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M&A goodwill, information asymmetry and stock price crash risk

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ABSTRACT

The collapse of stock prices have a huge negative impact on financial markets and the real economy, the mechanism and prevention methods of stock market crashes have become the focus of academic attention. This article takes Chinese A-share listed companies from 2008 to 2016 as samples and investigates the impact of M&A goodwill on the risk of stock price crashes. The study finds that, compared with non-goodwill companies, companies with goodwill have a greater risk of future stock price crashes; with the increase of goodwill value (GW), the risk of future stock price crashes increases significantly. Further research shows that the GW affects the risk of stock price crashes through information asymmetry at the corporate and market levels. This article not only deepens the research on the factors influencing the risk of stock price crashes, but also has great significance in understanding the role of M&A goodwill in the capital market and how to prevent stock price crashes and promote the orderly development of the capital market.

1. Introduction

As an important way to integrate capital market resources, M&A plays a significant role in improving the efficiency of capital allocation, rapidly expanding the scale of enterprises and enhancing competitiveness. With the rapid increase of mergers and acquisitions in recent years, goodwill value (GW), as an accompanying product of mergers and acquisitions, has blowout growth. The total net GW of A-share listed companies expanded from 37.613 billion RMB in 2007 to 1445.7 billion RMB in 2018. Merger and acquisition of goodwill has become the focus of capital market attention. Although goodwill can bring excess profits to enterprises, due to the opacity of M&A information disclosure and the deviation of goodwill measurement methods in A-share listed enterprises, the real value of goodwill disclosed by many enterprises has not been reflected, and the problem of the sharp rise and fall of stock

prices caused by M&A has gradually become prominent. In theory, the collapse of stock prices has attracted much attention because it cannot be explained by the traditional efficient market theory.

Some scholars have analysed the influencing factors of stock price collapse risk from the perspective of management behaviour. Xu Nianxing et al. (2012) studied the herding behaviour of institutional investors, Li Bilian (2016) studied pledge of major shareholders, Kim et al. (2011) analysed equity incentive. Others examine earnings quality, such as Yang Mianzhi and Liu Yang (2016), Ye Kangtao et al. (2015) analysed disclosure of internal control information by analysing accounting information quality. However, few scholars have paid attention to the impact of M&A goodwill on stock price crashes. Only Wang Wenjiao et al. (2017) and Yang Wei et al. (2018) have studied the relationship between goodwill and stock price collapse from the perspective of accounting conservatism and stock price bubbles. The effects of information asymmetry and investor overreaction on goodwill and stock price crash are still not discussed.

This article investigates the impact of M&A goodwill on the risk of stock price crash by taking A-share listed companies from 2008 to 2016 as samples. The results show that: (1) Compared with non-goodwill companies, the goodwill companies can significantly increase the risk of future stock price crash; (2) The GW is positively correlated with the risk of future stock price crash; (3) Further research shows that the multiplier of goodwill and information opacity is positively correlated with the risk of stock price crash, which indicates that the information asymmetry hypothesis has an effective effect on the impact of M&A goodwill on the risk of stock price crash; and (4) The multiplier of goodwill and negative media reports is negatively correlated with the risk of stock price crash, which indicates that the information asymmetry hypothesis effectively acts on the impact of M&A goodwill on the risk of stock price crash. The main contributions of this article are as follows: Firstly, the existing research on the risk of stock price crash has not paid enough attention to merger goodwill. This article examines the relationship between goodwill and stock price crash risk, enriching the research in this field. Secondly, unlike the previous literature which focuses on one of the internal and market levels, this article studies the mechanism of goodwill's impact on the risk of stock price crash at the market level and company levels based on the information asymmetry hypothesis.

2. Theoretical analysis and hypothesis

Because the stock price crash will have a huge negative impact on the financial market and the real economy, scholars have carried out extensive and thorough research on the mechanism of the risk of stock price crash. As early as the 1980s, scholars began to theoretically model the risk of stock price collapse. Blanchard and Watson (1982) found that the price of assets would deviate from the basic value under the rational behaviour and rational expectation, and a bubble item was derived from the linear rational expectation model. Therefore, they believed that the stock price bubble was the reason for the collapse of share price. Campbell and Hentschel (1992) argued that both bad and good news would increase expected stock price volatility. In order

to compensate for the risk of stock price volatility, investors would demand higher returns. Good news would lead to upward fluctuations in stock prices, but higher expected returns would offset some fluctuations. However, when bad news came, investors would expect higher returns. The degree of influence of share price fluctuation caused by sharp negative news is larger than that caused by positive news, so it can be inferred that the stock price crash is caused by asymmetric volatility. Later, some scholars relaxed the condition of complete information, and studied the phenomenon of stock price soaring and plunging from the perspective of information asymmetry. Based on the information asymmetry hypothesis, Grossman (1988) proposed that the stock market is an incomplete information market, and then explained the causes of stock price crash from the perspective of information asymmetry by using incomplete information to build a model. Subsequently, Romer (1993) further found that the incomplete information in the stock market is mainly internal information. Hutton et al. (2009) pointed out that managers tend to conceal 'bad news' because of career concerns, job promotion and option exercise. When negative news accumulates to a limit that cannot be concealed, it will erupt in the external market, and the company's share price will be hit so hard that it crashes.

These theories and hypotheses enriched the academic research on the causes of stock price crash. However, previous studies had shown that the main reason for the risk of stock price crash was that managers hide bad news from investors and markets in order to realise their own interests (Kothari et al., 2009; Kim et al., 2011). Under this theoretical framework, scholars mainly studied the risk of stock price crash from the market level and corporate level. At the company level, Jiang Hongyun and Wang Xiongyuan (Hongyun & Xiongyuan, 2018) proposed that the more fully the disclosure of internal supervision information and the higher the quality of internal control, the lower the risk of stock price collapse. Sun Shuwei et al. (2017) found that there was a significant positive correlation between executive reduction and stock price crash risk. Wang Huacheng et al. (2015) found that the higher the proportion of major shareholders, the stronger the supervisory role of the company, and the lower the risk of stock price collapse. On the market level, Lin Yongjian et al. (2018) believed that the higher the liquidity of stock, the greater the risk of stock price crash. Xu et al. (2013) found that the more external analysts focused on companies, the greater the risk of stock price crash, the more optimistic the analysts, the higher the risk.

Goodwill refers to the difference between the acquirer's merger cost and the fair value of the identifiable net assets acquired from the acquiree in the merger. The asset injection behaviour of the major shareholders will not change the goodwill of the company. Only when the listed company implements the nonrelated market-oriented M&A will the premium paid be included in the goodwill, so the goodwill is equal to the premium paid in the market-oriented M&A of the listed company. Few articles have studied the impact of M&A goodwill on stock price crash under the mechanism of asymmetric information. According to the provisions of Accounting Standards for Enterprises No. 20-Merger of Enterprises, in the merger of enterprises under different control, the difference between the purchaser's merger cost and the fair value share of the purchased party's identifiable net assets obtained in the merger

shall be recognised as goodwill of merger and acquisition. M&A goodwill, as an intangible asset accompanied by merger and acquisition, has relatively low transparency in the process of value confirmation. At the corporate level, M&A goodwill is likely to be manipulated by managers to achieve their own interests. Zhao Yan and Zhao Xiufang (2016) proposed that the amount of goodwill confirmed in M&A has a significant positive impact on the improvement of executive compensation after M&A. Masters-Stout et al. (2008) pointed out that if there is a large-scale impairment of goodwill, the tenure of senior executives generally does not exceed three years. Because M&A goodwill can improve company performance, and many company executives' salaries are linked to company profits, for the purpose of career and salary, company managers tend to increase the price of M&A goodwill to ensure their positions and salaries. At the market level, M&A goodwill may be used by companies to modify current accounting information. Zheng Haiying et al. (2014) believed that the company paid higher goodwill could improve the current company performance, and goodwill cost had a significant negative correlation with the company performance in the future. This shows that goodwill cannot continuously improve the company's performance, so the price of goodwill recorded on the balance sheet (historical cost) can not reflect its true value, goodwill is likely to exist as a tool for companies to whitewash accounting information.

The M&A of Chinese listed companies needs a long period of administrative approval. The repeated and continuous 'fermentation' of M&A favourable information easily pushes up the stock price. Investors are prone to overreact to M&A, which is a major event in improving the company's fundamentals. At the same time, the longer administrative approval process and the restricted circulation of new shares in the lock up period create favourable conditions for the rise in stock prices, which makes the stock price easy to generate bubbles. The result is that investors will overreact to M&A, which will lead to bubbles and collapse of share prices. Therefore, this article argues that the confirmation of M&A goodwill exists in information asymmetry at both corporate and market levels, and information asymmetry will make the stock price deviate from its basic value. When the negative news caused by information asymmetry breaks out in the market, it will trigger the stock price crash. Based on the above research, we propose hypotheses H_1 and H_2:

> **Hypothesis H_1:** Companies that generate goodwill are more likely to exacerbate the risk of future stock price crashes than companies that do not generate goodwill.

> **Hypothesis H_2:** Goodwill adjusted by net profit is positively correlated with future stock price crash risk.

In order to explain the impact of goodwill on stock price collapse on the basis of information asymmetry, this article argues that at the corporate level, information opacity can effectively capture the traces of corporate earnings manipulated by corporate management through huge goodwill mergers for their own interests. Fu Chao, et al. (2016) found that the goodwill of some listed companies has the problem of accounting information quality, and further pointed out that goodwill may become a tool for corporate executives to manipulate earnings. Therefore, this article defines the absolute value of manoeuvrable accruals as information opacity to reflect the behaviour of corporate management in controlling the scale of mergers and acquisitions goodwill. On the market level, the amount of bad news disclosed by the media

reflects the degree of information asymmetry between companies and investors. The more negative news the media has, the more widely the company's information whitewash is known by the market and investors. On the contrary, the less negative news the media has, the less supervision the media has on the company, the more covert the company's behaviour of tampering with accounting information. The degree of information asymmetry between companies and investors is higher, which is more likely to trigger stock price crashes. Regarding the role of the media in the stock price crash, Luo Jinhui and Du Xingqiang (Jinhui & Xingqiang, 2014) argued that compared with enterprises with high media attention, enterprises with less media attention have a higher degree of information asymmetry and a more significant risk of stock price crashes. Therefore, this article defines the amount of bad news disclosed by the media as negative media reports to reflect the degree of information asymmetry between the company and the market. According to the representation of asymmetric information usage mechanism at the corporate and market levels, hypotheses H3 and H4 are proposed in this article.

> **Hypothesis H3:** The more opaque the company's information and the more room for management to manipulate earnings, the more positive impact of GW on the risk of future stock price crash.

> **Hypothesis H4:** The less negative media coverage and the less media supervision over companies, the more positive impact of GW on future stock price crash risk.

3. Research design

3.1. Sample selection and data sources

Goodwill officially appeared in corporate statements in 2007 as a separate subject. However, due to the small scale of goodwill in 2007, goodwill was included in the balance sheet gradually and normalised after 2008. Therefore, this article takes A-share listed companies in 2008–2016 as the research object. Based on the existing literature (Xuanyu & Nianxing, 2015; Kangtao et al., 2015), this article excludes the following samples: (1) Regulated financial companies, as well as companies whose stocks are specially processed; (2) Companies that have withdrawn from the market; (3) Samples with less than 30 trading weeks per year so as to avoid the impact of too few trading weeks on the estimation of stock price crash risk; and (4) Data missing samples. The annual sample of 17,142 listed companies was obtained. This article uses the command winsor2 to tail the continuous variables on both sides of this article at the 1% level. In addition, We cluster the regression criteria at the corporate level to ensure that the regression results are unbiased. The relevant data in this article are from Cathay Tai'an database, Wind database and Baidu News.

3.2. Variable definition

3.2.1. Stock price crash risk
Referring to Hutton et al. (2009), Kim et al. (2011), this article uses two indicators to measure the risk of stock price crash. The specific process is as follows:

Firstly, in model (1), the weekly return of stock i was regressed by market rate of return.

$$R_{i,t} = \alpha_i + \beta_1 R_{m,t-2} + \beta_2 R_{m,t-1} + \beta_3 R_{m,t} + \beta_4 R_{m,t+1} + \beta_5 R_{m,t+2} + \varepsilon_{i,t} \quad (1)$$

Among them, Ri, t is the weekly rate of return of stock i, Rm,t is the A-share market yield rate considering the cash income, εi, t is the residual of regression result of model 1, which is the part of the stock return that cannot be explained by the market. If this part is negative, it means that stock i is falling when it is affected by factors other than the market. Therefore, if εi,t is negative, and the absolute value is larger, it means that the company's stock price has a larger decline due to non-market reasons, and the more likely it is to cause the stock price collapse risk. In order to achieve the normal distribution of e, we use the formula Wi, t = ln(1 + εi,t) to adjust εi,t to obtain the trait yield Wi,t.

The first indicator of negative income skewness coefficient NCSKEWi, t is calculated as:

$$NCSKEW_{i,t} = -\left[n(n-1)^{3/2} \sum W_{i,t}^3 \right] \Big/ \left[(n-1)(n-2)\left(\sum W_{i,t}^2\right)^{3/2} \right] \quad (2)$$

In model 2, n is the number of trading weeks of stock i in year t. The larger the value of this indicator, the higher the risk of stock price collapse.

The second indicator yield is the upper and lower volatility ratio DUVOLi, t, which is calculated as:

$$DUVOL_{i,t} = \log \left\{ \left[(n_u - 1)\sum\nolimits_{down} W_{i,t}^2 \right] \Big/ \left[(n_d - 1)\sum\nolimits_{up} W_{i,t}^2 \right] \right\} \quad (3)$$

Among them, nu (nd) is the number of weeks in which the weekly return of stock i is higher (lower than) the average of the current year's return. The greater the DUVOLi, t, the higher the risk of stock price collapse.

3.2.2. Goodwill

(1) This article uses the dummy variable (GW_dum) to divide the observation into a goodwill group and a non-goodwill group. When generating goodwill, the dummy variable is 1, otherwise it is 0.

(2) This article selects the GW adjusted by net profit as the explanatory variable. We use the GW of the company's t-year balance sheet minus the GW recorded in the company's t-1 year balance sheet to get the increment value of goodwill. The incremental value is then divided by the company's net profit for the t-year to get the GW.

There are three reasons for the design of the explanatory variables: Firstly, the GW adjusted by the net profit can effectively show the increment value of goodwill every year to determine whether the merger or acquisition of the company occurs. Secondly, according to the research of Zheng Haiying et al. (2014), goodwill is positively correlated with the company's performance. The greater the GW, the smaller the ability of goodwill to improve the performance of the current year, which shows that the

goodwill price does not match its true value, and there are traces of human manipulation. Thirdly, the GW adjusted by net profit can effectively control the interference of the company's net profit on the scale of goodwill.

3.2.3. Information asymmetry

(1) This article uses information opacity AbsACC as a variable to measure the degree of information asymmetry of listed companies at the company level, that is, the absolute value of manipulated accruals obtained according to the Jones model. The greater the value of AbsACC, the lower the transparency of the company's information. Here is the formula used to calculate AbsACC:

$$TA_t/A_{t-1} = \alpha_1(1/A_{t-1}) + \alpha_2(\Delta S_t/A_{t-1}) + \alpha_3(PPE_t/A_{t-1}) + \varepsilon \quad (4)$$

$$NDA_t = \alpha_1(1/A_{t-1}) + \alpha_2(\Delta S_t - \Delta R_t)/A_{t-1} + \alpha_3(PPE_t/A_{t-1}) \quad (5)$$

$$DA_t = TA_t/A_{t-1} - NDA_t \quad (6)$$

$$AbsACC = abs(DA_t) \quad (7)$$

Firstly, the model (4) is used to control the year and the industry to perform regression, and the coefficients α1, α2, and α3 are obtained. Secondly, the coefficient is substituted into the model (5) to calculate NDAt. Then, DAt is calculated using the data obtained by the models (4) and (5) in the model (6). Finally, the absolute value of DAt is obtained, and the information opacity AbsACC is obtained.

Among them, TAt is the total accrual item of the company in this year, which is the difference between net profit and operating cash flow; At-1 is the total assets of the company in the previous year; NDAt is the non-manipulated accrued surplus of the company this year; ΔSt is the company's non-manipulated accrued surplus for the current year; ΔRt is the increment of accounts receivable of the company in the current year and the previous year; PPEt is the fixed assets of the company for the current year; DAt is the operational accrued surplus of the company for the current year.

(2) Media negative reports (Badnewst) refers to the number of bad news of a company disclosed by the media in the t-th year. This article uses Badnewst as a variable to measure the degree of information asymmetry of listed companies at the market level. The smaller the number of Badnewst, the higher the information asymmetry of the company. The source of this variable is Baidu News. We use the name of the listed company as the keyword, search the full text of the article in Baidu News, and find the negative news number by searching the topic and keywords, that is, the number of negative messages on the company i in the t-year.

3.2.4. Control variables

See Chen et al. (2001), Hutton et al. (2009), Kim et al. (2011) and Wang Huacheng et al. (2015) for related research. This article selects the company size, Tobin Q value, total return on assets, asset-liability ratio, monthly average excess turnover rate,

Table 1. Definition and measurement of variables.

	Variable symbol	Variable name and measurement method
Dependent Variables	$NCSKEW_{t+1}$	The Skewness Coefficient of Negative Stock Return in $t+1$ Year to Measure the Risk of Stock Market Crashes.
	$DUVOL_{t+1}$	The fluctuation ratio of the company's stock return in $T+1$ year to measure the risk of stock price crashes.
Independent Variables	GW_dum_t	Dummy variable, when the sample produces goodwill in the t-year, the dummy variable is 1, otherwise 0.
	GW_t	The adjusted value of goodwill in the year t, calculated as (the GW on the balance sheet of this year – the GW on the balance sheet of last year)/ the total assets of this year.
	$AbsACC_t$	The absolute value of accruals can be manipulated by the company in year t, which is calculated according to Jones model.
	$Badnews_t$	The number of bad news about a company disclosed by the media in year t comes from Baidu News.
Control Variables	$Size_t$	The size of the company in year t, equal to the natural logarithm value of the total assets of the company.
	$TobinQ_t$	Tobin Q value in year t, equal to the company's market value/asset replacement cost.
	ROA_t	Total Return On Asset in Year t
	Lev_t	Asset-liability ratio in year t
	$Turn_t$	Trend-adjusted stock turnover rate in year t, equal to the average monthly turnover rate in this year – the average monthly turnover rate in the previous year.
	Ret_t	The annual average of idiosyncratic rate of return in year t.
	$Sigma_t$	The annual S.D of idiosyncratic rate of return in year t.
	Year	Dummy variable, when the sample belongs to a certain year, the dummy variable takes 1, otherwise takes 0. The sample span of this article is eight years, with 2008 as the base period, a total of seven annual virtual variables annual factors are introduced to control the factors.
	Industry	Dummy variable, when the sample belongs to a certain industry, the virtual variable takes 1, otherwise takes 0. According to the Guidelines for Classification of Listed Companies in 2001, 17 industries were obtained after excluding insurance and financial industries. Therefore, 16 industry virtual variables were introduced to control industry factors.

Source: The Authors.

annual average of trait yield, and annual standard deviation of trait yield as control variables . In addition, this article also controls the year and industry (Table 1).

3.3. Test model

3.3.1. Test model for Hypothesis 1

The study assumes that the test model for H1 is as in model (8). NTSKEW and DUVOL of $t+1$ years respectively measure the future collapse risk of the company's stock price, Crashi, $t+1$; GW_dum is the dummy variable of whether the company generates goodwill this year; Year and Industry are dummy variables.

$$Crash_{i, t+1} = \beta_0 + \beta_1 GW_d um_{i, t} + \gamma ControlVariables_t + Year + Industry + \varepsilon \quad (8)$$

3.3.2. Test model for Hypothesis 2

This article uses model (9) to analyse the goodwill on the risk of stock price collapse, where GW is the goodwill adjusted by net profit.

$$\text{Crash}_{i,t+1} = \beta_0 + \beta_1 \text{GW}_{i,t} + \gamma \text{ControlVariables}_t + \text{Year} + \text{Industry} + \varepsilon \qquad (9)$$

This article uses the model (10) to test whether there is a nonlinear relationship between the goodwill and the stock price crash risk.

$$\text{Crash}_{i,t+1} = \beta_0 + \beta_1 \text{GW}_{i,t} \times P_1 + \beta_2 \text{GW}_{i,t} \times P_2 + \beta_3 \text{GW}_{i,t} \times P_3 + \beta_4 \text{GW}_{i,t} \times P_4$$
$$+ \gamma \text{ControlVariables}_t + \text{Year} + \text{Industry} + \varepsilon \qquad (10)$$

P1–P5 divides the observations with goodwill greater than 0 from small to large into five dummy variables generated by quintiles.

3.3.3. Test model for Hypothesis 3

In order to test whether information asymmetry is the mechanism of goodwill's risk of stock price collapse, and analyse the influence of information opacity on the relationship between goodwill and stock price collapse, this article adds the intersection term GW × AbsACC to obtain model (11). According to the hypothesis H3, the coefficient of the intersection term GW × AbsACC should be significantly positive, and the coefficient of the two measures of the goodwill GW and the stock price crash risk should still be significantly positive, indicating that the higher the information opacity, the more significant the positive correlation between goodwill and stock price collapse risk.

$$\text{Crash}_{i,t+1} = \beta_0 + \text{GW}_{i,t} + \beta_2 \text{GW}_{i,t} \times \text{AbsACC}_t + \gamma \text{ControlVariables}_t + \text{Year}$$
$$+ \text{Industry} + \varepsilon \qquad (11)$$

3.3.4. Test model for Hypothesis 4

In order to test whether information asymmetry is the mechanism of goodwill to aggravate the risk of stock price collapse, and analyse the influence of negative media reports on the relationship between goodwill and stock price collapse, this article adds the intersection term GW × Badnews to model (12). According to the hypothesis H3, the coefficient of the intersection term GW × Badnews should be significantly negative, but the coefficient of the two measures of GW and stock price collapse risk should still be significantly positive; This means that the fewer negative media reports, the stronger the positive impact of goodwill on the stock price crash risk.

$$\text{Crash}_{i,t+1} = \beta_0 + \beta_1 \text{GW}_{i,t} + \beta_2 \text{GW}_{i,t} \times \text{Badnews}_t + \gamma \text{ControlVariables}_t + \text{Year}$$
$$+ \text{Industry} + \varepsilon \qquad (12)$$

4. Empirical research results

4.1. Descriptive statistics

Table 2 shows the descriptive statistical results of the main variables studied in this article. The results show that the mean values of NCKSEWt + 1 and DUVOLt + 1

Table 2. Descriptive Statistics of Major Variables.

Variable symbol	Sample size	Mean	Median	S.D	Min	Max
$NCSKEW_{t+1}$	17142	−0.2559	−0.2148	0.6815	−2.3310	1.5052
$DUVOL_{t+1}$	17142	−0.1658	−0.1577	0.4715	−1.3320	0.9927
GW_t	17142	0.1809	0.0000	0.8797	−0. 3621	6.8301
GW_dum_t	17142	0.2388	0.0000	0.4264	0.0000	1.0000
$Badnews_t$	17142	44.0615	24.0000	55.4792	2.0000	294.0000
$AbsACC_t$	17142	0. 0749	0.0435	0.0863	0.0009	0.5183
$Size_t$	17142	21.9722	21.7919	1.2760	19.4517	25.8784
$TobinQ_t$	17142	2.6784	2.0472	1.9377	0.9111	11.8096
ROA_t	17142	0.0451	0.0398	0.0558	−0.1573	0.2235
Lev_t	17142	0.4446	0.4419	0.2162	0.0478	0.9458
$Turn_t$	17142	−0.0054	−0.0282	0.4646	−1.0901	1.7232
Ret_t	17142	−0.0015	−0.0011	0.0013	−0.0076	−0.0002
$Sigma_t$	17142	0.0511	0.0474	0.0200	0.0186	0.1229

Source: The Authors.

are −0.2559 and −0.1658, the median values are −0.2148 and −0.1577, and the standard deviations are 0.6815 and 0.4715 respectively. This indicates that there is a large difference between the two indicators, and the distribution is left-sided. The mean value of goodwill is 0.1809 greater than the median value (0.0000), the maximum value is 6.8301, and the minimum value is −0.3621. It represents goodwill with strong right bias, and the difference of GW between companies has increased. The standard deviation of GW_dum is 0.4264. The degree of goodwill produced by listed companies varies greatly. The maximum value of Badnews is 294 and the minimum value is 2. There are obvious differences in the negative reports of the media on each company. The standard deviation of AbsACC is 0.0863, and the maximum and minimum values are 0.5183 and 0.0009. The difference of information opacity between listed companies is not obvious.

4.2. Statistical analysis of correlation

Table 3 analyses Pearson correlation coefficients of the main variables. The correlation between dependent variables NCKSEWt + 1 and DUVOLt + 1 is 0.88, which is a very significant positive correlation, representing the strong consistency of the two variables. The correlation coefficients between goodwill (GW_dum) and the two dependent variables are 0.041 and 0.031, respectively, which are significantly positive at the level of 1%. In addition, the correlation between goodwill and the two dependent variables is significantly positive at the level of 1%. The correlation is 0.043 and 0.040, which preliminarily proves H1 and H2. As for the relationship between information asymmetry index and dependent variable, AbsACC and dependent variables are not significant, but Badnews and two dependent variables are significantly positively correlated at the level of 1%.

4.3. Univariate analysis

Before regression analysis, we did univariate analysis of the main variables. According to whether the sample company produces goodwill this year, we divide the total sample into sub-samples of goodwill this year (hereinafter referred to as goodwill) and

Table 3. Relevance analysis of major variables.

变量	NCSKEWt + 1	DUVOLt + 1	GWt	GW_dumt	AbsACCt	Badnewst	Sizet	TobinQt	ROAt	Levt	Turnt	Rett	Sigmat
NCSKEWt+1	1.000												
DUVOLt+1	0.880***	1.000											
GWt	0.043***	0.040***	1.000										
GW_dumt	0.041***	0.031***	0.367***	1.000									
AbsACCt	0.002	−0.002	0.021***	−0.014*	1.000								
Badnewst	−0.056***	−0.072***	−0.041***	0.038***	0.006	1.000							
Sizet	−0.130***	−0.147***	0.008	0.112***	−0.046***	0.482***	1.000						
TobinQt	0.149***	0.147***	0.062***	0.029***	0.055***	−0.109***	−0.466***	1.000					
ROAt	0.076***	0.074***	−0.001	0.056***	0.028***	0.102***	−0.005	0.251***	1.000				
Levt	−0.094***	−0.111***	−0.069***	−0.026***	0.114***	0.172***	0.443***	−0.329***	−0.409***	1.000			
Turnt	−0.000	0.005	0.011	−0.012	0.034***	−0.004	−0.064***	0.180***	0.067***	−0.094***	1.000		
Rett	−0.014*	0.000	−0.190***	−0.091***	−0.042***	0.099***	0.212***	−0.453***	0.018**	0.074***	−0.381***	1.000	
Sigmat	0.031***	0.015**	0.180***	0.090***	0.053***	−0.119***	−0.260***	0.453***	−0.020***	−0.076***	0.381***	−0.970***	1.000

Source: The Authors.

Table 4. Difference test.

| Variables | Non-goodwill (1) | | Goodwill (2) | | Difference test (2)–(1) |
	N	Mean	N	Mean	T
$NCSKEW_{t+1}$	13048	−0.272	4094	−0.206	0.066***
$DUVOL_{t+1}$	13048	−0.174	4094	−0.140	0.034***
GW_t	13048	0.000	4094	0.758	0.758***
$Badnews_t$	13048	42.876	4094	47.839	4.963***
$AbsACC_t$	13048	0.070	4094	0.067	−0.003*
$Size_t$	13048	21.892	4094	22.228	0.336***
$TobinQ_t$	13048	2.647	4094	2.778	0.131***
ROA_t	13048	0.043	4094	0.051	0.008***
Lev_t	13048	0.448	4094	0.435	−0.013***
$Turnover_t$	13048	−0.002	4094	−0.015	−−0.013
Ret_t	13048	−0.001	4094	−0.002	−0.001***
$Sigma_t$	13048	0.050	4094	0.054	0.004***

Source: The Authors.

sub-samples of non-goodwill this year (hereinafter referred to as non-goodwill). Table 4 shows descriptive statistics and their difference tests for the relevant variables under sample grouping.

By comparing the two groups of samples, we draw four conclusions: (1) The negative return skewness coefficient NCSKEWt + 1 and the fluctuation ratio DUVOLt + 1 of return are higher in the goodwill group than in the non-goodwill group, indicating that the stock price collapse risk of the goodwill sub-sample is higher in this year; (2) The number of bad news in the goodwill group is higher than that in the non-goodwill group, which indicates that the media tends to disclose more bad news to the companies that produce goodwill in M&A; and (3) The company size, Tobin Q value and total asset return of the goodwill group are significantly higher than that of the non-goodwill group, indicating that M&A goodwill mostly occurs in the companies with larger scale, overvalued market value and better profitability. The difference test results provide preliminary support for hypothesis H1.

4.4. Regression analysis

4.4.1. Verify Hypothesis H1
Table 5 shows the regression results between goodwill and the risk of stock price crash. The results of regression (1) and (3) show that the coefficients of GW_dum and NCSKEWt + 1 and DUVOL t + 1 are 0.0466 and 0.0164 respectively, and there is a significant positive correlation between GW_dum and NCSKEWt + 1 and DUVOL t + 1 at 5% and 10% levels. After adding control variables, the regression coefficients of (2) and (4) were 0.0559 and 0.0270 respectively, with significant positive correlation at 1% and 5% levels. Compared with regression (1) and (3), the significance was improved. The above results are consistent with hypothesis H1.

4.4.2. Verify Hypothesis H2
The results of Table 6 show that goodwill in regression (1–4) is positively correlated with NCKSEWt + 1 and DUVOLt + 1 at 1% level, with coefficients of 0.0226, 0.0214, 0.0120 and 0.0123 respectively. The significance of goodwill GW to

Table 5. The regression result of goodwill and stock price crash risk.

Variable	NCSKEWt + 1		DUVOLt + 1	
	(1)	(2)	(3)	(4)
GW_dumt	0.0466**	0.0559***	0.0164*	0.0270**
	(3.89)	(5.31)	(2.17)	(3.93)
Sizet		−0.0356***		−0.0361***
		(−9.11)		(−9.07)
TobinQt		0.0249***		0.0135***
		(9.36)		(7.49)
ROAt		0.578***		0.379***
		(6.18)		(4.64)
Levt		−0.0271		−0.0259
		(−0.67)		(−0.71)
Turnovert		−0.0362***		−0.0109
		(−5.10)		(−1.58)
Rett		96.51***		69.63***
		(5.74)		(9.93)
Sigmat		7.730***		5.201***
		(7.33)		(11.00)
_cons	−0.413***	−0.0159	−0.339***	0.208*
	(−13.48)	(−0.18)	(−16.41)	(2.30)
year&ind	control	control	control	control
Cluster	control	control	control	control
N	17142	17142	17142	17142
adj. R − sq	0.056	0.079	0.063	0.088

Source: The Authors.

Table 6. The regression result of goodwill value and stock price crash risk.

Variable	NCSKEWt + 1		DUVOLt + 1	
	(1)	(2)	(3)	(4)
GWt	0.0226***	0.0214***	0.0120***	0.0123***
	(6.98)	(6.57)	(4.81)	(4.92)
Sizet		−0.0315***		−0.0338***
		(−8.87)		(−9.01)
TobinQt		0.0263***		0.0147***
		(10.29)		(8.49)
ROAt		0.554***		0.353***
		(5.71)		(4.25)
Levt		−0.0316		−0.0293
		(−0.77)		(−0.82)
Turnt		−0.0383***		−0.0127*
		(−5.60)		(−2.00)
Rett		98.02***		69.55***
		(6.14)		(10.50)
Sigmat		7.876***		5.244***
		(7.58)		(11.04)
_cons	−0.398***	−0.0961	−0.330***	0.162
	(−14.04)	(−1.17)	(−17.63)	(1.94)
year&ind	control	control	control	control
Cluster	control	control	control	control
N	17142	17142	17142	17142
adj. R-sq	0.0578	0.0799	0.0644	0.0892

Source: The Authors.

NCKSEWt + 1 is stronger than that of DUVOLt + 1, but different from regression (2) t value decreases after adding control variables, and regression (4) which explains the relationship between goodwill GW and DUVOLt + 1 increases significantly after

Table 7. Nonlinear relationship between goodwill value and stock price crash risk.

Variable	NCSKEWt + 1		DUVOLt + 1	
	(1)	(2)	(3)	(4)
P1 × GWt	2.101	4.063	−0.990	0.275
	(0.73)	(1.45)	(−0.51)	(0.14)
P2 × GWt	1.082	1.039	0.504	0.460
	(1.47)	(1.44)	(1.07)	(1.02)
P3 × GWt	0.370**	0.319*	0.210	0.164
	(2.65)	(2.45)	(1.86)	(1.67)
P4 × GWt	0.0612*	0.0307	0.0283	0.00794
	(2.34)	(1.04)	(1.29)	(0.34)
P5 × GWt	0.0214***	0.0179***	0.0154***	0.0139***
	(4.15)	(3.67)	(4.54)	(4.73)
Sizet		−0.0703***		−0.0601***
		(−6.60)		(−8.47)
TobinQt		0.0259**		0.0122**
		(2.83)		(2.65)
ROAt		0.640**		0.357
		(2.59)		(1.82)
Levt		0.0337		0.00936
		(0.43)		(0.20)
Turnt		−0.0582**		−0.0177
		(−2.72)		(−0.63)
Rett		43.17		48.94*
		(1.28)		(2.51)
Sigmat		3.751		3.031*
		(1.57)		(1.97)
_cons	−0.521***	0.755**	−0.405***	0.752***
	(−6.07)	(2.60)	(−7.42)	(4.26)
year&ind	control	control	control	control
Cluster	control	control	control	control
N	3153	3153	3153	3153
adj. R − sq	0.0613	0.0938	0.0690	0.1010

Source: The Authors.

adding control variables. Therefore, we can find that the results of regression (1) ∼ (4) are consistent with the hypothesis H2, and the results are very significant.

The results in Table 6 show that there is a significant positive correlation between GW and stock price crash risk. However, in this article, we find the relationship between GW and management position and annual salary in M&A. Management is motivated to improve performance and realise their own interests by raising the price of goodwill in M&A. We speculate that when goodwill is higher than a critical point, the price of goodwill includes the part manipulated by management, which leads to the risk of stock price collapse. Therefore, 3153 observations of goodwill GW greater than 0 adjusted by net profit are selected and divided into five groups from small to large. Five virtual variables P1–P5 are formed. The values of P1–P5 are 1, 2, 3, 4 and 5 respectively. When the GW of the observed value falls within the range set by the dummy variable, the dummy variable takes one of 1–5, otherwise it takes 0. Then, we use GW and these five dummy variables to compose cross-multiplier, and then use the cross-multiplier to make a regression analysis with the two indicators of stock price crash risk.

Table 7 validates whether goodwill can cause stock price crash risk when it is above a critical point. Regression (1–4) shows that the multiplier between P5 and goodwill GW (P5 * GW) are significantly positive with the risk of stock price crash at the level of 1%, while the regression results of the multiplier of P1–P4 between

goodwill GW (P1–P4 * GW) are only sporadic and significant with the risk of stock price crash, and the results are not obvious. Therefore, when GW is higher than a certain threshold value, it is possible for management to manipulate earnings through mergers and acquisitions of goodwill to realise their own interests. The information asymmetry between enterprises and external investors is higher, which is more likely to cause stock price crash.

4.5. Mechanism analysis-information asymmetry theory

Although the previous analysis supports H2, the underlying mechanism has not yet been verified. Based on the theory of information asymmetry, H3 and H4 analyse the mechanism of goodwill aggravating the risk of stock price crash from the corporate and market levels. According to relevant research and analysis, we infer that the higher the degree of information asymmetry, the more significant the positive correlation between goodwill and stock price crash risk. In order to verify the above speculation, at the corporate level, AbsACC is used as an indicator of information asymmetry; at the market level, Badnews is used as an indicator of information asymmetry. Information opacity AbsACC corresponds to the extent to which management conceals negative information. The greater the value of AbsACC is, the more bad news managers conceal from investors, which means the more serious the information asymmetry is. Negative media reports correspond to the supervision role of the media on listed companies. The less negative media coverage of Badnews, the less effective it represents the role of media supervision, and the less the market understands the bad news of the company. The more false accounting information, the higher the degree of information asymmetry. Therefore, we will use GW * AbsACC, the multiplier of goodwill and information opacity, and GW * Badnews, the multiplier of goodwill and negative media reports, to carry out regression analysis with two indicators measuring the risk of stock price crash respectively, and jointly explain the mechanism of information asymmetry to aggravate the risk of stock price crash.

4.5.1. Corporate level: information opacity to verify Hypothesis H3
From the perspective of information opacity, Jin and Myers (2006) found that companies with low information transparency were more likely to hide negative information and trigger stock price crash. Because the valuation of M&A goodwill involves R&D projects and asset investment, these M&A information cannot be fully disclosed; and the higher the value of M&A goodwill, it gives managers more room to manipulate earnings and hide bad news. Therefore, we predict that information opacity can aggravate the impact of goodwill on the risk of stock price crash.

Table 8 shows the results of regression analysis of the multiplier (GW * AbsACC) and the risk of stock price crash. The coefficients of GW in regression (1–4) were 0.0153, 0.0132, 0.0760 and 0.0893 respectively, which were significantly positive at 5% and 10% levels. More importantly, GW*AbsACC and NCSKEWt + 1 were positively correlated at 1% level in regression (1) and (2), although the coefficients of GW*AbsACC and DUL decreased significantly, the conclusions of regression (1) and (2) remained unchanged. This shows that the higher the opacity of information, the

Table 8. Information asymmetry hypothesis: information opacity.

	NCSKEWt + 1		DUVOLt + 1	
Variable	(1)	(2)	(3)	(4)
GWt	0.0153**	0.0132**	0.00549*	0.00507*
	(3.03)	(2.62)	(2.24)	(1.97)
GWt × AbsACCt	0.0840***	0.101***	0.0760**	0.0893*
	(3.62)	(3.50)	(2.83)	(2.04)
Sizet		−0.0320***		−0.0342***
		(−9.46)		(−9.46)
TobinQt		0.0260***		0.0144***
		(9.25)		(8.51)
ROAt		0.561***		0.362***
		(6.13)		(4.53)
Levt		−0.0299		−0.0273
		(−0.73)		(−0.76)
Turnt		−0.0378***		−0.0122
		(−5.32)		(−1.90)
Rett		98.85***		70.77***
		(6.16)		(10.70)
Sigmat		7.954***		5.323***
		(7.58)		(11.39)
_cons	−0.404***	−0.0856	−0.334***	0.171*
	(−15.14)	(−1.10)	(−19.32)	(2.12)
year&ind	control	control	control	control
Cluster	control	control	control	control
N	17131	17131	17131	17131
adj. R − sq	0.0580	0.0799	0.0648	0.0893

Source: The Authors.

more significant the positive correlation between goodwill and stock price crash risk. This result is consistent with hypothesis H3. Therefore, we can conclude that at the corporate level, information asymmetry theory can effectively explain why goodwill aggravates the risk of stock price crashes.

4.5.2. Market level: media negative reporting to verify Hypothesis H4

Zhang Feng and Xie Jing (2016) proposed that the media as an intermediary of information dissemination would cause synchronous fluctuations in stock prices. Luo Jinhui and Du Xingqiang (Jinhui & Xingqiang, 2014) further pointed out that media coverage of listed companies can significantly reduce the risk of stock price crash. The emergence of negative media reports represents the internal information of the company transmitted to the market. The situation of information asymmetry is reversed. The more information investors get, the closer the stock price is to its basic economic value. Therefore, we speculate that the degree of information asymmetry is relatively high when the media pay less attention to the company and few bad news is known by the market. Lack of negative media coverage will aggravate the impact of goodwill on the risk of stock price crash.

Table 9 shows the results of regression analysis between GW * Badnews and the risk of stock price crash. In regression (1) and (2), GW and NCSKEWt + 1 were significantly positive at 1% level, and the corresponding coefficients of GW*Badnews were −0.000139 and −0.000656 respectively, which were negatively correlated with NCSKEWt + 1 at 1% level. In addition, we found that GW and DUVOLt + 1 in regression (3) and (4) were still positively correlated at 5% level, and the corresponding GW*Badnews coefficients were −0.000780 and −0.000323 respectively, which

Table 9. Asymmetric information hypothesis: negative media reporting.

Variable	NCSKEWt + 1		DUVOLt + 1	
	(1)	(2)	(3)	(4)
GWt	0.0268***	0.0233***	0.0144**	0.0124**
	(4.90)	(4.26)	(2.74)	(2.73)
GWt × Badnewst	−0.000139***	−0.0000656***	−0.0000780*	−0.00000323*
	(−3.42)	(−3.87)	(−1.97)	(−2.46)
Sizet		99.29***		71.31***
		(6.21)		(11.02)
TobinQt		7.970***		5.347***
		(7.63)		(11.60)
ROAt		−0.0275***		−0.0303***
		(−7.20)		(−9.50)
Levt		0.0268***		0.0151***
		(8.25)		(8.33)
Turnt		0.564***		0.365***
		(6.04)		(4.56)
Rett		−0.0340		−0.0302
		(−0.82)		(−0.83)
Sigmat		−0.0383***		−0.0124*
		(−5.59)		(−1.98)
_cons	−0.376***	−0.179*	−0.310***	0.0905
	(−15.31)	(−2.10)	(−20.86)	(1.35)
year&ind	control	control	control	control
Cluster	control	control	control	control
N	17131	17131	17131	17131
adj. R − sq	0.0598	0.0798	0.0681	

Source: The Authors.

were significantly negative with DUVOLt + 1 at 10% level. This proves that the positive correlation between goodwill and stock price crash risk is more significant with less negative media coverage, and confirms the hypothesis of H4. Therefore, we can conclude that information asymmetry theory can effectively influence the impact of goodwill on the risk of stock price crash at the market level.

4.6. Robustness check

4.6.1. Replacement of variables and model metrics

1.   Other Indicators to Measure the Risk of Stock Price Crash

According to the research of Callen and Fang (2015), Wu Xiaohui et al. (2019), we use the difference between downward and upward frequencies of company stock returns to balance the stock price risk. When the company's weekly idiosyncratic yield wi, t is lower than (above) its average of 3.09 standard deviations, we define this week as the down-week (up-week). Then, we calculate the the difference of stock returns between down-week's and up-week's within one year, which is expressed in CRASH COUNTt. The greater the CRASH COUNTt, the greater the probability of price crash. Since CRASH COUNTt is a discrete variable, we test hypotheses H1–H4 by using ordered series multiclass logistic regression, and the relevant conclusions are still valid.

2.   Other Indicators to Measure Goodwill

Table 10. IV estimation results.

Variable	First stage regression (1) GWt	Second stage regression	
		(2) NCSKEWt + 1	(3) DUVOLt + 1
Instrumented GWt		0.304***	0.184***
		(5.15)	(4.60)
Industry-average GW	0.793***		
	(8.38)		
Province-average GW	0.413***		
	(3.57)		
Ownership-average GW	0.622***		
	(9.57)		
Sizet	0.0699***	−0.0447***	−0.0410***
	(8.61)	(−5.79)	(−7.86)
TobinQt	−0.0403***	0.0372***	0.0212***
	(−7.63)	(8.19)	(6.80)
ROAt	−0.303**	0.663***	0.430***
	(−2.90)	(6.01)	(5.66)
Levt	−0.293***	0.0731	0.0350
	(−6.77)	(1.87)	(1.31)
Turnt	−0.150***	0.00731	0.0159
	(−7.57)	(0.44)	(1.40)
Rett	−136.4***	137.9***	94.60***
	(−3.60)	(6.34)	(6.51)
Sigmat	1.216	7.318***	4.927***
	(0.60)	(5.63)	(5.68)
AbsACCt	0.498***	0.176***	0.105***
	(4.99)	(5.48)	(5.56)
Badnewst	−0.000604***	−0.0000451**	−0.0000121**
	(−5.70)	(−2.81)	(−2.92)
_cons	−1.916***	0.249	0.355**
	(−9.39)	(1.33)	(2.81)
year&ind	control	control	control
Cluster	control	control	control
N	17142	17142	17142
adj. R-sq	0.112	.	.

Source: The Authors.

This article uses the adjusted goodwill (the increment of goodwill in this year except the operating profit in this year) and the adjusted goodwill (the increment of goodwill in this year except the total assets in this year) to replace the original adjusted GW, which is adjusted by net profit, to test the hypothesis of H2–H4, and the relevant conclusions remain unchanged.

4.6.2. Endogenous test

Referring to the existing research (Kangtao et al., 2015), this article uses the mean value of goodwill of the same industry, the same region and the same property rights as the tool variable of goodwill, and uses the two-stage least squares (2SLS) method to test the endogeneity. In terms of relevance, there are similarities in business operations, local policies and corporate systems of companies of the same industry, region and property nature, so they are related to the goodwill of the company. In addition, in terms of endogeneity, there is no literature to prove that the goodwill of other companies in the same industry, same region and the same property rights will affect the future stock price crash risk of our company, so the above instrumental variables are exogenous. Table 10 shows the 2SLS estimation results of goodwill and stock

price crash risk. The first stage results show that the relationship between goodwill and three instrumental variables is significant at 1% level. The second stage regression results show that goodwill and $t + 1$ year stock price crash risks are still significantly positively correlated, which is the same as the conclusion of hypothesis H2.

5. Conclusion

Based on the merger goodwill data of Shanghai and Shenzhen A-share listed companies from 2008 to 2016, this article studies the relationship among goodwill, information asymmetry and stock price crash risk on the basis of theoretical analysis and empirical research. The results show that goodwill companies can significantly increase the risk of future stock price crashes. The GW is positively correlated with the risk of future stock price crash. Researches on the mechanism show that information asymmetry theory effectively affects the relationship between goodwill and stock price crash risk. That is, when goodwill affects stock price crash risk, the more opaque corporate information is and the more likely managers manipulate goodwill to realise their own interests, the greater the risk of a stock price crash. The less negative corporate news and the less media supervision, the higher the degree of information asymmetry between companies and investors, and the more significant the risk of stock price crash. The above empirical evidence shows that one of the economic consequences of high goodwill M&A is to aggravate the risk of future stock price crash, but companies can reduce this risk by improving the quality of information disclosure and reducing the degree of information asymmetry.

What needs to be explained is that although this article finds that mergers and acquisitions will lead to the adverse consequences of share price bubbles and collapse, this does not mean a complete negation of the role of the M&A market in optimising the allocation of resources. This article also has some shortcomings. Firstly, the sample of goodwill impairment is insufficient. Secondly, there are many mechanisms of goodwill intensifying the risk of stock price collapse, such as the stochastic bubble hypothesis and the volatility feedback hypothesis. This article studies the mechanism of asymmetric information hypothesis which provides a further perfect space for future research.

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