37)	0.002*** (2.80)	0.002*** (2.71)
Sigma	−0.012** (−2.24)	0.013*** (5.21)	−0.013*** (−2.57)	−0.013** (−2.43)
Ret	0.079*** (15.38)	−0.006** (−2.32)	0.078*** (15.28)	0.079*** (15.47)
Size	−0.009*** (−4.07)	0.016*** (15.33)	−0.012*** (−5.17)	−0.010*** (−4.58)

Table 6. (*Continued*).

	(1)	(2)	(3)	(4)
Variables	**F.Ncskew**	**Transparency**	**F.Ncskew**	**F.Ncskew**
BM	0.000 (−0.02)	0.029*** (5.59)	−0.002 (−0.22)	−0.003 (−0.23)
LEV	0.072*** (5.41)	0.005 (0.88)	0.074*** (5.58)	0.071*** (5.38)
ROA	−0.217*** (−5.36)	0.593*** (30.97)	−0.294*** (−7.14)	−0.262*** (−6.22)
Constant	1.820*** (37.75)	−0.406*** (−17.79)	1.840*** (37.72)	1.851*** (37.88)
Number	11,069	11,069	11,069	11,069
R-squared	0.065	0.148	0.032	0.066
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In identifying the effect of multicollinearity on the regression analysis, this study employed the Variance Inflation Factor (VIF) test. The VIF measures the amount of variance explained by each of the independent variables in the model and detects multicollinearity by assessing the degree of its dependence on the other independent variables. The results presented in **Table 7** indicate that the VIF value for each variable is around 1. This indicates that there is no serious multicollinearity among the selected independent variables. Therefore, it can be concluded that the regression model in this study excludes the interference of multicollinearity and has the basis for further analysis.

Table 7. Variance inflation factor (VIF) test for variables.

Variable	VIF	1/VIF
ICeffectivenness	1.16	0.862069
DTurn	1.01	0.985392
Sigma	1.19	0.839335
Ret	1.09	0.920918
Size	1.04	0.957851
BM	1.01	0.985392
LEV	1.21	0.825309
ROA	1.01	0.989491

As shown in **Table 8** Robustness test, one period lagged stock volatility ratio (FDuvol) measures the risk of stock price crash and according to the stepwise method of Baron and Kenny (1986), the result as shown in column (1), the correlation coefficient of FDuvol is −1.002 which is significant at 1% level. It indicates that the higher the internal control effectiveness the lower the risk of stock price collapse of the firm. The second step tests whether internal control effectiveness significantly affects information transparency, and the results, as shown in column (2), show that the correlation coefficient of FDuvol is 1.040, which

is significant at the 5% level, indicating that the higher the internal control effectiveness, the higher the information transparency of the company, and H1 is supported. The third step tests whether information transparency significantly affects the trend of stock price plunge, and the results are shown in column (3) with a coefficient of −0.071, which is significant at the 1% level. It indicates that the trend of stock price plunge is weaker for companies with higher information transparency and H2 is supported. The fourth step tests whether information transparency plays a mediating effect in the relationship between the effectiveness of internal control and the risk of stock price crash, and the results are shown in column (4). The coefficient of FDuvol is −1.02, which is significant at the 5% level. It indicates that effective internal control can reduce the tendency of stock price crashes by improving information transparency and thus H3 is supported.

Table 8. Robustness test.

	(1)	(2)	(3)	(4)
Variables	**F.Duvol**	**Transparency**	**F.Duvol**	**F.Duvol**
ICeffectivenness	−1.002*** (−3.25)	1.040** (2.62)		−1.12*** (−3.23)
Transparency			−0.071*** (−3.24)	0.071*** (−3.23)
Duvol	0.030*** (3.12)	0.001 (0.71)	0.030*** (3.11)	0.030*** (3.11)
DTurn	0.004* (1.69)	−0.001** (−2.39)	0.004* (1.72)	0.004* (1.72)
Sigma	0.020 (1.32)	0.013*** (5.19)	0.019 (1.25)	0.019 (1.26)
Ret	0.045*** (3.13)	−0.006** (−2.44)	0.046*** (3.15)	0.046*** (3.16)
Size	−0.043*** (−6.75)	0.016*** (15.35)	−0.045*** (−6.98)	−0.044*** (−6.86)
BM	0.136*** (4.30)	0.029*** (5.57)	0.134*** (4.23)	0.134*** (4.23)
LEV	0.074** (1.97)	0.006 (0.89)	0.074** (1.97)	0.074** (1.96)
ROA	−0.607*** (−5.28)	0.593*** (31.16)	−0.656*** (−5.61)	−0.649*** (−5.41)
Constant	1.366*** (10.57)	−0.403*** (−18.88)	1.392*** (10.64)	1.395*** (10.63)
Sample Size	11,069	11,069	11,069	11,069
R-squared	0.013	0.148	0.002	0.013
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Discussion

Using causal inference, this paper finds that firms' disclosure of internal control deficiencies does not by itself cause significant fluctuations in share price crash risk,

but firms with internal control deficiencies are more likely to experience future share price crashes. This view is consistent with Xue and Ying (2020).

There is a relative lack of research on the impact of internal control on stock price collapse, this paper argues that information transparency is the key path linking the effectiveness of internal control and the risk of stock price collapse, and empirical research through the mediation effect test process finds that effective internal control can improve the transparency of corporate information and thus reduce the risk of stock price collapse. The study's view is consistent with Yin (2023).

Regarding the mechanism and path of influence of internal control effectiveness on stock price crash risk. Considering the characteristics of China's internal control norms which are classified and implemented in batches, this paper examines the impact of the implementation of internal control norms on the effectiveness of internal control, information transparency, and even the risk of stock price collapse of listed companies, and finds that after the implementation of the internal control norms, the effectiveness of internal control of listed companies has been significantly strengthened, the transparency of information has been significantly improved, and the risk of stock price collapse has been effectively suppressed.

These findings support the notion that transparency, facilitated by effective internal control, plays a crucial role in mitigating the risk of stock price collapse (Yang, 2022).

6. Conclusion

Firms with higher internal control effectiveness have higher information transparency. Strengthening firms' internal controls is important for reducing the risk of stock price crashes, i.e., improving the quality of internal controls in Chinese listed firms helps reduce the risk of stock price crashes due to management concealing bad news, and this impact effect also still holds during the stock market crash. This finding holds after controlling for endogeneity problems.

The more transparent the information, the lower the likelihood of negative extreme returns in the share price of the company. Market risks are exacerbated when capital markets are not sufficiently transparent and when there are various interest groups that lead to ambiguous market information or even deliberately distorted interpretations. Listed companies need to continuously improve the transparency of company information so that investors can promptly grasp the true cause of the crash, and understand whether the crash is caused by individual company risks, or whether the crash is triggered by systemic risks in the industry.

Information transparency plays the role of a mediating variable in the relationship between internal control and stock price crash. This paper tests the mechanism by which internal control effectiveness affects stock price crash risk by influencing information transparency and confirms that information transparency is the critical path through which internal control effectiveness affects stock price crash risk.

There are some limitations to the research in this paper. There are more methods of measuring the quality of internal control. Academics have not formed a

unified opinion on exactly which method to use. This paper adopts the DIB internal control index as a measure of internal control quality, which may be incomplete. There are many factors affecting the risk of stock price collapse, and this paper does not put more influencing factors into the research model at the same time to control for them, which may leave out certain variables. Subsequent studies may consider more comprehensive control of variables to improve the fit of the model. The sample used in this paper is the data of Chinese A-share main board listed companies. This paper chooses the data on securities in China, whether the research results can reflect the actual situation in other countries needs to be further studied.

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