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Does ESG report greenwashing increase stock price crash risk?

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ABSTRACT

From the perspective of non-financial information greenwashing, this paper investigates the impact mechanism of environmental, social and governance (ESG) report greenwashing on stock price crash risk. The results indicate that ESG report greenwashing increases the stock price crash risk. In high earnings management companies, ESG report greenwashing is positively correlated with stock price crash risk, and ESG report greenwashing and earnings management are complementary. Further analysis shows that better internal and external corporate governance can suppress the impact of ESG greenwashing. In addition, in the voluntary disclosure and private enterprise samples, ESG report greenwashing has a greater impact on the stock price crash risk. Mechanism analysis found that the greenwashing of ESG reports intensified the information asymmetry, which increased the stock price crash risk. Overall, our evidence is consistent with the masking effect of socially responsible information, and that ESG greenwashing increases the stock price crash risk.

KEYWORDS

Environmental, social and governance; environmental, social and governance report; social responsibility information; greenwashing; stock price crash risk

1. Introduction

Climate change risks and COVID-19 impact the sustainable development of the global economy. As the social responsibility information for evaluating the sustainable development of companies, the environmental, social and governance (ESG) report plays an increasingly important role in the capital market. For example, on 18 September 2015, the US Environmental Protection Agency found that Volkswagen installed special software on the engine controller to avoid the official inspection of exhaust emissions. After the exposure of the behaviour that the emission of exhaust gas went from 10 to 40 times beyond the standard to greenwashing to high environmental protection standards, its share price fell by 40% in 1 month.[1] After Chinese 'dual carbon' goal was put forward, the asset management scale of domestic ESG public funds increased by more than 100 billion, and the number of A-share listed companies that disclosed CSR/ESG reports in 2021 has

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[1]https://baike.baidu.com/item/%E5%A4%A7%E4%BC%97%E6%B1%BD%E8%BD%A6%E5%B0%BE%E6%B0%94%E9%80%A0%E5%81%87%E4%BA%8B%E4%BB%B6/18682048

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reached 1,400.[2] Previous researches have studied the relationship between social responsibility information and stock price crash risk from the perspective of information asymmetry and agency theory. From the perspective of information asymmetry and shareholder theory, social responsibility information disclosure has a communication effect and reduces the risk of stock price crash (Dai et al., 2019; Kim et al., 2014), and ESG rating can reduce stock price crash risk (Feng et al., 2022). From the perspective of agency theory, social responsibility information disclosure has a disguising effect and increases the risk of stock price crash (Barnea & Rubin, 2010; Quan & Xiao, 2016; Tian & Wang, 2017). However, existing studies only measure social responsibility information disclosure or ESG information from a single dimension, which is difficult to observe the specific motivation of management to disclose social responsibility information. What's more, corporate ESG disclosure information is different from institutional ESG rating information. There are few literatures integrating corporate ESG disclosure information and institutional ESG rating information to study the relationship between ESG information and stock price crash risk from the perspective of greenwashing.

Greenwashing is an attempt by enterprises to cover up relatively poor ESG performance by disclosing false ESG information (Yu et al., 2020), mainly in order to gain legitimacy benefits (Seele & Gatti, 2017). This is different from the motivation for management to hoard bad news from the agency perspective, such as compensation contract, professional concern and empire establishment (Ball, 2009; Kothari et al., 2009). Therefore, it is of great theoretical value to research the relationship between ESG report greenwashing and stock price crash risk. On the one hand, most of the ESG reports disclosed by listed companies are non-quantitative and without audit assurance, which makes it easy for companies to manage or manipulate or greenwash the disclosure of ESG reports, thereby covering up bad information to convey a good corporate image to investors (Barnea & Rubin, 2010; Yu et al., 2020). This ESG report greenwashing behaviour may be a new mechanism for managers to hide bad news, which needs to be empirically test. On the other hand, the share price of companies fell after the exposure of greenwashing behaviour (Wang et al., 2015). Different from their research, selective disclosure, exaggeration of real performance and other greenwashing behaviours in ESG report were not directly exposed (Yu et al., 2020). The media, investors and analysts can judge the company's greenwashing behaviour by comparing the differences between the ESG disclosure quality and the ESG performance rating results to expose these negative information, and then the risk of a company's stock price crash increased (Jin & Myers, 2006).

The purpose of this paper is to empirically test the impact of ESG report greenwashing on the risk of stock price crash, and provide empirical evidence and decision-making basis for institutional investors, financial institutions and other stakeholders. This paper takes Chinese listed companies from 2014 to 2021 as a research sample, draws on the measurement method of ESG report greenwashing by Yu et al. (2020) which uses the difference between ESG report disclosure score and ESG actual performance score to measure ESG report greenwashing, and uses PSM method, Heckman and other methods to study the impact of ESG report greenwashing on stock price crash risk. We find that ESG report greenwashing behaviour significantly increases stock price crash risk and it is more

[2]The data comes from the 2022 China ESG Development White Paper.

significant in private companies. ESG report greenwashing and earnings management complement each other to increase the risk of stock price crash. Among companies that voluntarily disclose social responsibility information, ESG report greenwashing significantly increases the risk of stock price crash. The mediation mechanism test finds that information asymmetry is the mediating variable in the ESG report greenwashing affecting the risk of stock price crash.

The theoretical contribution of this paper lies in three aspects: First, this paper finds that ESG report greenwashing is a new stock price crash risk mechanism, which expands the stock price crash risk theory from the perspective of legitimacy. Stock price crash risk theory holds that management's motivation to hide negative information is based on career and compensation concerns (Ball, 2009; Jin & Myers, 2006), but the motivation of the ESG report greenwashing is to attract green investors to invest or maintain the legitimacy of companies (Lyon & Maxwell, 2011; Seele & Gatti, 2017). We supplement the theoretical motivation of stock price crash risk from the perspective of ESG report greenwashing. Furthermore, previous literature has found that management uses accruals management (Hutton et al., 2009), accounting conservatism (Kim & Zhang, 2016), comparability of financial statements (Kim et al., 2016), voluntary disclosure of social responsibility information (Kim et al., 2014) and other mechanisms to hide bad news. This paper finds that ESG report greenwashing is a new means of hiding bad news. Second, the literature on corporate social responsibility information and stock price crash risk is enriched from the perspective of ESG report greenwashing. Although many literatures have discussed the relationship between CSR/ESG disclosure and stock price collapse (Feng et al., 2022; Kim et al., 2014; Quan & Xiao, 2016; Song et al., 2017; Tian & Wang, 2017), but they simply take the quality of information disclosure as the research object and ignore the greenwashing behaviour in disclosure. This paper focuses on the 'inconsistency between words and deeds' in ESG. Third, the conclusion of this paper has important practical significance. Our findings provide external investors with a way to judge whether a company is greenwashing and empirical evidence on the stock price effects of ESG reporting greenwashing, which is helpful for external investors to make stock investment decisions. This study also provides empirical evidence that ESG report greenwashing increases the stock price crash risk for government departments, which has an important reference for the formulation of ESG information disclosure system and supervision work, and helps to maintain the stability of the capital market.

2. Institutional background, literature review and research hypothesis

2.1. Institutional background

At present, China has not introduced a special ESG report disclosure system, and the relevant disclosure requirements are mainly reflected in social responsibility reports. In September 2006, Shenzhen Stock Exchange took the lead in formulating and issuing the Guidelines on Social Responsibility of Listed Companies. In May 2008, the Shanghai Stock Exchange issued the Notice on Strengthening the Social Responsibility of Listed Companies. On 31 December of the same year, it issued the Notice on Doing a Good Job in the 2008 Annual Report of Listed Companies, requiring sample companies listed on the Shanghai Stock Exchange in the 'Shanghai Stock Exchange corporate governance

sector', companies issuing foreign-funded shares listed overseas, financial companies and listed companies on the 'Shenzhen 100 Index' to disclose reports on fulfilling social responsibilities, for other companies, the principle of encouragement is applied. Environmental protection authorities also require listed companies or key pollutant dischargers in heavily pollution industries to disclose environmental information. Most listed companies adopt the principle of voluntary disclosure, while some are mandatory disclosure. On 30 September 2018, the CSRC issued a revised Code of Governance for Listed Companies, which requires listed companies to increase disclosure of corporate governance information in accordance with relevant laws and regulations. On 10 November 2018, Asset Management Association of China officially released the 'Research Report on ESG Evaluation System of Chinese Listed Companies' and 'Green Investment Guidelines (Trial)' to promote institutional investors to make ESG investments, serve the green development and transformation of the real economy, and achieve sustainable economic development.

2.2. Social responsibility information and stock price crash risk

The theory of the company's stock price crash risk holds that management has the motivation and ability to hide negative information due to information asymmetry and agency problems (Ball, 2009; Jin & Myers, 2006; Kim et al., 2016; Kothari et al., 2009), which ultimately triggers a stock price crash. Under information asymmetry, managers are prone to design accrual management (Hutton et al., 2009), accounting conservatism (Kim & Zhang, 2016), comparability of financial statements (Kim et al., 2016), and voluntary information disclosure such as social responsibility information disclosure (Kim et al., 2014) and other mechanisms to hide bad news, thereby increasing the risk of stock price crash.

Management takes advantage of voluntary disclosure of social responsibility information, may hide bad news or send signals to reduce information asymmetry, further affecting the risk of stock price crash. From the perspective of information asymmetry, the voluntary disclosure of CSR information can play a communication role, reduce information asymmetry and thus reduce the risk of stock price crash (Dai et al., 2019; Kim et al., 2014), that is the view of 'communication effect'. From the perspective of agency, the management takes CSR report as an egoistic tool, trying to cover up bad information with vague descriptions to convey a good corporate image to investors (Barnea & Rubin, 2010), that is, the view of 'disguise effect'.

China's social responsibility information disclosure system is a combination of mandatory disclosure and voluntary disclosure, and in this context, social responsibility information disclosure also reflects the above two effects. From the perspective of agency issues, Tian and Wang (2017) find the 'disguise effect' of mandatory social responsibility information disclosure. From the perspective of information asymmetry and investor sentiment, Song et al. (2017) believe that the information effect (communication effect) of social responsibility information disclosure reduces the risk of stock price crash. From the perspective of shareholders and management, Quan and Xiao (2016) believe that social responsibility information disclosure is an opportunistic behaviour of management and increases the stock price crash risk.

In 2018, the China Securities Regulatory Commission required listed companies to fully disclose ESG information on the basis of social responsibility reports, and the existing literature began to study the relationship between ESG information disclosure and stock price crash risk. ESG explicitly includes governance, while CSR indirectly includes governance issues related to environmental and social considerations. Therefore, ESG tends to be a broader term than CSR (Gillan et al., 2021). Feng et al. (2022) verify the communication effect of ESG information from the perspective of shareholders and find it reduce the risk of stock price crash. However, Murata and Hamori (2021) find that the ESG disclosure of American companies is not associated with stock price crash risk, while in Europe and Japan, ESG disclosure reduce the risk of stock price crash.

There are two reasons for the inconsistency of the existing research conclusions: first, there is an endogenous problem. There are measurement errors in social responsibility information. The social responsibility report scoring index of Runling Global Rating Agency has qualitative and quantitative indicators, the standards of qualitative and quantitative indicators are inconsistent, so it is difficult to accurately measure the social responsibility information with the total score calculated comprehensively. Moreover, it is not audited and its authenticity and reliability need to be tested. Second, the existing researches usually study stock price crash risk from a single dimension, either the disclosure of ESG report or the actual performance (rating) of ESG, but ESG report disclosure is not consistent with ESG actual performance (rating) (Christensen et al., 2022). Companies disclosing false ESG information to cover up relatively poor ESG performance are considered to be greenwashing (Yu et al., 2020). Therefore, the key to resolve the controversy of existing research is to study the impact of social responsibility information on the risk of stock price crash from the two different dimensions: ESG disclosure and ESG rating.

2.3. CSR/ESG report greenwashing

2.3.1. Definition of greenwashing

Greenwashing is defined differently in different subject disciplines. For example, in the field of marketing, greenwashing is considered to be the behaviour of companies that mislead consumers in terms of environmental practices, environmental benefits of products or services (Delmas & Burbano, 2011). In the field of financial, greenwashing is regarded as an issuer who fraudulently made an environmental commitment at the time of issuance, but actually did not use the raised funds for sustainable development projects (Baldi & Pandimiglio, 2022). In the field of accounting, there are two main types of greenwashing: selective disclosure and expressive manipulation. Selective disclosure refers to the disclosure of information that is beneficial to the company in order to maintain a positive image of the company (Lyon & Maxwell, 2011). Expressive manipulation refers to the manipulation of understandable information by companies to influence the views of information recipients on companies (Brennan et al., 2009). Such companies often show the behaviour of 'more words and less actions' with more symbolic disclosures but less substantive actions (Walker & Wan, 2012). Cao et al. (2022) defined greenwashing as selective disclosure and descriptive manipulation based on previous studies.

2.3.2. Differences between social responsibility information greenwashing and ESG greenwashing

Under the background of implementing the 'double carbon' target policy, stakeholders such as government, institutional investors and financial institutions are increasingly concerned about the risks and opportunities brought by the ESG practice of companies. Institutional investors and financial institutions use ESG reports disclosed by listed companies to make investment and loan decisions. On the basis of CSR report disclosure, listed companies gradually transition to ESG report disclosure to meet the needs of institutional investors, financial institutions and other stakeholders. ESG reports contain more information about governance than CSR reports, which is related to the business objectives of companies (Gillan et al., 2021). At the same time, ESG reports disclose more quantitative non-financial data information, while most of the information disclosed in CSR reports is narrative and non-quantitative information. Therefore, ESG report greenwashing is different from social responsibility information greenwashing. Yu et al. (2020) defined greenwashing company as a company that disclosed a large amount of ESG data, but the ESG performance was poor. This paper refers to greenwashing's definition of Yu et al. (2020), and defines the ESG report greenwashing as that companies cover up relatively poor ESG performance by disclosing false ESG information.

2.3.3. The motivation and consequences of CSR or ESG report greenwashing

The existing research on the motivation of CSR greenwashing information mainly has two views: legitimacy and impression management. Based on legitimacy view, companies seek to obtain or maintain legitimacy by disproportionately disclosing beneficial or relatively benign performance indicators to mask their less impressive overall performance (Marquis et al., 2016). As Reber et al. (2022) argues that companies strive to achieve ESG performance and communicate their efforts to demonstrate that they comply with sustainability-related norms, thereby obtaining and maintaining a social business licence. Based on impression management view, in order to leave a 'good' impression on external stakeholders such as investors, companies selectively disclose positive information about social or environmental behaviour (Marquis et al., 2016). Greenwashing is a strategy for companies to pursue legitimacy, using impression management to communicate symbolically, rather than addressing these issues substantively in action (Gacek, 2020). Therefore, the core of both views is impression management.

2.3.4. The influence of CSR or ESG report greenwashing on a company's investment, performance and share price

If companies disclose unreliable environmental, social, and governance information, greenwashing can become an obstacle to ESG investment decisions (Yu et al., 2020). The impact of greenwashing on the company's stakeholders will eventually lead to a decline in financial performance, which is not conducive to investment (Pizzetti et al., 2021). However, there is little literature to study the impact of ESG report greenwashing on the risk of stock price crash.

2.4. Research hypothesis

The agency problem and the motivation of management to hide bad news under information asymmetry are both motivated by managers to gain personal benefits. However, ESG 'greenwashing' that hides bad news and discloses good news is to create a positive corporate image to gain stakeholder support and maintain corporate legitimacy (Lyon & Maxwell, 2011; Seele & Gatti, 2017). Once a company's ESG report greenwashing behaviour is exposed, the stock price falls. The main body of company ESG report greenwashing may be management or major shareholders. Therefore, ESG report greenwashing is a new research perspective to explain the risk of stock price crash. Based on ESG report greenwashing perspective, the analysis is carried out from three stages including managers' motivation to conceal ESG bad news, the mechanism and the process of exposure.

ESG report greenwashing is that management or major shareholders conceal negative non-financial information, and the motivation is for impression management to maintain corporate image or legitimacy. On one hand, ESG report greenwashing is based on the purpose of maintaining the legitimacy position of the company in order to gain the support of stakeholders, while management hiding negative financial information stems from typical agency problems, i.e. concern about position promotion, management compensation, potential dismissal, litigation risk, and reputation decline (Ball, 2009; Kothari et al., 2009). On the other hand, ESG report greenwashing is to create a positive corporate image (Lyon & Maxwell, 2011). Olatubosun and Nyazenga (2019) found that many companies have ESG symbolic greenwashing behaviours and impression management. Listed companies may strategically disclose voluntary information to achieve a particular purpose of the company or the managers themselves (Dai et al., 2019), and may selectively and incorrectly disclose ESG social responsibility information (Cho & Patten, 2007; Geerts, 2014; Lyon & Maxwell, 2011; McCrory & Langvardt, 2012), ESG disclosure 'greenwashing'. Regardless of the ESG report greenwashing motivation, if market participants find that a company has an ESG report greenwashing behaviours, they will be bearish on the stock price of the greenwashing company.

The management of ESG report greenwashing company have the ability to hide negative ESG information. ESG report greenwashing is a new mechanism to influence the stock price crash risk. Previous literature has found that management used accrual management (Hutton et al., 2009), accounting conservatism (Kim & Zhang, 2016), comparability of financial statements (Kim et al., 2016), voluntary disclosures such as social responsibility disclosures (Kim et al., 2014) and other mechanisms to hide bad news. Impression management theory suggests that the management of ESG report greenwashing companies have ability to use the mechanism of voluntary disclosure to hide negative ESG information, increasing information asymmetry and leading to an increased risk of stock price crash. Greenwashing is a corporate legitimacy-seeking strategy used to symbolically communicate with environmental issues rather than substantively address them in action (Gacek, 2020). Companies with high ESG scores are not necessarily true charities (Choi & Hong, 2022). On one hand, the environmental, social and governance (ESG) data provided in corporate sustainability reports are often unaudited, making it difficult for investors to judge the quality of ESG information. In the same industry, companies with high reputation are more likely to greenwash their ESG (Ruiz-Blanco

et al., 2022). This phenomenon makes it more difficult for investors to assess the quality of ESG social responsibility disclosures. The quality of a company's ESG disclosure makes it difficult to communicate company-specific risks to outside investors. On the other hand, there is no uniform disclosure regulation for ESG reports, and the disclosure standards vary from company to company, which facilitates management to hide poor ESG reports and leads to an increased information asymmetry between insiders (informed traders) and external investors (uninformed traders) of ESG report greenwashing companies, resulting in an increased risk of stock price crash.

The exposure of ESG report greenwashing behaviours leads to increased risk of stock price crash. Unlike greenwashing of a company's products or services, the purpose of ESG report greenwashing is to preserve corporate image and legitimacy (Lyon & Maxwell, 2011; Seele & Gatti, 2017). Greenwashing of a company's products or services is easily exposed by consumers, the media and regulators. ESG report greenwashing have a greater invisibility due to information asymmetry. Compared with consumers, media and regulators, capital market participants always pay attention to the ESG behaviour of listed companies, they can identify false ESG reports before the negative information exposure. Previous literature suggests that management hoards negative bad news and when the accumulated bad news eventually exceeds a critical threshold, managers immediately release all the bad news, leading to a stock price crash (Jin & Myers, 2006). In fact, it is rare for listed companies to automatically release bad news, and most companies passively expose bad news because of CSRC penalties or revelations by capital market participants such as investors. Capital market participants can analyse the inconsistency between ESG disclosure and actual ESG performance of a company, and expose the ESG report greenwashing behaviour of a company. If investors know that a company has ESG report greenwashing behaviour, they will underestimate the stock price of that company. Based on the above reasons, our first hypothesis is as follows:

H1: All else being equal, ESG report greenwashing increases the stock price crash risk for greenwashing companies.

Next, we examine whether ESG report greenwashing can be used as a supplement or substitute for earnings management in terms of its impact on stock price crash risk. It is well documented that earnings management is a mechanism for managers to hide bad news (Hutton et al., 2009), and ESG reports greenwashing is a new mechanism for managers to hide bad news that may complement or replace earnings management to increase the stock crash risk. The ESG reports greenwashing may be complementary to earnings management. On the one hand, when the company's earnings do not meet the management's expectations, the management applies impression management in the management's performance analysis and discussion report to mitigate the negative impact in this regard (Aerts & Cheng, 2011; Zhang & Aerts, 2015). If earnings management does not improve corporate impression management to the satisfaction of managers, managers may further supplement it by greenwashing ESG report, thus adding to the pile of bad news. On the other hand, companies selectively disclose social responsibility reports to cover up some misconduct (Hemingway & Maclagan, 2004). For example, management may choose to greenwash in order to cover up earnings management (Gonçalves et al., 2021),

further exacerbating the risk of stock price crash. Therefore, companies with high earnings management may also greenwash ESG report. The combination of the two makes enterprises face more severe risk of stock price collapse.

However, if management have a low-risk appetite, they will choose to greenwash ESG report. Because the legitimacy risk of ESG report greenwashing is less than earnings management. ESG report greenwashing plays an alternative role in influencing stock price crash risk. For example, companies choosing earnings management have a higher risk of litigation (DuCharme et al., 2004; Hsu et al., 2022), but bear a lower risk for social responsibility information that has not been normatively audited. Secondly, earnings management will only bring short-term benefits, which will be reversed in the subsequent period (Hsu et al., 2022), in contrast, corporate social responsibility is more of a long-term value (Dai et al., 2019), which leads management to be more inclined to disclose or even greenwash ESG reports. Finally, with the continuous improvement of accounting standards and the level of financial information supervision, it will be more and more difficult for companies to obtain benefits through earnings management, and then they will use ESG greenwashing to replace earnings management, making it a new trigger for stock price crash. Based on the above analysis, we propose the opposing hypothesis:

H2a: There is a certain complementary relationship between earnings management and ESG report greenwashing on the impact of stock price crash risk.

H2b: There is a certain substitutional relationship between earnings management and ESG report greenwashing on the impact of stock price crash risk.

Chinese listed companies currently follow two disclosure systems to disclose social responsibility information[3] voluntary disclosure and mandatory disclosure. This paper considers the impact of ESG report greenwashing on the stock price crash risk from the perspective of social responsibility information disclosure system. The difference between mandatory disclosure and voluntary disclosure is that mandatory disclosure belongs to the category that must be disclosed according to the policy. Mandatory provisions are made in the structural framework, index content, application mode, etc. firms that follow mandatory disclosure are more standardised in the disclosure of ESG reports, and the disclosure of some quantitative indicators is not easy to manipulate. The management has less autonomy on whether to disclose (Li & Luo, 2016), thus reducing the opportunity for selective disclosure by the management. Therefore, companies under mandatory disclosure have less space to manipulate disclosure information, less content and items to selectively disclose, and the possibility of stock price crash caused by hiding bad news is relatively low. Compared with mandatory disclosure, voluntary disclosure does not have rigid requirements for disclosing specific information. The management can selectively disclose positive ESG information and retain negative information, which exacerbates

[3]According to China's current disclosure system, sample companies in the Shanghai Stock Exchange's corporate governance sector, companies issuing overseas listed foreign shares, financial companies, and the Shenzhen Stock Exchange 100 Index must disclose social responsibility reports. At present, ESG information in China mainly comes from CSR reports independently released by companies. Therefore, this paper regards the disclosure of social responsibility reports as mandatory ESG reports.

information opacity and ultimately leads to a stock price crash (Xu et al., 2021). Based on the above analysis, we propose the following hypothesis:

H3: Compared to companies under mandatory disclosure of social responsibility information, ESG report greenwashing have a more significant positive impact on stock price crash risk in voluntary disclosure companies.

3. Research design

3.1. Sample and data

We use a sample of Chinese A-share listed companies from 2014 to 2021. We select this time interval because Chinese Academy of Sciences issued the Guidelines for the Preparation of CSR Reports of Chinese Companies in January 2014. There is a total of 25,852 firm-years data from 2014 to 2021, then we exclude the 2197 ST, ST* and PT samples, 762 financial service samples, 4695 samples with missing control variables, 6138 ESG disclosure and ESG performance data for which one is available and the other is missing samples and 881 samples that were required to make mandatory ESG reporting disclosure but for which both ESG disclosure and performance data were missing, to ensure as much as possible that companies with missing disclosure and performance data did not issue ESG reports. Finally, we obtain 11,179 firm-year observations as our research object. After the above processing, the samples in this paper can be divided into two categories, one is 1266 samples with both ESG disclosure and performance data. In the other category, there were 9,913 samples with neither.

The ESG performance and ESG information data in this paper are, respectively, from the Thomson Reuters Eikon datastream and Bloomberg databases, other data are from the CSMAR database. All continuous variables are winsorised at the 1% and 99% levels to eliminate the effect of outliers.

3.2. Variable measurement and model setting

The dependent variable Crash is the stock price crash risk, which are the one-period lagged negative return skewness coefficient (F.NCSKEW), and the one-period lagged return up/down volatility ratio (F.DUVOL), respectively. Following the research methods of Hutton et al. (2009) and Kim et al. (2014) to measure the stock price crash risk at the firm level, the specific indicators are the negative return skewness coefficient (NCSKEW) and the upward and downward volatility ratio of returns (DUVOL), respectively.

The independent variable is Greenwashing. We define ESG report greenwashing as the act of ESG performance not reaching the level stated in the ESG report, i.e. the act of using ESG report to whitewash ESG performance. Following Yu et al. (2020) and Zhang (2022), we use the difference between the industry-standardised ESG information disclosure score and the standardised ESG performance score to determine whether and to what extent a company greenwashes ESG information. The specific calculation formula is as follows:

$$Greenwashing_i = \frac{D_i - \overline{D}}{\sigma_D} - \frac{P_i - \overline{P}}{\sigma_P} \tag{1}$$

The higher the value, the greater the degree of ESG report greenwashing. If the difference is positive, we can say there is a phenomenon of greenwashing in ESG information; otherwise, the company has not greenwashed ESG report. Among them, the ESG information disclosure rating provided by Bloomberg only reflects the amount of ESG data disclosed by the company to the public, but it does not measure company's ESG performance (Yu et al., 2020). The ESG performance rating provided by Thomson Reuters Eikon is often used to represent the company's real performance in terms of ESG (Rees & Rodionova, 2015). Therefore, this measurement method is consistent with our definition of ESG report greenwashing, which can be used to accurately identify whether companies engage in greenwashing behaviours. In addition, the measurement requires that companies must have both ESG disclosure and performance scores. However, China does not mandate the disclosure of ESG information, the missing data for the large number of companies that do not disclose ESG information may affect the empirical conclusions. And according to our definition of ESG report greenwashing, failure to disclose ESG information also means that companies do not embellish their poor ESG performance through ESG reports, and the difference between standardised ESG disclosure and performance rating is 0. Therefore, the ESG report greenwashing index for this sample is assigned a value of 0. To make the empirical conclusion more significant, the 1,266 samples for which both ESG disclosure and performance data are available are treated as separate subsamples and subjected to an additional regression test.

Control variables: With reference to the studies of Kim et al. (2014), Cao and Zhang (2020), we control the following variables: the independent variable of the current period

Table 1. Definition of main variables.

Variable Type	Variable Name	Variable abbreviation	Variable Definition
Independent Variable	stock price crash risk	*NCSKEW* *DUVOL*	The negative return skewness coefficient and return volatility obtained using the weekly returns of individual stocks, larger values indicate a higher degree of negative stock price deviation and higher earnings volatility, and a higher likelihood of a crash.
Dependent Variable	ESG reports greenwashing Index	*Greenwashing*	The degree of ESG disclosure, calculated in model (1)
Control Variable	leverage ratio	*Lev*	The ratio of liabilities to assets
	return on assets	*Roa*	The ratio of net income to assets
	firm size	*Size*	The natural logarithm of total assets.
	standard deviation of the return rate	*Sigma*	The annual standard deviation of weekly individual stock returns
	average return rate	*Ret*	The annual average of weekly individual stock returns
	book-to-market ratio	*Bm*	The ratio of book value to total market value
	earnings manipulation	*ABACC*	The absolute value of unsigned discretionary accruals
	monthly average excess turnover rate	*DTURN*	Current year's average monthly stock turnover rate minus last year's average monthly stock turnover rate
	ownership nature	*SOE*	1 for state-owned firms, and 0 otherwise
	institutional shareholding ratio	*Institute*	The ratio of institutional investors' shareholding to circulating capital stock
	industry	*Industry*	Control industry fixed effects
	year	*Year*	Control year fixed effects

(NCSKEW or DUVOL), monthly average excess turnover rate (DTURN), standard deviation of the return rate (Sigma), average return rate (Ret), return on assets (Roa), book-to-market ratio (Bm), leverage ratio (Lev), firm size (Size), institutional shareholding ratio (Institute), information transparency (ABACC) and ownership nature (SOE). In addition, we also control years (Year) and industries (Industry). The main variable definitions are provided in Table 1.

Following Kim et al. (2014), Cao and Zhang (2020), we construct model (2) to test our assumptions:

$$Crash_{i,t+1} = a_0 + a_1 Greenwashing_{i,t} + a_i \sum Controls_{i,t} + \varepsilon_{i,t} \tag{2}$$

4. Empirical analysis

4.1. Descriptive statistics

In Table 2, Panel A presents descriptive statistics for the main variables of the whole sample. The mean value of NCSKEW is −0.401 and the median value is −0.366, which is less than the median and shows a leftward deviation, while the mean value of DUVOL −0.280 is slightly greater than the median value −0.290. The standard deviation of NCSKEW and DUVOL is 0.776/0.490, respectively. These large standard deviations indicate that the two measures of stock price collapse risk of the sample companies in the sample variables vary significantly. We find that the mean value of greenwashing in the whole sample is only 4.2%, which is mainly due to the fact that companies with both ESG information data and

Table 2. Descriptive statistics.

Panel A: Descriptive Statistics of the Main Variables for the Whole Sample

Variable	N	mean	max	median	Min	sd
NCSKEW	11179	−0.4013	1.8061	−0.3656	−2.6838	0.7756
DUVOL	11179	−0.2801	1.0029	−0.2898	−1.4890	0.4904
Greenwashing	11179	0.0628	1.5778	0.0000	−0.3795	0.2846
Lev	11179	0.3997	0.8919	0.3870	0.0539	0.1968
Roa	11179	0.0398	0.2141	0.0387	−0.2510	0.0623
Size	11179	22.0170	26.3641	21.7932	19.2502	1.2661
Sigma	11179	0.0665	0.2285	0.0608	0.0258	0.0266
Ret	11179	0.0029	0.0577	0.0016	−0.0230	0.0101
Bm	11179	0.9271	6.3760	0.5976	0.0793	1.0454
ABACC	11179	0.0667	0.4041	0.0451	0.0009	0.0708
DTURN	11179	−0.1335	1.1678	−0.0309	−2.3243	0.5670
SOE	11179	0.2728	1.0000	0.0000	0.0000	0.4454
Institute	11179	0.3575	0.8584	0.3534	0.0001	0.2309

Panel B: T-Test of Crash Risk for Greenwashing and Non-Greenwashing Groups

	Greenwashing		Non-Greenwashing		T-Test	
Variable	mean	sd	mean	sd	md	t-value
F. NCSKEW	−0.4198	0.7953	−0.2587	0.6621	−0.1611	−6.0227***
F. DUVOL	−0.2873	0.4928	−0.1895	0.4628	−0.0978	−5.8542***

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Basic regression results.

Panel A: Mixed Regression

	Whole sample		Subsample	
	(1)	(2)	(3)	(4)
Variable	F.NCSKEW	F.DUVOL	F.NCSKEW	F.DUVOL
Greenwashing	0.0550**	0.0351**	0.1142**	0.0677*
	(2.2390)	(2.1465)	(2.0159)	(1.6594)
Lev	−0.0134	−0.0314	0.0764	0.1685
	(−0.2585)	(−0.9844)	(0.1387)	(0.4429)
Roa	0.0431	0.0402	−0.4536	−0.2196
	(0.3251)	(0.4830)	(−0.4645)	(−0.3697)
Size	0.0457***	0.0229***	−0.0429	0.0404
	(4.5803)	(3.6411)	(−0.2173)	(0.2949)
Sigma	−2.2069***	−1.5336***	−5.1195**	−3.1556*
	(−4.7402)	(−5.2330)	(−2.0910)	(−1.7542)
Ret	17.0284***	10.6849***	5.3034	5.8091*
	(14.0757)	(13.5209)	(1.1410)	(1.7016)
BM	−0.0483***	−0.0273***	−0.1905***	−0.1261***
	(−4.4618)	(−4.1237)	(−3.0542)	(−2.9920)
ABACC	0.2453**	0.0742	0.3473	0.4381
	(2.4286)	(1.1381)	(0.9208)	(1.4973)
DTURN	−0.0600***	−0.0357***	0.0814	0.0706
	(−4.0784)	(−3.8610)	(0.6558)	(0.8246)
SOE	−0.1194***	−0.0699***	−0.5333**	−0.1757
	(−6.2215)	(−5.6585)	(−2.3724)	(−1.6178)
Institute	0.0359	0.0101	0.0484	0.1839
	(0.9283)	(0.4172)	(0.1256)	(0.7690)
Ncskew	0.0624***		−0.2794***	
	(6.0698)		(−7.7627)	
Duvol		0.0572***		−0.2997***
		(5.7095)		(−8.5890)
_cons	−1.1204***	−1.7926**	1.0555	−0.4826
	(−5.2202)	(−2.0530)	(0.2109)	(−0.1448)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.1305	0.0985	0.2877	0.2996
N	11179	11179	1266	1266

Panel B: Fixed Effect

	(1)	(2)
Variable	F.NCSKEW	F.DUVOL
Greenwashing	0.1083**	0.0649*
	(2.0645)	(1.8009)
CVs	Y	Y
_cons	2.8410	−0.5490
	(0.5692)	(−0.1736)
Firm&Year	Y	Y
Adj_R^2	0.2549	0.2317
N	1266	1266

Note: T-values in parentheses, using clustering robustness criteria to deal with heteroskedasticity,***, **, * denote significance at the 1%, 5%, and 10% levels, the same as below.

ESG performance data account for a small proportion and companies that do not disclose ESG information account for the majority.

Difference test in Panel B shows that the mean values of the one-period lagged stock crash risk (F. NCSKEW and F. DUVOL) for the ESG report greenwashing group are −0.2587 and −0.1895, respectively; the mean values of the stock crash risk indicators F. NCSKEW and F. DUVOL for the non-greenwashing group are −0.4198 and −0.2873.

The mean difference of the t-test indicates that the stock price crash risk is significantly lower in the ESG non-greenwashing group than that in the ESG report greenwashing group, which suggests that the stock price crash risk is greater in ESG report greenwashing companies.

4.2. Basic regression results

In Table 3, Panel A shows the empirical result for panel mixed regression. The results (1) and (2) are full sample regression results, and the results (3) and (4) are subsample regression results. It can be seen that the dependent variables F.NCSKEW and F.DUVOL are significantly and positively correlated with Greenwashing at the 5% level in the whole sample regression; and the dependent variables F.NCSKEW and F.DUVOL are significantly and positively correlated with Greenwashing at the 5% and 10% levels, respectively, in the subsample. This paper also controls the firm's fixed effect to reduce endogenous. Because the fixed effect model requires great differences between samples, and there are many companies in the whole sample that have not issued ESG reports for many consecutive years whose greenwashing index are assigned to zero, so this paper uses sub-samples that do not include such companies to conduct the fixed effect regression test. Panel B is the test result, which is consistent with mixed regression. The regression result indicates that the of stock price crash risk is higher for companies that engage in ESG report greenwashing, and supports Barnea and Rubin's (2010) view on the masking effect of social responsibility information disclosure, which validates the hypothesis of this paper.

Table 4. Test of the complementary (substitution) effect of earnings management.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable		F.NCSKEW			F.DUVOL	
Panel A: Jones Model						
Greenwashing		0.0550**	0.0170		0.0351**	0.0131
		(2.2390)	(0.2593)		(2.1465)	(0.6129)
GR_ABACC			0.9861**			0.4910**
			(1.9860)			(2.0600)
ABACC	0.2467**	0.2453**	0.1985	0.1558**	0.0742	0.0567
	(2.4439)	(2.4286)	(1.6221)	(2.0208)	(1.1381)	(0.8392)
CVs	Y	Y	Y	Y	Y	Y
_cons	−1.2607***	−1.1204***	−4.7984***	−0.7101***	−1.7926**	−0.5868***
	(−6.2908)	(−5.2202)	(−5.8301)	(−4.3122)	(−2.0530)	(−4.2468)
Industry&Year	Y	Y	Y	Y	Y	Y
Adj_R^2	0.1309	0.1305	0.1300	0.0984	0.0985	0.0983
N	11179	11179	11179	11179	11179	11179
Panel B: DD Model						
Greenwashing		0.0565**	0.0049		0.0369**	0.0323
		(2.2767)	(0.1442)		(2.2214)	(0.5502)
GR_DD			0.5669**			0.5012**
			(2.0153)			(1.9757)
DD	0.0671**	0.0032	0.0118	0.0518**	0.0078	0.0161
	(2.1380)	(0.0990)	(0.3605)	(2.0963)	(0.3180)	(0.5800)
CVs	Y	Y	Y	Y	Y	Y
_cons	−1.8397***	−1.0683***	−1.3013***	−0.8263***	−0.5537***	−0.4166***
	(−4.9686)	(−4.8881)	(−5.5777)	(−3.5553)	(−4.0294)	(−2.6664)
Industry&Year	Y	Y	Y	Y	Y	Y
Adj_R^2	0.1038	0.1341	0.1350	0.1009	0.1027	0.1034
N	11179	11179	11179	11179	11179	11179

Table 5. Disclosure system, ESG report greenwashing and stock rice crash risk.

	(1)	(2)	(3)	(4)
	F.NCSKEW		F.DUVOL	
Variable	Mandatory disclosure	Voluntary disclosure	Mandatory disclosure	Voluntary disclosure
Greenwashing	0.0344	0.0863**	0.0120	0.0608**
	(0.9013)	(2.0122)	(0.4466)	(2.0638)
CVs	Y	Y	Y	Y
_cons	−2.8931***	−1.4536***	−2.2678***	−0.5726**
	(−3.4527)	(−3.6682)	(−4.0478)	(−2.3777)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.1453	0.1273	0.1370	0.0997
N	692	10487	692	10487
Chow test	F=1.72		F=1.98	
P-Value	0.0268		0.0067	

To test whether management can use ESG report greenwashing to complement or substitute earnings management, this paper analyzes the regression coefficient of the interaction term to determine whether the two are complementary or substitutive, referring to the practice of Chen (2015). If ESG report greenwashing complements (substitutes) earnings management to increase stock price crash risk, then the interaction term coefficient between ESG report greenwashing and earnings management should be significantly positive (negative).

Table 4 shows the test results of the basic regression of H2. We choose the modified Jones model (ABACC) and DD model to measure the accrued profit earnings management. Columns (1) and (4) show the regression results of earnings management and stock price crash, which are basically consistent with previous results. The higher the earnings management, the higher the stock price crash risk. Columns (2) and (5) control for earnings management, excluding the impact of earnings management factors, and there is a significant positive correlation between ESG report greenwashing and stock price crash risk. Interaction terms (GR_ABACC and GR_DD) are further added to columns (3) and (6), and the coefficient of interaction terms is significantly positive, indicating that there is a complementary effect between ESG report greenwashing and earnings management. The regression results verify hypothesis 2a, which indicates that companies engaged in earnings management will also increase the demand for ESG report greenwashing to strengthen the purpose and effect of earnings management. Earnings management is to hide bad news of financial information, while ESG reporting is to hide bad news of non-financial information. When the sum of the bad news hidden by both exceeds a critical value, it will trigger a stock price crash.

Table 5 shows the test results of the basic regression of hypothesis 3. We have defined the dumb variable disclosure system. If the company is applicable to the mandatory disclosure system, then assign the value to 0, otherwise assign the value to 1, and then group for regression. Table 5 reports the results of the basic regression test. Column (2) and (4) are the regression results of the voluntary disclosure sample, and the correlation coefficients of independent variables are significantly positive at the level of 5%, but not significant in the mandatory disclosure sample. The regression results verify H3, indicating

that companies that voluntarily disclose CSR information are more inclined to use selective disclosure methods to greenwash ESG reports, and the concealment of negative news significantly increases the risk of stock price crash. The content and items of selective disclosure are reduced for companies under mandatory disclosure of CSR information, and the space for expression manipulation is limited, which makes the impact of ESG report greenwashing on crash risk no longer significant.

4.3. Cross-sectional analysis of managerial motivation, ESG report greenwashing and stock price crash risk

To support our hypothesis that ESG report greenwashing increases the crash risk of firms, we examine the relationship between ESG report greenwashing and stock price crash risk under different internal and external governance scenarios. Existing studies suggesting that corporate governance inhibits ESG report greenwashing behaviour (Yu et al., 2020), while corporate governance reduces stock price crash risk by affecting the quality of corporate financial reporting (Andreou et al., 2016). Excluding the influence of internal and external corporate governance factors, we expect that managements reduce the incentives for ESG report greenwashing under good corporate governance.

In this paper, we consider both internal and external corporate governance aspects of the firm. Referring to Yu et al. (2020), we analyse the effect of internal governance on greenwashing in terms of both board size and institutional investor ownership, expecting that the managements inhibit the incentive to greenwash ESG reporting under good internal corporate governance. We divide the sample into high and low groups with median to test the regressions separately. And Panel A and B in Table 6 report the regression results. The results show that the correlation between greenwashing of ESG report and the stock price crash risk is not significant when the board size is larger and the shareholding of institutional investors is higher. This is consistent with the finding of Yu et al. (2020). Internal governance can play a governance role in ESG report greenwashing, and when the level of internal governance is high, managers have an incentive to discourage ESG report greenwashing, thus the positive effect on the risk of stock price crash is no longer significant.

In addition, different property rights may also affect the role of ESG reporting greenwashing on stock price crash risk. Compared with private companies, not only do state-owned companies receive more government support in finance and politics but managers of state-owned companies are less sensitive to performance (Jiang & Kim, 2015) and more enthusiastic about political pursuits. In contrast, private companies are a dominant equity structure, and major shareholders have greater motivation to greenwash ESG reports to obtain higher economic benefits. Therefore, this paper predicts that in the sample of private companies, ESG reporting greenwashing is significantly positively correlated with stock price crash risk, but not correlated in the sample of state-owned companies. Panel C examines the heterogeneity of the nature of property rights. The results are consistent with the hypothesis in this paper, and the regression coefficients of the ESG greenwashing index of private companies listed in (2) and (4) in Panel C are 0.1663 and 0.1086, both of which are significant at the 5% and 10% levels, respectively. The regression

Table 6. Internal governance, ESG report greenwashing and the risk of stock price crash.

Panel A: Board

	(1)	(2)	(3)	(4)
	F.NCSKEW		F.DUVOL	
Variable	High	Low	High	Low
Greenwashing	−0.0530	0.0711**	−0.0297	0.0472**
	(−0.9500)	(2.5368)	(−0.8234)	(2.4461)
CVs	Y	Y	Y	Y
_cons	−2.0353***	−1.0300***	−1.4556***	−0.4973***
	(−2.9375)	(−4.3456)	(−3.2874)	(−3.3552)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.1374	0.1374	0.1315	0.1065
N	1064	10115	1064	10115
Chow test	F=1.44		F=1.83	
P-Value	0.0384		0.0105	

Panel B: Institutional Investor

	(1)	(2)	(3)	(4)
	F.NCSKEW		F.DUVOL	
Variable	High	Low	High	Low
Greenwashing	0.0264	0.5209**	0.0151	0.3420**
	(0.9873)	(2.5489)	(0.8237)	(2.3733)
CVs	Y	Y	Y	Y
_cons	−1.3095***	−4.0083***	−0.7711***	−2.3891***
	(−5.0210)	(−3.2989)	(−4.6197)	(−3.1382)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.1231	0.0798	0.0916	0.0780
N	5586	5593	5586	5593
Chow test	F=1.53		F=1.66	
P-Value	0.0182		0.0057	

Panel C: Property Right

	(1)	(2)	(3)	(4)
	F.NCSKEW		F.DUVOL	
Variable	SOE	Non-SOE	SOE	Non-SOE
Greenwashing	0.0444	0.1663**	−0.0085	0.1086*
	(0.5375)	(1.9784)	(−0.1424)	(1.8598)
CVs	Y	Y	Y	Y
_cons	−1.922	−2.9386***	−1.221	−1.6980***
	(−1.1364)	(−2.9984)	(−1.1514)	(−2.7287)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.0855	0.0902	0.0972	0.0918
N	3052	8127	3052	8127
Chow test	F=2.25		F=1.81	
P-Value	0.0023		0.0212	

results show that the impact of ESG report greenwashing on stock price crash risk is significantly positively correlated in private companies and not in state-owned companies.

Based on Li et al. (2022), this paper examines the relationship between ESG report greenwashing and crash risk under external governance in terms of both environmental regulation and media attention. Referring to Chen et al. (2018), we use the frequency of environmental words in local government reports to measure

Table 7. External governance, ESG report greenwashing and the risk of stock price crash.

	(1)	(2)	(3)	(4)
	F.NCSKEW		F.DUVOL	
Variable	High	Low	High	Low
Panel A: Environmental Regulation				
Greenwashing	0.0592	0.1444***	0.0204	0.0475**
	(1.6005)	(2.5906)	(0.8540)	(2.0401)
CVs	Y	Y	Y	Y
_cons	−1.3994***	−0.9133***	−0.8152***	−0.4194**
	(−4.0513)	(−3.2606)	(−4.0720)	(−2.2746)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.1011	0.0989	0.0895	0.0669
N	5385	5794	5385	5794
Chow test	F=1.57		F=1.51	
P-Value	0.0164		0.0263	
Panel B: Media Supervision				
Greenwashing	0.0884	0.7666***	0.0387	0.3243*
	(1.4259)	(2.9916)	(0.8983)	(1.8422)
CVs	Y	Y	Y	Y
_cons	−3.9659***	−6.1473***	−2.3981***	−3.7497***
	(−3.4952)	(−4.2177)	(−3.2226)	(−4.1641)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.1007	0.1071	0.1016	0.1094
N	5607	5572	5607	5572
Chow test	F=2.10		F=1.78	
P-Value	0.0002		0.0030	

environmental regulation. Media attention is measured by the total number of network and newspaper reports on companies in the CNRDS database. The results of the regressions are shown in Table 7, which suggest that the ESG report greenwashing and the risk of share price collapse is significant in the low environmental regulation group and weak media attention, but not in the high environmental regulation group and high media attention. This is consistent with the conclusion of Li et al. (2022), indicating that under the pressure of high environmental regulations and high media attention, the ESG activities of companies are subject to more strict supervision, which makes the gap between the ESG communication

Table 8. Mediation mechanism test.

	(1)	(2)	(3)
Variable	PIN	F.NCSKEW	F.DUVOL
Greenwashing	0.0024**	0.0438*	0.0294*
	(1.9861)	(1.7658)	(1.8132)
PIN		3.1662***	2.1116***
		(6.4789)	(6.9458)
_cons	0.2282***	−2.3353***	−1.3624***
	(8.7811)	(−8.0407)	(−7.5844)
CVs	Y	Y	Y
Industry&Year	Y	Y	Y
Adj_R^2	0.4067	0.1287	0.1026
N	11179	11179	11179

and the ESG practice of companies transparent, thus indirectly reducing the motivation of the management to greenwash the ESG report and reducing the risk of stock price crash.

4.4. Mediation mechanism test

Full disclosure of ESG information by companies can reduce information asymmetry between companies and stakeholders, thereby significantly reducing the stock price crash risk (da Silva, 2022; Murata & Hamori, 2021); Conversely, the higher the degree of information asymmetry, the greater the stock price crash risk (Hutton et al., 2009; Jin & Myers, 2006). If companies greenwash ESG reports in order to hide bad news or deliberately create good news, stakeholders will be difficult to identify (Li et al., 2022), resulting in an increase in the degree of information asymmetry, and causing the stock price crash after the bad news cannot be hidden.

Referring to the practice of Kim and Lim (2017), this paper uses the informed transaction probability (PIN) calculated by the EKO market microstructure model as an index to measure the degree of information asymmetry. The higher the probability of informed transaction, the greater the degree of information asymmetry. As shown in Table 8, ESG reporting greenwashing is significantly positively correlated with information asymmetry at the 5% level, indicating that ESG greenwashing increases the degree of information asymmetry between insiders (informed traders) and external investors (uninformed traders) of the company.

Table 9. Robustness tests: propensity score matching.

Panel A: Balancing Assumption Test

	Before matching			After matching			
Variable	Treated	Control	T-Test	Treated	Control	T-Test	bias
Lev	0.5036	0.3894	17.89***	0.5077	0.4989	0.95	4.6
Roa	0.0594	0.0378	10.60***	0.0586	0.0654	−2.61***	−11.4
Size	24.549	21.764	86.19***	24.478	24.428	0.92	4.6
Sigma	0.0497	0.0682	−21.66***	0.0503	0.0503	−0.00	−0.0
Ret	0.0038	0.0028	2.97***	0.0038	0.0043	−1.29	−5.2
ABACC	0.0512	0.0510	−7.30***	0.0510	0.0572	−2.26**	−9.9
DTURN	−0.0015	−0.1467	7.80***	−0.0010	0.0033	−0.47	−1.0

Panel B: PSM Test

	(1)	(2)	(3)	(4)
Variable	F.NCSKEW	F.DUVOL	F.NCSKEW	F.DUVOL
Greenwashing	0.1150**	0.0682*		
	(2.1598)	(1.8398)		
Greenwashing_MSCI			0.0960**	0.0582*
			(2.0368)	(1.7529)
CVs	Y	Y	Y	Y
_cons	−2.1923**	−1.4843**	−0.818	−1.5207**
	(−2.2884)	(−2.1968)	(−0.7122)	(−2.2547)
Industry&Year	Y	Y	Y	Y
Adj_R^2	0.1705	0.1588	0.1282	0.1586
N	1404	1404	1404	1404

4.5. Robustness tests

4.5.1. Propensity Score Matching (PSM) method

Due to the self-selection bias of the sample, there are endogenous issues of ESG report greenwashing. On one hand, ESG report greenwashing is not a policy randomly assigned to listed companies, but a strategy that companies can choose on their own; on the other hand, whether companies implement ESG report greenwashing or not is influenced by internal and external factors. Since the number of companies in the greenwashing group in the subsample is 940, which is far more than the non-greenwashing group of 326, it is not suitable for PSM method, so this paper only performs PSM test on the whole sample, and we also use the greenwashing index of two institutions for regression test. According to Ruiz-Blanco et al. (2022), Velte (2021) and Delmas and Burbano (2011), greenwashing behaviour is related to company characteristics, earnings management, and market factors. Therefore, this paper has selected continuous variables Lev, Roa, Size, Sigma, Ret, ABACC, and DTURN for one-to-one nearest neighbour matching. The matched results are shown in Panel A in Table 9. The T-Tests are mostly insignificant after matching, and the bias is basically within 10%, indicating good matching results. The PSM regression results are shown in Table 9, and the greenwashing index calculated by both Reuters and MSCI agency ratings are significant with stock price crash risk at the 5% level, indicating that the basis regression test in this paper is robust.

Table 10. Robustness tests: Heckman two-stage method.

Panel A: Heckman first stage regression

	(1)	(2)
Variable	Whole sample	Subsample
AQI	0.0142***	0.0077**
	(2.7002)	(2.0667)
CVs	Y	Y
_cons	−17.1259***	−4.3088**
	(−18.8498)	(−2.3636)
Industry&Year	Y	Y
N	11179	1266

Panel B: Heckman second stage regression

	Whole sample		Subsample	
	(1)	(2)	(3)	(4)
Variable	F.NCSKEW	F.DUVOL	F.NCSKEW	F.DUVOL
Greenwashing	0.0973*	0.0651*	0.2500**	0.1616**
	(1.8785)	(1.7710)	(2.3341)	(2.1343)
CVs	Y	Y	Y	Y
_cons	−1.9808***	−1.3734***	−0.8340	−1.1357*
	(−6.5894)	(−5.9749)	(−0.9663)	(−1.8544)
Inverse Mills ratio	0.1658***	0.0474**	−0.0087	−0.0072
	(2.6109)	(2.4902)	(−0.0847)	(−0.0991)
Industry&Year	Y	Y	Y	Y
N	11179	11179	1266	1266

4.5.2. Heckman two-stage method

In addition to the self-selection problem, this study also suffers from the endogenous issue of sample selection bias. In this paper, the sample was selected by excluding those samples for which the ESG greenwashing index could not be calculated due to missing data, which resulted in biased estimation results. To deal with the effect of sample selection bias, we implement the Heckman two-stage method, and construct the following model:

$$\Pr(Greenwashing_dummy_{i,t} = 1) = \phi(\gamma Z_{i,t}) = \beta_0 + \beta_1 AQI_{i,t} + \beta_i \sum Controls_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$Crash_{i,t+1} = \beta_0 + \beta_1 Greenwashing_{i,t} + \rho\sigma\hat{\lambda}(\gamma Z_{i,t}) + \beta_i \sum Controls_{i,t} + \varepsilon_{i,t} \quad (4)$$

To predict whether a firm has implemented greenwashing, we introduce an exogenous variable that may affect the firm's decision to make a greenwashing strategy in model (3): the air quality index (AQI) of the prefecture-level city where the firm is located. Air quality represents to a certain extent the pollution level of a city, and if the city where the firm is located is more polluted it may affect the firm's motivation to greenwashing, but it will not directly affect the firm's stock price collapse risk. The air quality index data is sourced from CSMAR, and a larger air quality index indicates worse air quality. The regression results are reported in Panel A in Table 10, which show that the correlation coefficient of AQI is significantly positive, indicating that the worse the true ESG performance of firms in cities with poor air quality, the more inclined they are to greenwashing.

Panel B reports the regression results for model (4), the second stage. We find that the coefficient of Inverse Mills ratio in the whole sample is significantly positive, indicating that selection bias may indeed exist in the whole sample. After controlling for selection bias, the coefficient of Greenwashing is still significantly positive, and the conclusion is the same as the basis regression.

4.5.3. Other robustness tests

This paper also uses the following three methods to test robustness, and the results remain unchanged. This paper excludes the cross-listed 'A+H' and 'A+B' stocks, and conducts benchmark regression tests on the whole sample and subsamples, respectively.

Rating opinions of different rating agencies may be divergent (Christensen et al., 2022), and the conclusions drawn from data from only one rating agency are not convincing. We also recalculate the greenwashing index using ESG performance data from MSCI rating agencies. We substitute the independent variables with the above two measures and test again, the results are reported in Table 10, which show that our core hypothesis still valid even after replacing the greenwashing measures.

5. Conclusions and limitations

Based on the perspective of non-financial information greenwashing, this paper studies the impact of ESG report greenwashing on the stock price crash risk. The findings reveal that the behaviour of ESG report greenwashing increases the stock price crash risk, and this effect is more obvious in companies that voluntarily disclose social responsibility information. This paper finds that ESG report greenwashing has a greater impact on stock

price crash risk in companies with high levels of earnings management. The relationship of earnings management and ESG report greenwashing is complementary. The cross-sectional analysis shows that effective internal governance and stringent environmental regulation will inhibit the motivation of management's ESG report greenwashing, while in the case of low media attention, the management's motivation of ESG report greenwashing is greater. Among private companies, ESG report greenwashing has a more significant impact on stock price crash risk. Mechanism analysis found that ESG report greenwashing intensified the information asymmetry between insiders and external investors, which increased the stock price crash risk.

This study also has theoretical and practical implications. On one hand, this paper finds a new mechanism of stock price crash risk from the perspective of non-financial information greenwashing, which is market participants revealing the bad ESG information hidden by the management. This finding expands and integrates the ESG report greenwashing theory and stock crash risk theory, enriches the literature on the relationship between social responsibility information disclosure and stock price crash risk. The original research on social responsibility disclosure and stock crash risk only measures social responsibility disclosure from a single dimension, such as Kim et al. (2014) using social responsibility rating data from MSCI ESG database. In contrast, this paper measures social responsibility information (ESG information) from two dimensions, ESG disclosure and ESG performance, which is a more accurate measurement and can avoid the measurement error issue to some extent. On the other hand, the results of this study also provide empirical evidence on the relationship between ESG report greenwashing and stock price crash risk for emerging market investors and regulatory authorities. It provides a reliable decision-making reference for the high-quality development of Chinese listed companies.

There are two main limitations of this paper: First, this paper uses the method of Yu et al. (2020) to measure the degree of greenwashing of ESG reports, but this measure may be subject to error. The reason for adopting this approach is that all ESG disclosure and rating data can be obtained from the database, and the disadvantage of subjectivity of textual analysis can be overcome. We also use the greenwashing index calculated by text analysis for robustness testing, but there may still be some errors. Second, due to the missing data of institutional ratings of some companies, some samples cannot be calculated for the greenwashing index, and this paper excludes these missing value samples and does robustness tests, which may have some impact on the generalisation of the conclusions. Therefore, it is difficult to accurately measure the greenwashing of ESG reports, and there is still much room for exploration, so subsequent studies can start from this and develop more accurate measurement methods.

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