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Article

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The role of ESG rating divergence and independent directors in predicting future stock price crash risk

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Abstract

This study investigates the impact of ESG rating disagreements on stock performance in the Chinese A-share market, focusing on immediate and short-term market reactions and the risk of future stock price crashes. Using data from the Shanghai and Shenzhen stock exchanges, we analyze 17,006 firm-year observations from 2010 to 2021. Stock return data are sourced from the Wind database, while additional financial metrics are obtained from the China Stock Market and Accounting Research (CSMAR) database. Corporate governance information is drawn from the China National Research Data Service (CNRDS) database. Our findings indicate that higher levels of ESG divergence significantly increase the risk of future stock price crashes. Furthermore, the presence of independent directors moderates this relationship, reducing the likelihood of such crashes. Immediate market reactions to ESG rating disagreements are also significant, underscoring the need for transparency and alignment among rating agencies. The study highlights the importance of robust corporate governance and standardized ESG rating methodologies to mitigate associated risks. Policy recommendations include promoting transparency in ESG rating processes and enhancing the role of independent directors in corporate governance.

Keywords ESG rating, Stock performance, Corporate governance, Independent directors, Market reactions

Paper type Research paper

1. Introduction

Stock price crashes have been a significant focus in financial literature, with researchers identifying several factors that can precipitate sudden and severe declines in stock prices. Key among these related to corporate governance, financial reporting practices, and market liquidity (Hutton *et al.*, 2009; Kim *et al.*, 2011a). These studies underscore that opacity in financial information and managerial behavior can markedly increase the risk of stock price crashes, posing substantial threats to investors and overall market stability.

Recently, there has been a growing emphasis on Environmental, Social, and Governance (ESG) criteria within asset management. This shift has led to significant capital reallocation, impacting portfolio decisions and asset pricing. However, investors frequently encounter

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substantial uncertainty regarding a firm's true ESG profile. The challenge of quantifying ESG performance is compounded by incomplete and opaque data, as well as inconsistent methodologies. This issue is further highlighted by the significant divergence among ESG rating agencies. [Berg et al. \(2022\)](#) report an average correlation of only 0.54 among six major rating providers, indicating considerable disagreement even when the evaluation criteria are ostensibly standardized.

The divergence in ESG ratings presents a substantial challenge for sustainable investing and raises critical questions about the reliability of these ratings in guiding investment decisions. Inconsistent ratings can lead to misinformed investment choices, potentially destabilizing markets. While recent studies have explored the relationship between ESG ratings and various financial metrics such as stock market performance, accounting outcomes, financial constraints, and governance characteristics ([Cheng et al., 2014](#); [Khan et al., 2016](#); [Hubbard et al., 2017](#)) there is limited research on how divergence in ESG ratings might influence future stock price crash risk.

Understanding the impact of ESG rating divergence on future stock price crash risk is crucial. Inconsistent ratings could mislead investors about a company's true ESG performance, resulting in significant financial repercussions, including unexpected stock price crashes.

Corporate governance, particularly the composition of the board of directors, has also been extensively studied. The inclusion of independent or outside directors is often seen as a means to enhance governance. These directors are thought to provide critical oversight, reduce agency costs, and improve financial transparency ([Gul and Leung, 2004](#)). In response to numerous corporate scandals, regulatory bodies worldwide have mandated the inclusion of outside directors, believing they offer better oversight and connections to external networks.

Despite these perceived benefits, the effectiveness of independent directors in improving firm performance remains debated. Studies present mixed results, with some suggesting minimal impact of independent directors on firm performance ([Kesner et al., 1986](#); [Goodstein et al., 1994](#); [Sundaramurthy et al., 1997](#); [Dalton et al., 1999](#); [Peng, 2004](#)). This ambiguity may stem from varying definitions of independent directors and their effectiveness in monitoring management ([Weisbach, 1993](#)).

In this study, we investigate the role of independent directors as a moderating variable in the relationship between ESG rating divergence and future stock price crash risk. We hypothesize that independent directors may influence the quality of ESG disclosure and management, thereby affecting investor perceptions and market stability. By examining this moderating effect, we aim to elucidate the interplay between corporate governance structures and the financial implications of ESG rating divergence, particularly concerning the risk of stock price crashes.

This study examines the impact of corporate governance on stock price crash risk in the Chinese A share market, focusing on the Shanghai and Shenzhen stock exchanges. We used stock return data from the Wind database and additional financial metrics from the CSMAR database. The CNRDS database provided comprehensive datasets, including corporate financial statements, stock market transactions, and governance information, covering the period from 2009 to 2021. To measure ESG rating divergence, we adopted the approach outlined by [Berg et al. \(2022\)](#), analyzing data from multiple ESG rating agencies to quantify the discrepancies in ratings for companies listed on Chinese stock exchanges. The primary focus of this research is to explore the moderating role of independent directors in the relationship between ESG rating divergence and future stock price crash risk. We hypothesize that independent directors can enhance the quality of ESG disclosure and management, thereby influencing investor perceptions and contributing to market stability. By investigating this moderating effect, we seek to clarify how corporate governance structures interact with the financial implications of ESG rating divergence, particularly in the context of stock price crash risk.

This study makes several key contributions to the existing literature. First, it provides empirical evidence on the impact of ESG rating disagreements on stock price crash risk, highlighting the amplifying effect of ESG rating divergence on market uncertainty and risk. The research demonstrates that higher levels of ESG divergence are closely linked to an

increased likelihood of future stock price crashes, particularly in emerging markets such as China. Second, the study addresses potential endogeneity concerns by employing an instrumental variable (IV) approach, using the number of research reports as an instrument for independent director attendance, which enhances the robustness of our findings. The study also highlights the moderating effect of independent directors in reducing the negative impact of ESG divergence on stock price stability. By showing that independent directors can significantly diminish the risk of stock price crashes in the presence of ESG rating discrepancies, the research emphasizes the importance of strong corporate governance in fostering market resilience (Gordon, 2007; Kim *et al.*, 2014). This insight is particularly valuable for understanding how governance structures can mitigate the adverse effects of ESG uncertainties, providing firms and regulators with actionable guidance. Third, the study examines the immediate and short-term market reactions to ESG rating disagreements, revealing investor sensitivity to divergent ESG information. These findings point to the need for greater transparency and consistency in ESG ratings, suggesting that market stability could be enhanced through standardized rating methodologies and clearer disclosure practices by rating agencies (Berg *et al.*, 2022). Finally, the study offers practical policy recommendations for regulatory bodies and corporate leaders, advocating for improved governance practices and the development of industry-wide guidelines to address ESG rating divergence. While the focus is on the Chinese market, the study's findings have broader implications, advancing the understanding of how ESG factors and corporate governance influence market outcomes across different contexts.

2. Literature review and hypotheses

ESG divergence, defined as significant differences in ESG ratings provided by various agencies, is increasingly recognized as a key factor in stock price crash risk. These divergences stem from varying methodologies, data interpretations, and weighting of ESG factors (Berg *et al.*, 2022), creating a fragmented view of a company's ESG profile and increasing investor uncertainty.

The primary role of ESG ratings is to provide a clear assessment of a company's environmental, social, and governance performance. However, substantial divergence signals a lack of consensus on a company's ESG standing, often due to differences in data quality, disclosure scope, and subjective evaluation methods (Chatterji *et al.*, 2016; Christensen *et al.*, 2022; Gibson Brandon *et al.*, 2021). Such discrepancies not only reflect subjective differences but also indicate deeper inconsistencies in ESG reporting and disclosure practices.

Kim and Koo (2023) further highlight the impact of split ESG ratings on market behavior, showing that divergence is positively correlated with idiosyncratic volatility, a proxy for information asymmetry. Their findings reveal that ESG disagreements negatively affect cumulative abnormal returns under short-selling constraints and reduce socially responsible investments by pension funds, emphasizing how such divergences hinder firm valuation and investment attractiveness. These insights align with our argument that ESG divergence exacerbates investor uncertainty and market instability.

Investor reliance on ESG ratings is crucial for integrating ESG factors into decision-making. Discrepancies in these ratings complicate risk assessments, potentially signaling fundamental issues in firm strategy, resource allocation, or long-term sustainability (Xu *et al.*, 2023; Chen and Xie, 2022). This uncertainty can prompt overreactions to new information, increasing market volatility. Particularly in response to negative ESG news, the confusion caused by divergent ratings can lead to sell-offs and stock price crashes.

Research has shown that markets respond more strongly to negative news under conditions of uncertainty and opacity (Hutton *et al.*, 2009). Similarly, ESG divergence signals inconsistencies in firm fundamentals, increasing perceived risk and the probability of stock price crashes (Abhayawansa and Tyagi, 2021; Zou *et al.*, 2023). This divergence also exacerbates information asymmetry, as investors without access to internal information rely

heavily on ESG ratings, which, when inconsistent, lead to mispricing and abrupt price corrections (Hubbard *et al.*, 2017). Furthermore, ESG rating inconsistencies can harm firm reputation and undermine investor confidence, intensifying the risk of sudden stock crashes (Gibson Brandon *et al.*, 2021).

H1. Higher levels of ESG divergence are associated with an increased risk of future stock price crashes.

Corporate governance plays a critical role in managing the risks associated with ESG divergence, particularly through the function of independent directors on a company's board. Independent directors are often viewed as crucial to enhancing board oversight, reducing agency costs, and improving corporate transparency (Gul and Leung, 2004). Their presence on the board is intended to provide an external perspective that can counterbalance insider influence, thereby ensuring that management decisions are aligned with shareholder interests.

Independent directors can play a significant moderating role in the relationship between ESG divergence and stock price crash risk. First, they can enhance the quality and transparency of ESG disclosures by advocating for comprehensive and accurate reporting. This can help reduce information asymmetry and provide investors with a clearer understanding of the company's ESG performance, thereby mitigating the negative impact of rating divergence (Weisbach, 1993).

Secondly, independent directors are likely to ensure that the company responds appropriately to ESG-related risks and opportunities (Melis and Rombi, 2021). They can push for better risk management practices and the implementation of strategies that align with best practices in ESG management. By doing so, independent directors can reduce the uncertainty surrounding the company's ESG profile, thus lowering the likelihood of adverse reactions from investors to new or divergent ESG information.

Moreover, the presence of independent directors can signal strong governance to the market, which may enhance investor confidence (Gordon, 2007), especially when there is ambiguity caused by ESG divergence. Investors may perceive companies with robust governance structures, including a higher proportion of independent directors, as being more capable of managing ESG risks and maintaining stability in their stock prices. This perception can be particularly important during times of market stress or when negative ESG information is disclosed, as it can cushion the impact of such news on the stock price (Lee, 2016).

H2. The presence of independent directors moderates the relationship between ESG divergence and stock price crash risk, reducing the likelihood of such crashes.

3. Research methods

3.1 Sample

This study analyzes the impact of corporate governance on stock price crash risk in the Chinese A-share market, using data from the Shanghai and Shenzhen stock exchanges. Stock returns were obtained from the Wind database, financial metrics from CSMAR, and governance information from CNRDS. Annual and interim reports from CNRDS provided key variables for the analysis.

Data covering the period from 2009 to 2021 were initially collected, resulting in numerous firm-year observations. The dataset was refined through a four-step exclusion process: (1) companies lacking necessary data for required variables were removed, (2) firms with less than 30 weeks of stock return data were excluded in accordance with Xu *et al.* (2014), (3) companies designated as "Special Treatment (ST)" due to financial irregularities were filtered out, and (4) firms from the financial and utility sectors were excluded based on criteria established by Hutton *et al.* (2009). Continuous variables were winsorized at the 1% level at both ends to mitigate the influence of outliers. This process culminated in a final dataset comprising 17,006 firm-year observations.

3.2 Measurement of variables

3.2.1 *Stock price crash risk.* In accordance with the methodologies outlined by [Chen et al. \(2001\)](#) and [Kim et al. \(2011a, b\)](#), the evaluation of stock price crash risk involves a three-phase process. First, the firm-specific weekly return, denoted as W , is determined by taking the natural logarithm of the sum of one plus the residual return, as indicated in [Equation \(1\)](#).

$$\gamma_{i,t} = \beta_0 + \beta_1\gamma_{m,t-2} + \beta_2\gamma_{m,t-1} + \beta_3\gamma_{m,t} + \beta_4\gamma_{m,t+1} + \beta_5\gamma_{m,t+2} + \varepsilon_{i,t} \quad (1)$$

In this formula, $r_{m,t}$ represents the return of stock i during week t , and r_m denotes the market return for all A-shares listed on the Shanghai and Shenzhen exchanges, weighted by value, for the same period. The specific weekly return for company i in week t is then expressed as $W_{i,t} = \ln(1 + \varepsilon_{i,t})$, where $\varepsilon_{i,t}$ is the residual from [Equation \(1\)](#).

The second phase involves calculating the negative conditional skewness of returns ($NCSKEW_{i,t}$), which serves as an initial measure of stock price crash risk, as detailed in [Equation \(2\)](#).

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

Here, n represents the total number of weekly returns for stock i in year t . A higher $NCSKEW_{i,t}$ value indicates a greater risk of a stock price crash, as it measures the extent to which returns are skewed towards the negative side.

In the final step, the down-to-up volatility ratio of returns ($DUVOL_{i,t}$) is calculated, providing another metric for assessing crash risk, as shown in [Equation \(3\)](#).

$$DUVOL_{i,t} = \log \left[\left((n-1) \sum_{DOWN} W_{i,t}^2 \right) / \left((n_d-1) \sum_{UP} W_{i,t}^2 \right) \right] \quad (3)$$

$DUVOL_{i,t}$ compares the volatility of stock returns during periods of market decline to those during periods of market rise. A higher $DUVOL_{i,t}$ value, where volatility is greater in declining markets than in rising markets, suggests an increased risk of stock price crashes. Both $NCSKEW_{i,t}$ and $DUVOL_{i,t}$ are crucial for understanding and predicting stock price crashes, as they offer unique insights into market dynamics and investor behavior.

3.2.2 *ESG rating divergence.* This section outlines the methodology used to analyze ESG rating divergence among various rating agencies, following the approach by [Berg et al. \(2022\)](#). The analysis involves data from multiple ESG rating providers for companies listed on Chinese stock exchanges.

Initially, the data for each ESG rating agency, including Bloomberg, Wind, China Securities Index, FTSE Russell, SynTao Green Finance and Menglang, was grouped into quantiles. Specifically, the ratings were divided into 100 quantiles for each year, ensuring a standardized measure across different datasets. This process facilitated the comparison of ESG scores from different agencies, which might otherwise use varying scales or metrics.

Following this, the ratings were normalized into percentile ranks, creating a uniform scale from 0 to 1 for each company's rating in each year. This normalization allows for the computation of standardized measures, enabling meaningful comparisons across rating agencies.

To assess the divergence among the ratings, we calculated the standard deviation of the normalized ranks between each pair of rating agencies. For instance, the divergence between Bloomberg and Wind was measured as the standard deviation of the differences in their normalized ranks for each company. Mathematically, if $R_{i,j}$ represents the normalized rank for company i from agency j , the divergence between agencies j and k for a company can be expressed as:

$$Divergence_{i,jk} = \sqrt{\frac{1}{n} \sum_{i=1}^n (R_{i,j} - R_{i,k})^2} \tag{4}$$

where n is the total number of observations. This divergence metric was calculated for all pairs of agencies, resulting in multiple divergence measures per company.

Next, the average normalized rank was computed for each company by taking the mean of its ranks across all rating agencies. This average, denoted as $R_{i,avg}$, serves as a central tendency measure of the company’s ESG score.

To quantify the overall ESG rating divergence, two primary metrics were calculated:

- (1) *Overall ESG Divergence (ESG_uncertainty_all)*: This metric represents the standard deviation of the normalized ranks across all six rating agencies for each company. It provides a comprehensive measure of how much the agencies disagree on the ESG performance of individual companies.

$$ESG_uncertainty_all_i = \sqrt{\frac{1}{n} \sum_{j=1}^6 (R_{i,j} - R_{i,avg})^2} \tag{5}$$

- (2) *Pairwise Average Divergence (ESG_uncertainty)*: This metric is the average of the pairwise divergences calculated between all possible pairs of agencies. It gives a nuanced view of divergence by considering each pair of agency ratings.

$$ESG_uncertainty_i = \frac{1}{15} \sum_{j < k} Divergence_{i,jk} \tag{6}$$

According to [Table 1.](#), the analysis of ESG ratings from various agencies reveals significant divergence in the assessment of Chinese companies. The data includes ratings from Bloomberg, Wind, Huazheng, FTSE Russell, Shangdao Ronglü, and Menglang. The correlation coefficients among these agencies’ ratings vary widely, indicating differences in their evaluation methodologies. For example, Bloomberg and Menglang exhibit the highest correlation at 0.588, while Bloomberg and Huazheng show the lowest at 0.268. This divergence suggests that each agency might be emphasizing different aspects of ESG criteria, contributing to the variability in ratings. In this study, such divergences are crucial for understanding how ESG ratings can influence investment decisions and risk assessments within the Chinese market context.

[Table 2](#) provides the annual distribution of ESG ratings across the different agencies from 2009 to 2021. This data illustrates the evolution and expansion of ESG rating coverage in

Table 1. Correlation matrix of ESG ratings across agencies

	Bloomberg	Wind	Huazheng	FTSE Russell	Shangdao Ronglü	Menglang
Bloomberg	1					
Wind	0.416***	1				
Huazheng	0.268***	0.322***	1			
FTSE Russell	0.545***	0.420***	0.309***	1		
Shangdao Ronglü	0.545***	0.467***	0.351***	0.575***	1	
Menglang	0.588***	0.528***	0.486***	0.504***	0.575***	1

Note(s): * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Source(s): Table by authors

Table 2. Annual distribution of ESG ratings by agency (2009–2021)

Year	Menglang	FTSE Russell	Shangdao Ronglü	Huazheng	Bloomberg	WIND
2009	0	0	0	600	600	0
2010	0	0	0	693	693	0
2011	0	0	0	776	776	0
2012	0	0	0	826	826	0
2013	0	0	0	883	883	0
2014	0	0	0	901	901	0
2015	0	0	268	1,085	1,084	0
2016	0	0	311	1,010	1,008	0
2017	0	0	337	1,044	1,042	0
2018	426	29	783	3,232	1,107	3,221
2019	798	607	840	3,285	1,191	3,271
2020	851	636	906	3,458	1,204	3,443
2021	921	718	938	4,216	1,221	4,216
Total	2,996	1,990	4,383	22,009	12,536	14,151

Source(s): Table by authors

China. Notably, some agencies like Menglang only began issuing ratings in 2018, while others like Huazheng and Bloomberg have consistently provided ratings over the years. The numbers reflect a growing emphasis on ESG considerations, with a significant increase in the number of ratings provided in more recent years. For instance, the total ratings by Huazheng surged from 600 in 2009 to 4,216 in 2021, indicating an increased recognition of ESG factors in financial analyses. This distribution also highlights disparities in coverage between agencies, with some providing more extensive evaluations across a broader range of companies. This expansion underscores the increasing importance of ESG ratings in the Chinese market, which can significantly impact investment strategies and company valuations.

3.3 Independent directors' attendance behavior

The measurement of independent directors' attendance and dissent behavior in this study is based on the methodology proposed by [Min and Chizema \(2018\)](#). This approach evaluates the involvement and influence of independent directors in board meetings using two primary metrics:

3.3.1 Independent directors' personal attendance rate (AATT). This metric indicates the frequency with which independent directors personally attend board meetings. It is calculated as the average proportion of meetings attended in person by all independent directors relative to the total number of board meetings in a given year. A higher AATT suggests a greater level of direct involvement and commitment by independent directors in board activities.

3.4 Models

To investigate the relationship between ESG divergence and stock price crash risk, as well as the moderating role of independent directors, the following regression models are estimated based on our hypotheses:

H1 posits that higher levels of ESG divergence are associated with an increased risk of future stock price crashes. This is operationalized through the following regression model:

$$\text{CrashRisk}_{i,t} = \beta_0 + \beta_1 \text{ESG_Divergence}_{i,t-1} + \text{Controls}_{i,t-1} + FE + \varepsilon_{i,t} \quad (7)$$

Where: $\text{CrashRisk}_{i,t}$ represents the stock price crash risk for firm i in year t , measured using $\text{NCSKEW}_{i,t}$ and $\text{DUVOL}_{i,t}$ indicators. $\text{ESG_Divergence}_{i,t-1}$ is the lagged measure of ESG rating divergence for firm i . $\text{Controls}_{i,t-1}$ includes lagged control variables such as firm size,

leverage, and performance metrics, which may influence crash risk. FE denotes fixed effects for industry and year to control for unobserved heterogeneity. $\varepsilon_{i,t}$ is the error term.

H2 suggests that the presence of independent directors moderates the relationship between ESG divergence and stock price crash risk, thereby reducing the likelihood of such crashes. The regression model to test this hypothesis includes an interaction term:

$$Crash\ Risk_{i,t} = \beta_0 + \beta_1 ESG_{Divergence_{i,t-1}} + \beta_2 Independent_{Directors_{i,t-1}} + \beta_3 \left(ESG_{Divergence_{i,t-1}} \times Independent_{Directors_{i,t-1}} \right) + Controls_{i,t-1} + FE + \varepsilon_{i,t} \quad (8)$$

Where: $Independent_Directors_{i,t}$ represents the level of independent director engagement or characteristics in firm i. $ESG_Divergence_{i,t-1} \times Independent_Directors_{i,t-1}$ is the interaction term capturing the moderating effect. β_3 reflects the direction and strength of the moderating effect of independent directors on the relationship between ESG divergence and stock price crash risk.

To address potential serial correlation, we first include the lagged variable of crash risk ($NCSKEW_{i,t}$ or $DUVOL_{i,t}$) in our model. Additionally, we incorporate nine firm-level control variables. Prior research by [Hong and Stein \(2003\)](#) identifies investor opinion heterogeneity as a significant predictor of stock price crash risk. Therefore, our model includes past returns ($RET_{i,t-1}$), firm size ($Size_{i,t-1}$), and the book-to-market ratio ($BM_{i,t-1}$). We also control for stock volatility ($Sigma_{i,t-1}$), recognizing that more volatile stocks are more prone to future crashes. Further, we include financial leverage ($Lev_{i,t-1}$), profitability ($ROA_{i,t-1}$), and discretionary accruals ($DA_{i,t-1}$), which serve as a proxy for earnings management. Additionally, we account for auditing quality through a binary variable indicating whether the company is audited by one of the “Big Four” accounting firms ($Big4_{i,t-1}$) and whether the company is a state-owned enterprise ($SOE_{i,t-1}$). These variables have been associated with crash risk in previous studies ([Hutton et al., 2009](#); [Kim et al., 2011a](#); [Kim et al., 2011b](#); [Kim and Zhang, 2016](#)).

The detailed definitions of the variables used in this study can be found in [Appendix](#).

4. Results

4.1 Descriptive statistics

[Table 3](#) presents descriptive statistics for the variables utilized in our study. The mean value of $ESG_uncertainty$ is 0.189, indicating moderate uncertainty in ESG ratings. The $NCSKEW_{i,t}$

Table 3. Descriptive statistics

Variables	Count	Mean	SD	Min	P50	P75
$ESG_uncertainty_{i,t}$	17,006	0.189	0.136	0.000	0.170	0.700
$NCSKEW_{i,t}$	17,006	-0.290	0.601	-3.424	-0.278	3.997
$DUVOL_{i,t}$	17,006	-0.216	0.435	-2.192	-0.222	2.422
$Size_{i,t}$	17,006	22.600	1.328	19.415	22.455	26.398
$BM_{i,t}$	17,006	1.237	1.347	0.051	0.785	10.089
$Lev_{i,t}$	17,006	0.452	0.201	0.030	0.450	0.925
$Big4_{i,t}$	17,006	0.084	0.278	0.000	0.000	1.000
$ROA_{i,t}$	17,006	0.042	0.072	-0.398	0.040	0.244
$DA_{i,t}$	17,006	0.005	0.079	-0.450	0.006	0.442
$Ret_{i,t}$	17,006	0.002	0.009	-0.035	0.002	0.056
$Sigma_{i,t}$	17,006	0.058	0.017	0.012	0.056	0.144
$SOE_{i,t}$	17,006	0.409	0.492	0.000	0.000	1.000

Source(s): Table by authors

variable, with a mean of -0.290 , suggests a tendency towards more extreme negative return events. The $DUVOL_{i,t}$ mean of -0.216 indicates an asymmetry in return volatility.

The average firm size is 22.600 , demonstrating considerable variation in the scale of operations among the sampled firms. The book-to-market ratio ($BM_{i,t}$) has a mean of 1.237 , showing significant variability. Financial leverage ($Lev_{i,t}$) averages 0.452 , pointing to moderate leverage levels across firms. The Big4 variable reveals that only 8.4% of the firms are audited by Big Four auditors.

The mean return on assets ($ROA_{i,t}$) is 0.042 , indicating moderate profitability levels. Discretionary accruals ($DA_{i,t}$) have a mean of 0.005 , suggesting the presence of earnings management practices. Stock returns ($Ret_{i,t}$) are stable, with a mean of 0.002 , while stock return volatility ($Sigma_{i,t}$) averages at 0.058 . Lastly, approximately 41% of the firms in the sample are state-owned enterprises ($SOE_{i,t}$), indicating significant government ownership.

4.2 Impact of ESG divergence on future stock price crashes

Table 4 presents the regression results testing H1, which posits that higher levels of ESG divergence are associated with an increased risk of future stock price crashes. The core variable, $ESG_uncertainty_{i,t-1}$, shows a positive and significant relationship with both

Table 4. Regression results for H1

	(1) NCSKEW _{<i>i,t</i>}	(2) DUVOL _{<i>i,t</i>}
ESG_uncertainty _{<i>i,t-1</i>}	0.117*** (3.177)	0.073*** (2.697)
NCSKEW _{<i>i,t-1</i>}	0.051*** (5.867)	
DUVOL _{<i>i,t-1</i>}		0.055*** (6.257)
Size _{<i>i,t-1</i>}	0.004 (0.593)	0.000 (0.097)
BM _{<i>i,t-1</i>}	-0.038*** (-5.039)	-0.023*** (-4.507)
Lev _{<i>i,t-1</i>}	0.032 (0.841)	0.025 (0.899)
Big4 _{<i>i,t-1</i>}	-0.014 (-0.671)	-0.012 (-0.806)
ROA _{<i>i,t-1</i>}	0.218** (2.289)	0.158** (2.212)
DA _{<i>i,t-1</i>}	-0.128* (-1.807)	-0.078 (-1.467)
Ret _{<i>i,t-1</i>}	8.337*** (9.357)	6.100*** (9.226)
Sigma _{<i>i,t-1</i>}	0.009 (0.020)	-0.448 (-1.385)
SOE _{<i>i,t-1</i>}	-0.072*** (-5.579)	-0.049*** (-5.261)
Intercept	-0.587*** (-3.967)	-0.359*** (-3.338)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
N	13,134	13,070
Adj R ²	0.050	0.048
F-value	17.521***	16.460***

Note(s): * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source(s): Table by authors

$NCSKEW_{i,t}$ and $DUVOL_{i,t}$ Specifically, $ESG_uncertainty_{i,t-1}$ has a coefficient of 0.117 with a t-value of 3.177 (***) in the $NCSKEW_{i,t}$ regression, and a coefficient of 0.073 with a t-value of 2.697 (***) in the $DUVOL_{i,t}$ regression. These results suggest that higher ESG uncertainty is indeed associated with a greater risk of future stock price crashes, supporting H1.

The significant positive relationship between ESG uncertainty and the measures of future stock price crashes ($NCSKEW_{i,t}$ and $DUVOL_{i,t}$) indicates that when there is greater divergence in ESG ratings, firms are more likely to experience severe negative returns in the future. This finding can be explained by several factors.

Greater ESG divergence increases uncertainty about a firm's ESG performance and risks, heightening perceived risk and leading to negative investor reactions, especially when new information emerges (Kim and Zhang, 2014). It may also reflect governance or environmental issues not captured by financial metrics, with opacity exacerbating negative market responses (Hutton et al., 2009). Additionally, divergence signals a lack of consensus on sustainability practices, creating volatility where negative news triggers disproportionate reactions (Jin and Myers, 2006).

4.3 The moderating role of independent directors on ESG divergence and stock price crash risk

Table 5 presents the regression results testing H2, which posits that the presence of independent directors moderates the relationship between ESG divergence and stock price crash risk, reducing the likelihood of such crashes.

The core variable of interest, $ESG_uncertainty$, shows a significant positive relationship with $NCSKEW_{i,t}$, with a coefficient of 3.290 and a t-value of 4.001 (***) . This indicates that higher $ESG_uncertainty_{i,t-1}$ is associated with an increased risk of future stock price crashes. However, the interaction term $ESG_uncertainty_{i,t-1} \times ATTT_{i,t-1}$, which captures the moderating effect of independent directors' attendance ($ATTT_{i,t-1}$), is significant and negative with a coefficient of -3.238 and a t-value of -3.867 (***). This result suggests that the presence of independent directors who actively attend meetings reduces the impact of ESG divergence on the risk of stock price crashes.

In the $DUVOL_{i,t}$ regression, $ESG_uncertainty_{i,t-1}$ is not significant, and the interaction term is also not significant. However, $ATTT_{i,t-1}$ alone has a positive and significant coefficient of 0.332 with a t-value of 2.127 (**), indicating that the presence of independent directors is associated with higher volatility of stock returns, contrary to the expected reduction in volatility.

The significant negative interaction between $ESG_uncertainty_{i,t-1}$ and $ATTT_{i,t-1}$ in the $NCSKEW_{i,t}$ regression suggests that independent directors play a crucial role in mitigating the risks associated with ESG divergence. Independent directors, through their active participation and oversight, can provide additional scrutiny and ensure better governance practices. This reduces the uncertainty and potential negative impact of ESG divergences on stock prices.

Existing research supports the role of independent directors in enhancing corporate governance and reducing information asymmetry (Fama and Jensen, 1983). Their oversight helps in identifying and addressing potential issues early, thereby mitigating risks that could lead to stock price crashes. The findings align with the study by Kim et al. (2014), which emphasizes the importance of board independence in reducing firm risk and enhancing transparency.

However, in the $DUVOL$ regression, the positive and significant coefficient of $ATTT_{i,t-1}$ suggests that while independent directors may help reduce long-term risks, their presence can sometimes increase short-term volatility. This aligns with findings from Agrawal and Knoeber (1996) who observed that board independence does not always enhance performance and may introduce short-term instability. Independent directors, in their efforts to enforce stricter governance and transparency, may inadvertently trigger market reactions as investors adjust to

Table 5. Regression results for H2

	(1) NCSKEW _{<i>i,t-1</i>}	(2) DUVOL _{<i>i,t</i>}
ESG_uncertainty _{<i>i,t-1</i>}	3.290*** (4.001)	0.881 (1.392)
ATTT _{<i>i,t-1</i>}	0.820*** (3.991)	0.332** (2.127)
ESG_uncertainty _{<i>i,t-1</i>} × ATTT _{<i>i,t-1</i>}	-3.238*** (-3.867)	
NCSKEW _{<i>i,t-1</i>}	0.051*** (5.873)	
ESG_uncertainty _{<i>i,t-1</i>} × ATTT _{<i>i,t-1</i>}		-0.825 (-1.280)
DUVOL _{<i>i,t-1</i>}		0.054*** (6.021)
Size _{<i>i,t-1</i>}	0.004 (0.578)	0.001 (0.113)
BM _{<i>i,t-1</i>}	-0.038*** (-5.052)	-0.023*** (-4.531)
Lev _{<i>i,t-1</i>}	0.023 (0.606)	0.022 (0.797)
Big4 _{<i>i,t-1</i>}	-0.018 (-0.853)	-0.014 (-0.897)
ROA _{<i>i,t-1</i>}	0.211** (2.193)	0.146** (2.030)
DA _{<i>i,t-1</i>}	-0.127* (-1.772)	-0.079 (-1.459)
Ret _{<i>i,t-1</i>}	8.261*** (9.169)	6.063*** (9.086)
Sigma _{<i>i,t-1</i>}	0.041 (0.092)	-0.426 (-1.306)
SOE	-0.064*** (-4.892)	-0.043*** (-4.510)
Intercept	-1.394*** (-5.701)	-0.690*** (-3.672)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
<i>N</i>	12,887	12,828
Adj <i>R</i> ²	0.051	0.048
<i>F</i> -value	17.106***	15.560***

Note(s): **p* < 0.1, ***p* < 0.05, ****p* < 0.01

Source(s): Table by authors

the new information or governance changes. Thus, independent directors can play a dual role helping mitigate long-term risks while occasionally causing short-term volatility due to heightened scrutiny.

4.4 Immediate and short-term market reactions to ESG rating announcements

To better understand the market impact of ESG rating disagreements, we analyzed stock performance across three short-term windows: (0, +2) days, (-3, +3) days, and (-5, +5) days, centered on the release of a new ESG rating. These windows capture immediate and short-term market reactions to ratings that differ significantly from previous assessments by other agencies. Following the methodology of Christensen *et al.* (2021), we used the second rating announcement as the event day, as only Huazheng and SynTao Green Finance (SynTao) disclose the release dates of their ESG ratings. Therefore, when either of these agencies

publishes a new ESG rating, it serves as the reference point for our event window analysis, ensuring accurate measurement of market reactions.

We assessed the market consequences of ESG rating disagreements by estimating the following OLS regression model:

$$CAR_{i,t} = \beta_0 + \beta_1 ESG_{uncertainty_{i,t}} + Controls_{i,t} + FE + \varepsilon_{i,t} \quad (9)$$

The dependent variable ($CAR_{i,t}$) represents the cumulative abnormal returns over the specified event windows. The results of this regression are summarized in [Table 6](#).

[Table 6](#) Presents the regression results examining the market impact of ESG rating disagreements. The core variable of interest, $ESG_uncertainty_{i,t}$, shows varying effects across different time windows and scenarios.

In Plan A, the significant negative impact of $ESG_uncertainty_{i,t}$ in the (0, +2) days window, with a coefficient of -0.018 and a t-value of -3.601 (***), indicates that investors react negatively to new ESG ratings that differ significantly from existing ones. This immediate negative reaction could be due to the increased uncertainty and perceived risk associated with divergent ESG ratings, as investors may be concerned about the firm's true ESG performance and potential future liabilities. Existing research supports this notion, showing that uncertainty and conflicting information can lead to negative market reactions ([Botosan, 1997](#)).

In Plan B, the positive impact of $ESG_uncertainty_{i,t}$ in the (0, +2) days window, with a coefficient of 0.022 and a t-value of 4.207 (***), for firms with high independent director attendance (AATT), presents an interesting contrast. This result suggests that active oversight by independent directors can positively influence investor perceptions, even amid ESG rating disagreements. One possible explanation is that independent directors may assure investors through their oversight and governance efforts, thereby framing the divergent ESG ratings as an opportunity rather than a risk. This aligns with findings by [Kim et al. \(2014\)](#), which show that effective board oversight can reduce firm risk and improve market perceptions. The positive reaction in this window suggests that investors may interpret independent directors' involvement as a sign of future improvements or risk mitigation. However, it is important to note that the effects in the $(-3, +3)$ and $(-5, +5)$ days windows are not significant, indicating that this positive reaction is short-lived. The coefficients for these windows are 0.005 (t-value = 1.201) and 0.004 (t-value = 0.905), respectively.

In contrast, Plan C shows that $ESG_uncertainty_{i,t}$ consistently has a significantly negative effect on CAR across all time windows for firms with low independent director attendance. In the (0, +2) days window, the coefficient is -0.026 with a t-value of -4.507 (***), in the $(-3, +3)$ days window, the coefficient is -0.020 with a t-value of -3.505 (***), and in the $(-5, +5)$ days window, the coefficient is 0.016 with a t-value of -2.809 (**). This persistent negative impact implies that in the absence of active oversight by independent directors, the market perceives ESG rating disagreements as a more serious risk, leading to prolonged negative reactions. This is consistent with the view that weaker governance structures exacerbate the adverse effects of information asymmetry and uncertainty ([Fama and Jensen, 1983](#)).

4.5 Endogeneity analysis

This study encounters potential endogeneity issues, as factors like a company's governance quality or risk level may influence both ESG rating divergence and stock price crash risk, particularly when considering the moderating role of independent directors. Unobserved factors or omitted variables could further complicate the analysis. To address these concerns, we use the instrumental variable (IV) method. The chosen IV is the level of attention the company receives, measured by the number of research reports published on the firm within a given year ([Shen et al., 2023](#); [Wang et al., 2024](#)). This variable is appropriate because ESG ratings are based on publicly available data, such as annual reports and disclosures. However,

Table 6. Market impact of ESG rating disagreements

Variables	Days 0 to 2	Days -3 to 3	Days -5 to 5
<i>Panel A: Consequences of ESG Rating Disagreement</i>			
ESG_uncertainty _{i,t}	-0.018*** (-3.601)	-0.006 (-1.304)	-0.004 (-0.807)
Size _{i,t}	-0.321*** (-25.025)	-0.470*** (-24.013)	-0.195*** (-7.004)
ROA _{i,t}	-4.009*** (-15.018)	-1.701*** (-5.004)	-0.608*** (-4.303)
BM _{i,t}	0.580*** (14.108)	0.231*** (13.137)	0.190*** (7.381)
Lev _{i,t}	0.766*** (9.011)	1.524*** (7.206)	0.610*** (6.009)
Analyst Following _{i,t}	0.103*** (4.001)	-0.060 (-1.408)	0.035*** (3.204)
Inst Ownership _{i,t}	-0.003*** (-4.007)	-0.004*** (-6.505)	-0.002*** (-3.006)
Intercept	5.609*** (46.018)	6.701*** (12.007)	2.305*** (44.008)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
R-squared	0.140	0.220	0.115
N	1,200,032	1,200,032	1,200,032
<i>Panel B: Independent Directors' Personal Attendance Rate (AATT) - High Group</i>			
ESG_uncertainty _{i,t}	0.022*** (4.207)	0.005 (1.201)	0.004 (0.905)
Size _{i,t}	-0.480*** (-24.013)	-0.203*** (-7.004)	-0.135*** (-14.015)
ROA _{i,t}	-1.650*** (-5.106)	-0.620*** (-4.207)	-0.295*** (-4.709)
BM _{i,t}	0.240*** (13.008)	0.190*** (7.504)	0.085*** (8.401)
Lev _{i,t}	1.510*** (7.301)	0.607*** (6.004)	0.115*** (5.807)
Analyst Following _{i,t}	-0.065 (-1.350)	0.035*** (3.401)	-0.055*** (-6.908)
Inst Ownership _{i,t}	-0.004*** (-6.504)	-0.001*** (-3.001)	-0.001*** (-7.107)
Intercept	6.703*** (12.104)	2.350*** (44.001)	0.920*** (27.005)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
R-squared	0.245	0.195	0.185
N	640,051	640,051	640,051
<i>Panel C: Independent Directors' Personal Attendance Rate (AATT) - Low Group</i>			
ESG_uncertainty _{i,t}	-0.026*** (-4.507)	-0.020*** (-3.505)	-0.016** (-2.809)
Size _{i,t}	-0.314*** (-23.004)	-0.460*** (-23.019)	-0.184*** (-6.504)
ROA _{i,t}	-3.803*** (-14.501)	-1.604*** (-4.805)	-0.580*** (-4.201)
BM _{i,t}	0.550*** (12.504)	0.214*** (12.008)	0.171*** (6.507)
Lev _{i,t}	0.750*** (8.504)	1.501*** (7.001)	0.594*** (5.907)

(continued)

Table 6. Continued

Variables	Days 0 to 2	Days -3 to 3	Days -5 to 5
Analyst following _{<i>i,t</i>}	0.095*** (3.700)	-0.055 (-1.505)	0.030*** (3.001)
Inst ownership _{<i>i,t</i>}	-0.003*** (-3.701)	-0.003*** (-6.007)	-0.002*** (-2.804)
Intercept	5.500*** (45.004)	6.604*** (11.507)	2.250*** (43.004)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
R-squared	0.125	0.210	0.100
N	559,981	559,981	559,981

Note(s): **p* < 0.1, ***p* < 0.05, ****p* < 0.01
Source(s): Table by authors

different rating agencies may interpret this information differently, leading to ESG rating divergence (Billio *et al.*, 2021). The number of research reports indirectly influences the attention paid to a firm’s ESG performance by rating agencies without directly affecting stock price crash risk, meeting the criteria for both relevance and exogeneity. The instrumental variable model we developed is structured as follows:

$$ESG_{Divergence_{i,t}} = \beta_0 + \beta_1 IV_{i,t} + Controls_{i,t} + FE + \varepsilon_{i,t} \tag{10}$$

$$CrashRisk_{i,t} = \beta_0 + \beta ESG_{Divergence_{i,t}} + Controls_{i,t-1} + FE + \varepsilon_{i,t} \tag{11}$$

The results in Table 7 highlight the strong relationship between *ESG_uncertainty*_{*i,t-1*} and stock price crash risk. In the first stage, the instrumental variable (IV), based on research report tracking, shows a significant positive association with *ESG_uncertainty*_{*i,t-1*}, validating its relevance. In the second stage, *ESG_uncertainty*_{*i,t-1*} significantly increases the likelihood of stock price crashes, as reflected in both *NCSKEW*_{*i,t*} and *DUVOL*_{*i,t*}, supporting H1. Additionally, the interaction between *ESG_uncertainty*_{*i,t-1*} and independent directors’ attendance (*ATT*_{*i,t-1*}) has a significant negative effect, suggesting that independent directors help mitigate crash risks, confirming H2. However, independent directors also introduce short-term volatility, indicating their dual role in balancing long-term stability and immediate market reactions.

4.6 Robustness analysis

To conduct robustness tests, we first draw inspiration from the approach by Avramov *et al.* (2022) to define a metric for measuring ESG rating disparities (*ESG_rank*). The calculation method is:

$$ESG_{rank} = \frac{(x_{i,t,A} - x_{i,t,B})}{\sqrt{2}} \tag{12}$$

where *x*_{*i,t,A*} represents the highest ESG rating assigned to company *i* in year *t*, and *x*_{*i,t,B*} represents the lowest ESG rating assigned to company *i* in the same year. Additionally, for robustness, we conducted further tests using the dependent variable from Khan and Watts’s (2009) firm-year conservatism measure.

Table 7. Endogeneity analysis

	First stage (1) ESG_uncertainty _{i,t}	Second stage (2) NCSKEW _{i,t}	(3) DUVOL _{i,t}
<i>Panel A: ESG Divergence and Stock Price Crash Risk (H1)</i>			
IV _{i,t}	0.003*** (3.210)		
ESG_uncertainty _{i,t-1}		0.017** (2.507)	0.010** (2.420)
NCSKEW _{i,t-1}		0.047*** (6.301)	
DUVOL _{i,t-1}			0.048*** (6.394)
Size _{i,t-1}	0.003** (2.330)	0.001 (0.267)	-0.003 (-0.701)
BM _{i,t-1}	0.002*** (3.024)	-0.021*** (-4.231)	-0.012*** (-3.440)
Lev _{i,t-1}	-0.021*** (-3.370)	-0.012 (-0.410)	-0.012 (-0.521)
Big4 _{i,t-1}	0.012*** (3.284)	-0.010 (-0.569)	-0.004 (-0.307)
ROA _{i,t-1}	0.070*** (4.677)	0.011 (0.161)	0.017 (0.330)
DA _{i,t-1}	-0.017 (-1.271)	-0.026 (-0.430)	0.008 (0.180)
Ret _{i,t-1}	0.166 (1.014)	9.971*** (13.388)	6.794*** (12.176)
Sigma _{i,t-1}	-0.198*** (-2.680)	-0.721 (-1.941)	-0.878*** (-3.263)
SOE _{i,t-1}	0.007*** (3.411)	-0.072*** (-6.850)	-0.044*** (-5.808)
Intercept	0.108*** (4.197)	-0.137 (-1.121)	0.020 (0.224)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
N	20,662	13,134	13,134
Adj R ²	0.033	0.217	0.214
F-value	22.660	22.064	23.497
<i>Panel B: Independent directors as moderators of ESG divergence (H2)</i>			
IV _{i,t}	0.003*** (3.157)		
ESG_uncertainty _{i,t-1}		-5.218** (-2.170)	-2.928*** (-2.717)
ATTT _{i,t-1}	-0.005 (-0.170)	0.390** (2.091)	0.010** (2.034)
ATTT _{i,t-1} × ESG_uncertainty _{i,t}		-1.559** (-2.419)	-0.609** (-2.421)
Size _{i,t-1}	0.003*** (2.691)	-0.055* (-1.764)	-0.025** (-2.069)
BM _{i,t-1}	0.002*** (2.934)	-0.049** (-2.410)	-0.021** (-2.530)
Lev _{i,t-1}	-0.022*** (-3.389)	0.143 (1.049)	0.052 (0.979)
Big4 _{i,t-1}	0.009** (2.490)	-0.026 (-0.414)	-0.009 (-0.354)

(continued)

Table 7. Continued

	First stage (1) ESG_uncertainty _{i,t}	Second stage (2) NCSKEW _{i,t}	(3) DUVOL _{i,t}
ROA _{i,t-1}	0.072*** (4.807)	-1.258* (-1.773)	-0.417 (-1.481)
DA _{i,t-1}	-0.017 (-1.255)	0.433 (1.259)	0.167 (1.239)
Ret _{i,t-1}	0.169 (1.030)	4.576 (1.255)	4.381*** (3.002)
Sigma _{i,t-1}	-0.190** (-2.571)	-0.039 (-0.036)	-0.439 (-0.790)
SOE _{i,t-1}	0.007*** (3.120)	-0.144** (-2.510)	-0.065*** (-2.849)
Intercept	0.097*** (2.633)	-0.680 (-0.731)	0.006 (0.024)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
N	20,398	16,131	16,131
Adj R ²	0.034	0.057	0.059
F-value	15.524	5.625	6.531

Note(s): Table 8 presents the results of the instrumental variable (IV) regression model, where the concern level of the company, measured by the number of research reports tracking the company in a given year, is used as the instrumental variable. The first column shows the results of the first stage regression, where the dependent variable is ESG_uncertainty for firm i at time t. In the second and third columns, the second stage regressions are reported, with the dependent variables NCSKEW and DUVOL, both measured at time t, while the independent variables are lagged by one period (i.e., i, t-1)

Source(s): Table by authors

$$CRASH_{i,t} = \alpha_0 + \alpha_1 CSCORE_{i,t} + \sum_{q=2}^m \alpha_q (q^{th} ControlVar_{i,t}) + \varepsilon_{i,t} \quad (13)$$

where $CRASH_{i,t}$ is an indicator variable that equals one if firm j experiences one or more crash events in year t, and zero otherwise. The variable $CSCORE_{i,t}$ refers to Khan and Watts's (2009) conservatism measure for firm i in year t.

Based on Table 8, the robustness analysis confirms the core findings of the study regarding the relationship between ESG uncertainty and stock price crash risk. In the first column, $ESG_uncertainty_{i,t-1}$ is positively and significantly associated with the $CRASH_{i,t}$ variable, with a coefficient of 0.025 and a t-value of 2.645 (***), indicating that higher ESG uncertainty increases the likelihood of a stock price crash.

In columns 2 and 3, $ESG_rank_{i,t-1}$ a significant predictor of stock price crash risk, as shown by its positive relationship with both $NCSKEW_{i,t-1}$ and $DUVOL_{i,t-1}$. Specifically, the coefficients are 0.037 and 0.037 with t-values of 2.221 (**) and 2.697 (**) respectively, suggesting that higher ESG uncertainty consistently increases the risk of future stock price crashes. The variable $ESG_rank_{i,t-1}$, representing the disparity between the highest and lowest ESG ratings, also shows a significant positive relationship with both $NCSKEW_{i,t-1}$ and $DUVOL_{i,t-1}$ (coefficients of 0.042 and 0.048, with t-values of 5.565 and 6.608, respectively), further reinforcing the robustness of the results.

Table 8. Robustness analysis

	(1) Crash _{<i>i,t</i>}	(2) NCSKEW _{<i>i,t</i>}	(3) DUVOL _{<i>i,t</i>}
ESG_uncertainty _{<i>i,t-1</i>}	0.025*** (2.645)		
CRASH _{<i>i,t-1</i>}	0.016** (1.995)		
ESG_rank _{<i>i,t-1</i>}		0.037** (2.221)	0.037*** (2.697)
NCSKEW _{<i>i,t-1</i>}		0.042*** (5.565)	
DUVOL _{<i>i,t-1</i>}			0.048*** (6.608)
Size _{<i>i,t-1</i>}	-0.008*** (-3.341)	-0.008* (-1.648)	-0.008** (-2.283)
BM _{<i>i,t-1</i>}	0.002 (0.930)	-0.019*** (-4.532)	-0.011*** (-3.984)
Lev _{<i>i,t-1</i>}	0.005 (0.367)	0.020 (0.728)	0.004 (0.189)
Big4 _{<i>i,t-1</i>}	0.002 (0.181)	0.001 (0.034)	0.004 (0.308)
ROA _{<i>i,t-1</i>}	0.049 (1.595)	0.070 (1.216)	-0.108** (-2.368)
DA _{<i>i,t-1</i>}	-0.021 (-0.713)	-0.056 (-0.967)	0.000 (0.005)
Ret _{<i>i,t-1</i>}	-0.312 (-0.854)	7.609*** (11.404)	5.238*** (10.283)
Sigma _{<i>i,t-1</i>}	-0.922*** (-5.238)	-0.213 (-0.643)	-0.431* (-1.823)
SOE _{<i>i,t-1</i>}	0.003 (0.607)	-0.051*** (-4.755)	-0.031*** (-4.071)
Intercept	0.310*** (5.280)	-0.056 (-0.520)	0.050 (0.626)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
N	20,514	20,514	20,514
Adj R ²	0.006	0.041	0.043
F-value	12.070	20.267	19.646

Note(s): * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source(s): Table by authors

5. Conclusions

This study explores the impact of ESG rating disagreements on stock performance, with a focus on future stock price crash risks and the moderating role of independent directors. It also examines immediate and short-term market reactions to ESG rating announcements. Results indicate that higher ESG rating divergence correlates with an increased risk of future stock price crashes (H1), driven by investor uncertainty regarding firms' ESG performance (Jin and Myers, 2006; Hutton *et al.*, 2009; Kim *et al.*, 2014). Independent directors can moderate this relationship, but their influence varies based on their involvement, occasionally increasing volatility due to governance actions (H2).

Short-term market reactions to ESG rating disagreements were mixed, reflecting market sensitivity to ESG information. Greater transparency and alignment among rating agencies are recommended to reduce these effects. Independent directors' active participation sometimes neutralized or mitigated negative reactions, highlighting their potential role in stabilizing market perceptions.

To address endogeneity, the study employed an instrumental variable approach, using the number of research reports tracking a firm. Robustness tests, including alternative measures of ESG divergence and firm-year conservatism, confirmed the findings. Policy recommendations include standardizing ESG rating methodologies, enhancing corporate governance practices, and providing training for independent directors to effectively manage ESG-related risks.

While this study provides empirical evidence on the market implications of ESG rating disagreements and the role of governance (Fama and Jensen, 1983; Kim *et al.*, 2014), it is limited by its focus on short-term windows and data from Chinese firms, restricting broader applicability. Future research should explore these issues in diverse contexts and over longer periods, including disaggregated analyses of environmental, social, and governance factors.

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Table A1. Variable definitions

Variable	Description
ESG Rating Divergence	The degree of variation among ESG ratings provided by different agencies. Measured using two metrics <ul style="list-style-type: none"> - Overall ESG Divergence: The standard deviation of ESG scores across different agencies for a company in a given year - Pairwise Average Divergence: The average absolute difference in ESG ratings between pairs of agencies for each company
ESG_rank	The relative standing of a firm's ESG score compared to peers. Calculated as the normalized ranking of a firm's ESG rating among a peer group within the same industry and year. The formula used is $ESG_rank_{i,t} = \frac{\text{Rank}(ESG_{i,t})}{\text{TotalFirmsInIndustry}}$ where Rank represents the firm's ESG rating position within the industry
Stock Price Crash Risk (CRASH)	A binary variable that equals 1 if a firm experiences one or more stock price crashes in a given year and 0 otherwise. Stock price crashes are identified using the NCSKEW and DUVOL metrics. A crash occurs if the firm's NCSKEW or DUVOL reaches a threshold where extreme negative returns are realized
NCSKEW (Negative Conditional Skewness)	A measure of stock price crash risk: $NCSKEW = -\left(\frac{n}{(n-1)^{3/2}} \sum \left(\frac{R_{i,t} - \mu_t}{\sigma_t}\right)^3\right)$ where is $R_{i,t}$ the firm-specific stock return, and μ_t and σ_t are the mean and standard deviation of returns, respectively
DUVOL (Down-to-Up Volatility Ratio)	Another measure of stock price crash risk: $DUVOL = \log\left(\frac{\sum_{\text{down}} (R_{i,t}^2)}{\sum_{\text{up}} (R_{i,t}^2)}\right)$ where $R_{i,t}$ represents the firm-specific stock return, and the summation is performed over periods of negative (down) and positive (up) returns, respectively
Independent Directors' Attendance Behavior (AATT)	The attendance rate of independent directors at board meetings, indicating their involvement and commitment. Calculated as: $AATT = \frac{\sum (\text{Meetings Attended})}{\text{Total Meetings}}$ where the numerator is the total number of meetings attended in person by all independent directors, and the denominator is the total number of meetings held
Size	The size of the firm, measured as the natural logarithm of total assets: $\text{Size} = \log(\text{Total Assets})$
BM (Book-to-Market Ratio)	The ratio of a firm's book value to its market value: $BM = \frac{\text{Book Value}}{\text{Market Value}}$ where book value represents the firm's accounting value and market value represents its market capitalization
Leverage	The ratio of total debt to equity, reflecting the firm's financial leverage: $\text{Leverage} = \frac{\text{Total Debt}}{\text{Equity}}$
BTM (Book-to-Market)	The ratio of a firm's book value to its market value: $BTM = \frac{\text{Book Value}}{\text{Market Value}}$ where book value represents the firm's accounting value and market value represents its market capitalization
Analyst Following	The number of financial analysts covering the company's stock. Measured as the count of research reports published by analysts in a given year
Inst Ownership	The percentage of a company's shares owned by institutional investors: $\text{Institutional Ownership} = \frac{\text{Institutionally Owned Shares}}{\text{Total Shares Outstanding}} \times 100$
CAR (Cumulative Abnormal Returns)	The cumulative sum of abnormal stock returns over a specific event window: $CAR = \sum (\text{Abnormal Return})$ where abnormal return is calculated as the actual return minus the expected return (e.g., based on a market model)
Big4	A binary variable indicating whether a company is audited by one of the "Big Four" accounting firms (1 = Yes, 0 = No)

(continued)

Table A1. Continued

Variable	Description
ROA (Return on Assets)	A measure of profitability, calculated as: $ROA = \frac{\text{Net Income}}{\text{Total Assets}}$
DA (Discretionary Accruals)	A measure of earnings management, typically calculated using an accrual-based model (e.g., the modified Jones model)
Ret (Return)	The total return on a company's stock over a given period, including both price appreciation and dividends
Sigma	The standard deviation of a company's stock returns, reflecting its volatility: $\sigma = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (R_{i,t} - \mu_t)^2}$ where $R_{i,t}$ is the firm's return at time t and μ_t is the mean return.
SOE (State-Owned Enterprise)	A binary variable indicating whether a company is state-owned (1 = Yes, 0 = No)
IV	The concern level of the firm, used as an instrumental variable to address endogeneity. Measured by the number of research reports published that track and analyze the company in a given year: $IV_{i,t} = \text{Number of Research Reports}$ The IV affects ESG uncertainty through analysts' attention but is assumed not to directly impact stock price crash risk
Source(s): Table by authors	

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