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ESG rating disagreements and stock price crash risk: can distraction, regional digital economy and corporate intelligence maturity play important roles?

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Abstract

Purpose – ESG issues are gaining increasing attention from investors, but the environmental, social and governance (ESG) rating disagreement caused by different standards of rating agencies misleads investors' investment decisions. This can lead to an increased risk of stock price crashes, causing turbulence in the financial markets and reducing investors' confidence. The paper investigates whether ESG rating disagreement of the current period increases stock price crash risk and the mechanism to mitigate this impact.

Design/methodology/approach – With the sample of the listed companies of Shanghai and Shenzhen Stock Exchanges from 2010 to 2022 this paper examines the impact of ESG rating disagreement itself on stock price crash risk. Moreover, this paper examines the mechanisms by analyzing the moderating effect of distraction of investors; digital economy and corporate intelligence maturity.

Findings – This paper finds that ESG rating disagreement itself would amplify the stock price crash risk. When exploring the moderating effect of institutional investors' distraction, digital economic development level and corporate intelligence, the paper found that they would mitigate the impact of ESG rating disagreement on stock price crash risk. The relationship between ESG rating disagreement and stock price crash risk is more pronounced in the context of heavily-polluted, state-owned enterprises (SOEs) and enterprises with star analysts.

Originality/value – Currently, few articles discuss ESG rating disagreement, especially the impact of current ESG rating disagreement on stock price crash risk. This paper focuses on this topic and provides strategies to mitigate the impact of current ESG rating divergence on stock price crash risk.

Keywords ESG rating disagreements, Stock price crash risk, Distraction of investors, Digital economy, Corporate intelligence maturity

Paper type Research paper

1. Introduction

Nowadays, as sustainable development becomes an internationalized common goal, environmental, social and governance (ESG) disclosure and ESG rating are receiving increasing attention. Custom Market Insights has released the report, which illustrates that the global Environmental, Social and Governance Investing Market has achieved a valuation of USD 17.2 trillion by 2022 and analysts anticipate that the valuation will soar to USD 46.5

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trillion by 2032 (Custom Market Insights, 2023). The company's strong ESG performance is becoming increasingly important for attracting external investor investments (Kotsantonis *et al.*, 2016). Due to variations in the criteria, the same company may receive different ESG ratings from different ESG rating agencies (Billio *et al.*, 2021; Christensen *et al.*, 2022). Different ESG ratings convey the confusing investment information for investors, undoubtedly increasing the opacity of companies to investors and introducing significant investment risks (Christensen *et al.*, 2022; Fu and Li, 2023).

Avramov *et al.* (2022) found investors may be more inclined to seek higher returns to compensate for potential ESG-related risks when considering ESG uncertainty. Gibson Brandon *et al.* (2021) holds that the increased ESG rating disagreement may be interpreted as a factor contributing to uncertainty, leading to the demand for an uncertainty premium. Although there are studies about ESG rating disagreement and stock return (Avramov *et al.*, 2022; Gibson Brandon *et al.*, 2021; Yan, 2023), there is scarce research on the ESG rating disagreement and stock price crash risk.

Considering this context, the objective of this paper is to address this gap by examining the influence of ESG rating disagreement on the stock price crash risk of corporations. Past studies have indicated that information asymmetry between corporate management and external investors (Hutton *et al.*, 2009), along with the agency costs of the company (Jin and Myers, 2006), can lead to the increased stock price crash risk.

The problem is approached through the examination of Chinese common stocks listed on the main board of the Shanghai and Shenzhen Stock Exchange from 2010 to 2022. The ESG rating data are sourced from six ESG rating agencies: Bloomberg, Wind, Russell, Hexun, SynTao Green Finance and Huazheng Index Information Service. Following Avramov *et al.* (2022), Hu *et al.* (2023), the ESG rating disagreement is calculated. Variables for the stock price crash risk are measured following the approach proposed by Cen (2023), using two variables, NCSKEW and DUVOL (Luo *et al.*, 2023). While there are slight methodological differences in calculating these two variables, both of them effectively indicate the level of stock price crash risk. The calculation of ESG rating disagreement follows the methodology outlined by Hu *et al.* (2023), Luo *et al.* (2023). The regression results confirm that ESG rating disagreement could increase the stock price crash risk.

The second question is to address under what mechanism ESG rating disagreement reduces its impact on stock price crash risk. This paper explores the impact mechanisms of three moderating variables. The first moderating variable is the distraction of institutional investors. Following the approach proposed by Kempf *et al.* (2017), a variable is constructed to measure the distraction of institutional investors. Moreover, the level of digital development in the province could also be an important factor to have an impact on this process. According to the study (Gao *et al.*, 2022; Ren *et al.*, 2023), a variable is established to measure the level of digital economic development in the location where the company operates. The results indicate that a high level of regional digitization economy can reduce stock price crash risk. The third moderating variable is the maturity level of intelligence in the company. The intelligent upgrading of companies helps to increase company value and mitigate stock price crash risk (Kim *et al.*, 2021; Nenavani *et al.*, 2024). The companies have a high degree of intelligence experiencing lower stock price crash risk (Zhao *et al.*, 2023b). The variable used to analyze the moderating effect is constructed according to the method proposed in previous research (Manita *et al.*, 2020; Wu *et al.*, 2022).

To test whether the positive impact of ESG rating disagreement on stock price crash risk varies based on the characteristics of the firm, a series of heterogeneity tests is conducted as the following analysis. It is observed that the impact of ESG rating disagreement on stock price crash risk is greater and more significant for heavily-polluted companies, state-owned companies and companies covered by star analysts.

This paper makes contributions to various aspects of the existing literature from three aspects.

First, previous research on the relationship between ESG and stock price crash risk has predominantly focused on ESG disclosure (Ming-quan *et al.*, 2023) and performance (Chen *et al.*, 2023; Fang, 2023; Kim *et al.*, 2014). These articles have not considered the differences in ratings from different rating agencies. However, this paper complements this area of study by investigating ESG rating disagreement. By focusing on differences rather than disclosure and absolute numerical comparisons, insights can be gained into the impact of ESG discrepancies, which possess a confounding nature, on investment risk. Although the research of Dong *et al.* (2024) has found that the lagged ESG rating disagreement would mitigate stock price crash risk, their research has not explored the impact of ESG rating disagreement of current period on the stock price crash risk. This paper finds that ESG rating disagreement of current period could increase stock price crash risk and fill this gap.

Second, the contribution of this paper lies in exploring the impact of confusing information on stock price crash risk when such misleading information is present in the financial market. Previous studies on information leading to increased stock price crash risk primarily focused on the sudden disclosure of concealed negative information, resulting in a sharp change in investor sentiment, as seen in works (Shi, 2021; Tusheng *et al.*, 2017). The conclusion of this paper is that, like false disclosure information, confusing information also increases the stock price crash risk.

The third contribution is about how investors should respond to such confusing investment signals. The previous perspective was based on information disclosure, that is, disseminating information to the financial market. This paper's perspective, however, is based on information reception, that is, obtaining information from the financial market. As Sun and Zhao *et al.* discovered in their study (Sun and Xiao, 2018; Zhao *et al.*, 2023a), it is not the more information disclosed, the better; excessive disclosure can lead to stock price collapse. Investors should respond to the excessive information volume with appropriate distraction. Investors can also decide whether to invest based on exogenous factors such as corporate intelligence and the level of regional digitization development, which are not directly related to the confusing information itself.

The rest of this paper is structured as follows. Section 2 presents the literature review and six hypotheses. Section 3 shows the dataset and the variables used. Section 4 describes the design of research and results. Section 5 presents the results of additional analysis. Section 6 is the conclusion.

2. Literature review and hypothesis development

In this section, the relevant literature is reviewed, and the main hypotheses are proposed.

2.1 ESG rating disagreement and stock price crash risk

ESG rating disagreement reflects information asymmetry, so if ESG information accurately reflected the company's internal situation, ESG ratings would tend to be consistent (Liu *et al.*, 2024). However, due to the high opacity of the company's disclosures, there are obvious differences in ESG ratings. Most investors in capital markets rely on professional agencies for rating judgments, so ESG rating disagreement would affect investors' information and investment behavior (Wang *et al.*, 2024). Although investors may still invest in companies with high ESG rating disagreement, they tend to remain vigilant and skeptical. Therefore, the negative performance or adverse news reports regarding the company can trigger a strong reaction from those investors who lack the investment confidence, such as quickly selling off their shares (Kim, 2023). In such cases,

the risk of the company's stock price crashing significantly increases. Then, the first hypothesis is as follows:

H1. There is a positive relationship between ESG rating disagreement and stock price crash risk.

2.2 The mechanism

The paper explores three moderating mechanisms, which would mitigate the impact of ESG rating disagreement on the stock price crash risk.

2.2.1 Moderating effect of distraction of institutional investors. Because it is more difficult to observe and obtain information about most retailer investors' portfolios, whereas information about institutional investors' portfolios is more readily accessible, this paper examines the behavior of institutional investors. Since institutional investors generally have more expertise, they actively gather market information and maintain more diversified portfolios, the research conclusions may apply to retailer investors with these characteristics (Nguyen *et al*., 2020). The term "distraction of institutional investors" means that if an investor has investments in a company, and a noteworthy event occurs in another industry that is important to the investor's portfolio, then the investor is more likely to be distracted from the company.

Institutional investors play a crucial role in the capital markets, and retail investors often make similar reactions based on the judgments and professional analyses of institutional investors, even mimicking their buying and selling behavior (Guan, 2022; Polat, 2020). If institutional investors are distracted and not focused on companies with more ESG rating disagreement, it means that even though retail investors may have doubts about the true situation of these companies and lack investment confidence, the absence of institutional investors' analysis and the lack of stock selling behavior from institutional investors will reduce the actual selling of stocks by retail investors due to negative information. Additionally, because institutional investors have shifted their attention to other sector stocks within their portfolios, they themselves will not significantly change their holdings in companies with high ESG rating disagreement (Schmidt, 2019). Therefore, the risk of a stock price crash will decrease. Based on this, hypothesis H2 is proposed.

H2. With institutional investors' distraction plays a moderating role, the combined impact of ESG rating disagreement and distraction of institutional investors will lead to a negative shift in stock price crash risk.

2.2.2 Moderating effect of digital economic development level of the province. The maturity of digital infrastructure and technology in the region where a company is located contributes to the company delivering more authentic and accurate ESG reports (Ren *et al*., 2023). In regions with a high level of digital economic development, investors can utilize advanced digital technologies to search for real ESG information and analyze those information by themselves (Junyan *et al*., 2023). Therefore, they do not have to rely solely on the ratings provided by ESG rating agencies. Even if they still rely on these ratings, they can obtain additional information to assist their judgment when there are discrepancies between ESG ratings. This will increase their confidence in investing in the company and reduce doubts caused by ESG rating disagreements, which helps to mitigate stock price crash risk. Therefore, the third hypothesis of this paper is as follows:

H3. With the digital economic development level of the province serving as a moderator, the joint effect of ESG rating disagreement and the digitization level of the province will result in a negative shift in stock price crash risk.

2.2.3 Moderating effect of corporate intelligence maturity of the firm. When a company's smart infrastructure, including blockchain, the Cloud Computing, the Internet of Things (IoT) and Artificial Intelligence, is well-established with a high level of sophistication, it can positively impact the enhancement of ESG performance and contribute to the increase in the company's value (Kim *et al.*, 2021; Nenavani *et al.*, 2024). The intelligence transformation of a company can drive technological innovation and reduce information asymmetry. This significantly diminishes the operational risks for the company (Liu and Wang, 2023). By disclosing information related to its intangible assets concerning digitalization and intelligence, a company can reduce its stock price crash risk. Based on the above perspective, hypothesis H4 is proposed.

H4. With corporate intelligence maturity of the firm acting as a moderator, the combined influence of ESG rating disagreement and corporate intelligence maturity of the firm results in a negative alteration in stock price crash risk.

2.3 Further analyses on industry and ownership heterogeneity

First, companies with high levels of pollution, which would experience less distraction of investors due to their significant pollution attributes, experience a more pronounced enhancement in corporate value through ESG performance (Yin *et al.*, 2023). Polluting industries will be more motivated to demonstrate environmentally friendly practices to the external environment through ESG performance (Hsu and Chen, 2023). Therefore, the impact of ESG rating disagreement on stock price crash risk is greater and more significant for heavily-polluted firms. To validate the points mentioned above, the following hypothesis is proposed.

H5. The ESG rating disagreement of heavily-polluted firms will have a more pronounced positive impact on the stock price crash risk.

Second, as state-owned enterprises (SOEs) can more keenly grasp policy demands, the impact of ESG rating disagreement on the stock price crash is more significant for SOEs (Jin and Wu, 2023). Moreover, implicit social responsibilities are typically shouldered by SOEs. Non-state-owned firms are often driven by profit motives (Chen *et al.*, 2020). Some factors of enterprise have the more pronounced impact on state-owned firms in terms of analysts' coverage and equity financing costs (Chen *et al.*, 2011). Therefore, the stock price crash risk of SOEs will experience notably correlated movements under the influence of ESG rating disagreement. These arguments lead to the last hypothesis:

H6. A more notable positive effect on stock price crash risk is observed with the ESG rating disagreement of SOEs.

Third, this paper considers whether the company's analysts include star analysts. The star analysts discussed in this paper are those recognized as such by the New Fortune magazine. Star analysts are better at utilizing information related to companies to make predictions (Desai *et al.*, 2000). Star analysts not only find it easier to access company information, but they also amplify the impact of company-specific information on stock prices (Xu *et al.*, 2013). For the companies with the coverage of star analysts, this paper believes that ESG rating disagreement will have a more significant impact on the risk of stock price crash.

H7. Compared to companies without star analysts, the positive impact of ESG rating disagreement on the risk of stock price crash is more pronounced for companies with star analysts.

3. Data

3.1 Data sources

The sample includes all stock of listed companies on the main board of Shanghai and Shenzhen Stock Exchanges. The ESG rating data comes from six ESG rating agencies – Bloomberg, Wind, Russel, Hexun, SynTao Green Finance and Huazheng Index Information Service. Those ESG rating agencies are highly familiar with China market, and the ESG rating data they release is authoritative and widely utilized in previous research (Hu *et al.*, 2023). Other data, including financial statement data, are from China Stock Market and Accounting Research Database (CSMAR) and WIND database. This paper utilizes Excel and Stata17 for data cleaning, processing and regression analysis.

The time span of the sample data is 13 years, from 2010 to 2022. The financial companies, the companies which are listed as "Special Treatment" by Shanghai and Shenzhen Stock Exchanges and the companies which have missing values are excluded from the sample. All continuous variables in the article have been winsorized.

3.2 Main variables

3.2.1 Dependent variable: stock price crash risk. Stock price crash risk refers to the presence of significant declines in stock prices, characterized by extreme downward movements (Cen, 2023). The variable constructed to measure stock price crash risk follows the approach (Cen, 2023). There are two variables used to measure the stock price crash risk. The first one is NCSKEW, and the other one is DUVOL.

Initially, the weekly specific return $r_{i,T}$ for firm i in week T is computed as follows. r_m is the weighted market return. $r_{m,T}$ is the weighted market return in week T.

$$r_{i,T} = c_i + \beta_{1,i} r_{m,T+2} + \beta_{2,i} r_{m,T+1} + \beta_{3,i} r_{m,T} + \beta_{4,i} r_{m,T-1} + \beta_{5,i} r_{m,T-2} + \epsilon_{i,T} \tag{1}$$

To measure $F_{i,T}$, which is the weekly return specific to the firm, the residual of above Equation (1) is used.

$$F_{i,T} = \ln(1 + \widehat{\epsilon}_{i,T}) \tag{2}$$

Using $F_{i,T}$, NCSKEW and DUVOL could be calculated.

$$\text{NCSKEW}_{i,T} = \frac{-n(n-1)^{\frac{3}{2}} \sum F_{i,T}^3}{(n-1)(n-2)\left(\sum F_{i,T}^2\right)^{\frac{3}{2}}} \tag{3}$$

In the above equation, "n" is the quantity of trading weeks annually for firm i.

$$DUVOL_{i,T} = \log\left(\frac{(n_u - 1)\sum\limits_{Down} F_{i,T}^2}{(n_d - 1)\sum\limits_{Up} F_{i,T}^2}\right) \tag{4}$$

"n_u" is the quantity of weeks during which $F_{i,T}$ exceeds the annual average return. "n_d" is the quantity of weeks during which $F_{i,T}$ does not exceed the annual average return.

3.2.2 Main independent variable: ESG rating disagreement. Different ESG rating agencies employ varying scoring approaches, so all ESG rating scores are standardized to the range of

1–10 (Huang *et al.*, 2022). The ESG rating disagreement is calculated following Avramov *et al.* (2022), Hu *et al.* (2023). First, to form pairwise combinations between ESG rating agencies. For one specific firm, the difference in ratings for each pair ($ERD\_pairwise_{i,t}$) is calculated as follows for each year:

$$ERD\_pairwise_{i,t} = \frac{|ESG\_score_{i,a,t} - ESG\_score_{i,b,t}|}{\sqrt{2}} \tag{5}$$

$ESG\_score_{i,a,t}$ is the standardized ESG score for firm i in year t from "a", which is one of the six agencies, whereas $ESG\_score_{i,b,t}$ is the standardized ESG score for firm i in year t from "b", which is another agency. $ERD\_pairwise_{i,t}$ could measure the ESG rating difference between the pair of agencies for the specific firm i in year t. Among the six ESG rating agencies, a maximum of 15 $ERD\_pairwise_{i,t}$ can be formed.

Second, to calculate the mean of $ERD\_pairwise_{i,t}$, which would be the ESG rating disagreement for the specific firm i on year t.

$$ERD_{i,t} = \frac{\sum_{n=1}^{N} \text{ERD\_pairwise}_{i,t}}{N} \tag{6}$$

In the formula, "N" represents the number of pairs for ESG rating agencies that have rated company i in year t, with a maximum value of 15.

3.2.3 Moderator variable.

(1) Distraction of institutional investors

To construct variables measuring institutional investors' distraction, following the approach (Kempf *et al.*, 2017). Institutional investors would be more interested in positive news than negative news, since they face pressure from performance evaluations and their investors. So, when constructing the variable "$Distraction_{i,q}$", it only includes the distraction caused by the industries, which the firm i is excluded from, turn out to be the highest return.

$$Distraction_{i,q} = \sum_{v \in F_{q-1}} \sum_{IND \neq IND_f} w_{v,i,q-1} \times w_{v,q-1}^{IND} \times IS_q^{IND} \tag{7}$$

"v" represents the investor, whereas "i" represents the specific firm. The "q" in the equation means the calendar quarter q. F_{q-1} means, in the end of quarter q−1, the column of institutional investors who invest in firm i. IND means the industries which belong to one of the 12 Fama-French industry and IND_f is the industry which firm i belongs to.

$w_{v,q-1}^{IND}$ denotes the market-value weight of industry IND in investor v's investment portfolio.

IS_q^{IND} is an indicator variable, which equals to 1 if, in a given quarter, the return of industry IND is the highest or lowest among all 12 Fama-French industries.

$w_{v,i,q-1}$ represents the weight of firm i in investor v's investment portfolio, taking into account both the market-value weight of shares held in investor v's portfolio for firm i and the ownership proportion of the total number of shares issued by the firm i. It cannot be simply based on market-value weight because an investor might hold a significant proportion of firm i's all issued shares, but the overall market value of firm i in their portfolio may be relatively small.

$$w_{v,i,q-1} = \frac{QPFweight_{v,i,q-1} + QPercOwn_{v,i,q-1}}{\sum_{v \in F_{q-1}} \left(QPFweight_{v,i,q-1} + QPercOwn_{v,i,q-1}\right)} \tag{8}$$

$PercOwn_{v,i,q-1}$ is the proportion of shares of firm i owned by investor v, and $PFweight_{v,i,q-1}$ is the market value weight of firm f in investor i's portfolio. The stocks held by investor i in quarter q−1 are sorted into quintiles, labeled $QPFweight_{v,i,q-1}$, according to their $PFweight_{v,i,q-1}$. The shareholders of firm f are sorted into quintiles, denoted as $QPercOwn_{v,i,q-1}$, based on their $PercOwn_{v,i,q-1}$.

(2) Digital economic development level of the province

Following the approach of Liu and Wang (2023), use R-studio to capture the number of occurrences of terms related to the digital economy, such as "digitization" and "digital economy", in Baidu Index for each province from 2010 to 2022. Summing up the occurrences of these terms by province and year and dividing the sum by one million, a new variable – province level of digital economic development "Digital Economy" was created.

$$Digital\ Economy_{prov,t} = \frac{\sum_{n=1}^{N=365} Term_{prov,t}}{1,000,000} \tag{9}$$

$Digital\ Economy_{prov,t}$ are the total occurrences of terms for one of the provinces in year t. The formula $\sum_{n=1}^{N=365} Term_{prov,t}$ means to sum up the daily keyword search frequencies collected for year t of the specific province. This yields the total keyword search frequency for t year of the specific province. Dividing by 1,000,000 is to prevent the coefficient of this variable "Digital Economy" from becoming too small.

(3) Corporate intelligence maturity of the firm

The variable CIM (corporate intelligence maturity) is calculated by identifying intangible assets with names containing terms related to corporate intelligence (Leliaert *et al.*, 2003; Rodov and Leliaert, 2002), sum the values of these intangible assets and divide it by total intangible assets and take the natural logarithm.

$$CIM_{i,t} = \ln\left[\frac{\text{Digital intangible assets}_{i,t}}{Total\ \text{intangible assets}_{i,t}} \times 100\right] \tag{10}$$

$CIM_{i,t}$ is the variable which measures the degree of corporate intelligence maturity of firm i in year t. Digital intangible $\text{assets}_{i,t}$ represents the value of intangible assets which has been digitalized of firm i in year t, whereas $Total$ intangible $\text{assets}_{i,t}$ means the value of total intangible assets of firm i in year t.

3.2.4 Control variables. The control variables are selected following the previous studies (Chen *et al.*, 2022). INST is the ownership percentage of institutional investors among all investors in the company. Mshare is the ownership percentage of the management among all investors. Opinion takes a value of 1 if the company's financial report for the current year receives an unqualified audit opinion; otherwise, it takes a value of 0. BM ratio is the book-to-market ratio of the firm. Balance means equity balance, calculated as the sum of the ownership percentages of the second to fifth largest shareholders divided by the ownership

percentage of the largest shareholder. Size of the company is measured using assets, and the assets are taken in the natural logarithm. ROS is the return of the stock of firm i in year t, and it is calculated following Bei *et al.* (2011). RV is the logarithm of the annualized monthly return standard deviation of the stock and it is calculated following Su (2015). The reason to include these two variables into the model is because past return can forecast future stock risk and firms with more volatility are likely to experience more crashes (Chen *et al.*, 2001). The equation to calculate RV is as follows.

$$RV_{i,j,t} = \ln\left[\sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(r_{i,j,t} - \frac{1}{T}\sum_{t=1}^{T} r_{i,j,t}\right)^2}\right] \tag{11}$$

$r_{i,j,t}$ represents the return of firm i on the j-th month within year t, and T represents the total number of months in each fiscal year.

The definitions of all variables are listed in Table 1.

Table 2 provides an overview of the key variables utilized in this study through summary statistics.

The mean value of NCSKEW and DUVOL is below zero which means, on average, firms would not face the stock price crash risk. The average ERD is 2.4567, which means the average ESG rating disagreement for a company is 2.4567. The average of distraction is 0.0027, which means on average, a firm faces the situation which its intuitional investors are distracted by the positive extreme return by other industries with the degree of 0.0027. The average value of variable digital economy is 0.0635, indicating that the average level of digital economic development in the province where the enterprise is located is 0.0635. The average value of CIM is 11.7689, indicating that the average maturity level of internal intelligence within the enterprise is 11.7689. An average firm also has 48.1992 for INST,

Variable	Definition
NCSKEW	A variable which measures the stock price crash risk
DUVOL	Another variable which measures the stock price crash risk
ERD	ESG rating disagreement for the specific firm on that year
Distraction	The degree of institutional investors' distraction towards the firm
Digital economy	The variable measures the annual digital economic development level of the province which the firm is located in
CIM	The variable measures corporate intelligence maturity of the firm
INST	The ownership percentage of institutional investors among all investors which multiplied by 1,000
Mshare	The ownership percentage of the management among all investors which multiplied by 1,000
Opinion	An indicator variable, taking a value of 1 if the company's financial report for the current year receives an unqualified audit opinion
BM ratio	The ratio of book value to market value of the firm
Balance	Equity balance is calculated as the sum of the ownership percentages of the second to fifth largest shareholders divided by the ownership percentage of the largest shareholder
Size	Natural logarithm of total assets
ROS	Return of the stock of firm i in year t
RV	Natural logarithm of the annualized monthly return standard deviation of the stock

Source(s): This table is created by the author

Table 1. Definition of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
NCSKEW	17,066	−0.277	0.7275	−5.1707	5.0382
DUVOL	17,066	−0.1878	0.4864	−2.5615	2.2777
ERD	17,066	2.4567	0.809	0	5.8341
Distraction	17,066	0.0027	0.0061	0	0.0412
Digital economy	17,066	0.0635	0.0513	0.0002	0.1916
CIM	17,066	11.7689	6.6263	0	23.2072
INST	17,066	48.1992	25.2909	0.0014	157.0978
Mshare	17,066	13.4478	19.4083	0	89.1771
Opinion	17,066	0.9827	0.1304	0	1
BM ratio	17,066	0.6031	0.2573	0.0098	1.5592
Balance	17,066	0.7507	0.6223	0.0056	4
Size	17,066	22.4916	1.3492	17.8132	28.6365
ROS	19,483	0.189	0.588	−0.822	14.28
RV	19,483	−2.169	0.458	−3.973	0.661

Table 2.
Descriptive statistics

Source(s): This table is created by the author

13.4478 for Mshare, 0.9827 for opinion, BM ratio for 0.6031, balance for 0.7507 and 22.4916 for size, 0.189 for ROS and −2.169 for RV.

4. Research design and main results

4.1 Research design

In the main regression analysis, to test hypothesis H1, the following model is constructed, and also used the fixed effects model to analyze their panel data (Jiang *et al.*, 2023).

$$\begin{aligned} \text{NCSKEW}_{i,t} = {} & \alpha_0 + \alpha_1 \text{ERD}_{i,t} + \alpha_2 SIZE_{i,t} + \alpha_3 \text{INST}_{i,t} + \alpha_4 \text{Mshare}_{i,t} + \alpha_5 \text{Opinion}_{i,t} \\ & + \alpha_6 \text{BM ratio}_{i,t} + \alpha_7 \text{Balance}_{i,t} + \alpha_8 ROS_{i,t} + \alpha_9 \text{RV}_{i,t} + \alpha_{10} \text{NCSKEW}_{i,t-1} \\ & + Year_{FE} + Firm_{FE} + \varepsilon_{i,t} \end{aligned} \tag{12}$$

$$\begin{aligned} \text{DUVOL}_{i,t} = {} & \beta_0 + \beta_1 \text{ERD}_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 \text{INST}_{i,t} + \beta_4 \text{Mshare}_{i,t} + \beta_5 \text{Opinion}_{i,t} \\ & + \beta_6 \text{BM ratio}_{i,t} + \beta_7 \text{Balance}_{i,t} + \beta_8 ROS_{i,t} + \beta_9 \text{RV}_{i,t} + \beta_{10} \text{DUVOL}_{i,t-1} \\ & + Year_{FE} + Firm_{FE} + \varepsilon_{i,t} \end{aligned} \tag{13}$$

$\text{NCSKEW}_{i,t}$ and $\text{DUVOL}_{i,t}$ are the dependent variables which are used to measure the stock price crash risk. ERD is the independent variable defined earlier in the text. $\text{NCSKEW}_{i,t-1}$ and $\text{DUVOL}_{i,t-1}$ are used to capture the potential persistence of the third moment of stock returns following Chen *et al.* (2001). $Year_{FE}$ represents the year fixed effects. $Firm_{FE}$ means firm fixed effects. The double fixed effects model with both time and firm fixed effects provides comprehensive control when dealing with panel data (Jiang *et al.*, 2023).

Then, the moderating effects of institutional investors' distraction (H2), digital economic development level of the province (H3) and corporate intelligence maturity of the firm (H4) would be tested. The following models are constructed. Still using the panel dataset, the approach follows Li, who also use moderating effect in the research (Li *et al.*, 2023a).

$$\begin{aligned}\mathrm{NCSKEW}_{i,t} = {} & \alpha_0 + \alpha_1 \mathrm{ERD}_{i,t} + \alpha_2 M_{i,t} + \alpha_3 \mathrm{ERD}_{i,t} \times M_{i,t} + \alpha_4 SIZE_{i,t} + \alpha_5 \mathrm{INST}_{i,t} \\ & + \alpha_6 \mathrm{Mshare}_{i,t} + \alpha_7 \mathrm{Opinion}_{i,t} + \alpha_8 \mathrm{BM\,ratio}_{i,t} + \alpha_9 \mathrm{Balance}_{i,t} + \alpha_{10} ROS_{i,t} \\ & + \alpha_{11} \mathrm{RV}_{i,t} + \alpha_{12} \mathrm{NCSKEW}_{i,t-1} + Year_{FE} + Firm_{FE} + \varepsilon_{i,t}\end{aligned} \tag{12}$$

$$\begin{aligned}\mathrm{DUVOL}_{i,t} = {} & \beta_0 + \beta_1 \mathrm{ERD}_{i,t} + \beta_2 M_{i,t} + \beta_3 \mathrm{ERD}_{i,t} \times M_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 \mathrm{INST}_{i,t} \\ & + \beta_6 \mathrm{Mshare}_{i,t} + \beta_7 \mathrm{Opinion}_{i,t} + \beta_8 \mathrm{BM\,ratio}_{i,t} + \beta_9 \mathrm{Balance}_{i,t} + \beta_{10} ROS_{i,t} \\ & + \beta_{11} \mathrm{RV}_{i,t} + \beta_{12} \mathrm{DUVOL}_{i,t-1} + Year_{FE} + Firm_{FE} + \varepsilon_{i,t}\end{aligned} \tag{13}$$

$M_{i,t}$ is the variable which represents one of the three moderating variables. When conducting the following empirical research, $M_{i,t}$ should be replaced by distraction, digital economy and CIM. $\mathrm{ERD}_{i,t} \times M_{i,t}$ is the interaction term between ESG rating disagreement and one of the three moderating variables. If the coefficients of these interaction terms (α_3 and β_3) are significantly negative, it can validate hypothesis H2, H3 and H4.

All standard errors in the regression results of the paper are robust standard errors (Robust SE).

4.2 Main result

The main result represents the results of H1, which is the primary regression of this paper. In Table 3, column (1) and (2) are the regression results which do not include control variables. Column (3) and (4) are the ones including control variables. ERD's coefficient is significant at the 0.05 level of significance. With the inclusion of control variables, the ERD's coefficients are 0.0256 and 0.0163 for regression (3) and (4), respectively. This means 2.85 and 2.70% increase in stock price crash risk, when it is measured by NCSKEW and DUVOL, respectively, associated with a one standard deviation increase in ERD. With the addition of control variables, the model's explanatory power for stock price crash risk has slightly increased. All four of the ERD's coefficients are significant, which suggests the positive effects of ESG rating disagreement on stock price crash risk. The bigger the ESG rating disagreement is, the higher the stock price crash risk would be. Therefore, it can be concluded that hypothesis H1 holds true.

4.3 Mechanism analysis

To further examine what could decrease the effect of ESG rating disagreement on stock price crash risk, the moderating role of the three moderating variables should be tested.

4.3.1 Distraction of institutional investors. In Table 4, the coefficients of the interaction term in both regressions are significant at the 1% level of significance, which are −3.6741 and −2.2113, respectively, for NCSKEW and DUVOL. This indicates one standard deviation increase of the interaction term would lead to −7.82% and −7.04% decrease in NCSKEW and DUVOL, respectively. Both ESG rating disagreement and distraction of institutional investors having positive coefficients indicate that they individually have a positive impact on stock price crash risk. However, negative coefficients of the interaction term suggest that the combined effect of ESG rating disagreement and distraction of institutional investors could mitigate stock price crash risk, which confirms the hypothesis H2.

4.3.2 Digital economic development level of the province. The following regression involves using digital economic development level of the province as the moderating variable. The

	(1) NCSKEW	(2) DUVOL	(3) NCSKEW	(4) DUVOL
ERD	0.0176**	0.0122**	0.0256***	0.0163***
	(0.0087)	(0.0058)	(0.0089)	(0.0059)
Lagged NCSKEW or Lagged DUVOL			−0.0907***	−0.0967***
			(0.0083)	(0.0082)
INST			0.0045***	0.0035***
			(0.0006)	(0.0004)
Mshare			0.0056***	0.0041***
			(0.001)	(0.0007)
Opinion			−0.1844***	−0.1223***
			(0.0475)	(0.0315)
BM_ratio			−0.2215***	−0.0629*
			(0.0521)	(0.0345)
Balance			0.0444**	0.0288**
			(0.0213)	(0.0141)
size			−0.0205	−0.0452***
			(0.0174)	(0.0115)
ROS			−0.1332***	−0.1012***
			(0.0134)	(0.0089)
RV			−0.2752***	−0.1783***
			(0.0188)	(0.0124)
_cons	−0.3192***	−0.2176***	−0.4851	0.3207
	(0.0218)	(0.0146)	(0.3906)	(0.259)
Observations	17,066	17,066	16,782	16,782
R-squared	0.2297	0.2304	0.2757	0.2806

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 3.
Main result

	(1) NCSKEW	(2) DUVOL
ERD	0.0354***	0.0222***
	(0.0094)	(0.0063)
Distraction	11.248***	6.8684***
	(2.887)	(1.9142)
ERD × Distraction	−3.6741***	−2.2113***
	(1.155)	(0.7659)
Control variables	YES	YES
_cons	−0.5118	0.3051
	(0.3905)	(0.2589)
Firm FEs	YES	YES
Year FEs	YES	YES
Observations	16,782	16,782
R-squared	0.2766	0.2813

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 4.
Mechanism analysis - distraction

moderating variable "Digital Economy" measures the annual digital economic development level of the province which the firm is located in. For businesses, being located in regions with a high level of development in the digital economy is more advantageous for utilizing these digital tools for corporate governance and risk management.

In Table 5, the coefficients of the interaction term are statistically significant negative, which indicates that one standard deviation increase of the interaction term would lead to −11.72% and −10.21% decrease in NCSKEW and DUVOL, respectively. The combined effect of digital economy and ESG rating disagreement mitigates stock price crash risk. This regression result confirms that hypothesis H3 is valid.

4.3.3 Corporate intelligence maturity. Enterprises with high levels of CIM can utilize digital technology to better identify, assess and respond to risks. This diminishes the risk of stock price crash associated with ESG rating disagreement. The regression analysis here is to analyze the moderating effect of the last moderating variable, that is, CIM.

The result in Table 6 show similar conclusion as the main result that ESG rating disagreement has a positive impact on stock price crash risk, with the coefficient of 0.0806 for NCSKEW and 0.047 for DUVOL, respectively. The combined effect of digital economy and ESG rating disagreement on stock price crash risk is negative, with the coefficients (−0.0046 and −0.0026) of interaction term significant at the 5% level of significance. This shows that one standard deviation increase of the interaction term would lead to −12.00% and −9.97% decrease in NCSKEW and DUVOL, respectively. Based on the analysis above, hypothesis H4 is assumed to be valid.

4.4 Robustness tests

A series of robustness tests was conducted to ensure the robustness of main findings under alternative settings.

First, replace stock price crash risk with profit volatility as the dependent variable. The lower the profit volatility, the lower the stock price volatility, and the smaller the stock price crash risk (Gang and Qi, 2021). Also, profit volatility could measure corporate resilience to risk (Zhu and Xu, 2022). Therefore, using the variable PV, which can measure financial and market risks of the company, as the dependent variable, replaces NCSKEW and DUVOL.

	(1) NCSKEW	(2) DUVOL
ERD	0.0599***	0.0374***
	(0.013)	(0.0086)
Digital economy	−0.0601	−0.083
	(0.6154)	(0.4081)
ERD × Digital economy	−0.6246***	−0.3637***
	(0.1645)	(0.1091)
Control variables	YES	YES
_cons	−0.6617	0.2009
	(0.4175)	(0.2769)
Firm FEs	YES	YES
Year FEs	YES	YES
Observations	16,782	16,782
R-squared	0.2775	0.2818

Note(s): Standard errors are in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Source(s): This table is created by the author

Table 5. Mechanism analysis – digital economy

	(1) NCSKEW	(2) DUVOL
ERD	0.0806***	0.047***
	(0.0157)	(0.0104)
CIM	0.0117***	0.0055***
	(0.003)	(0.002)
ERD × CIM	−0.0046***	−0.0026***
	(0.0011)	(0.0007)
Control variables	YES	YES
_cons	−0.5351	0.2709
	(0.3946)	(0.2619)
Firm FEs	YES	YES
Year FEs	YES	YES
Observations	16,782	16,782
R-squared	0.2779	0.2823

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 6. Mechanism analysis – CIM

Profit volatility is defined as the three-year moving standard deviation of each company's return on assets (ROA) adjusted by subtracting its annual ROA from the industry average ROA (Zhu and Xu, 2022). ROA for company i is the ratio of earnings before interest, taxes, depreciation and amortization (EBITDA) to total assets at the end of the corresponding year.

In Table 7, column (1) represents a regression without control variables, while the second column represents a regression with control variables. This positive and statistically significant impact of ESG rating disagreement on profit volatility indicates that ESG rating disagreement could positively affect financial and market risks of the company, which is consistent with the main result.

Second, the robustness tests below primarily involve altering the time span. In order to avoid interference from macroeconomic changes on the main conclusions of this paper, I adopted the robustness test approach similar to the approach used in the study (Shangkun *et al.*, 2012). The selected three-time intervals have different start and end years, as well as varying time spans. The number of observations is relatively close across the three selected subsamples, which can help avoid some issues caused by the difference of the number of sample observations. By selecting three-time intervals, namely 2010–2017, 2013–2019 and

	(1) PV	(2) PV
ERD	0.0012***	0.0008**
	(0.0004)	(0.0004)
Control variables	No	YES
_cons	0.0303***	−0.0242
	(0.0011)	(0.0186)
Firm FEs	YES	YES
Year FEs	YES	YES
R-squared	0.5071	0.5504

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 7. Robustness test – PV

2015–2020, the aim is to examine whether the main conclusions are still robust. That is, whether the positive and significant impact of ESG rating disagreement on stock price crash risk remains unchanged despite variations in the time span.

The regressions still maintain firm fixed effects and year fixed effects in Table 8. When I explored the impact of ERD on NCSKEW, the coefficient of ERD is around 0.03, and when investigating the impact on DUVOL, the coefficient of ERD is around 0.02. In the following regressions, although the coefficient of ERD has changed, the impact of ESG rating disagreement on stock price crash risk is statistically significant and positive. Therefore, this indicates that the main result of this study is not affected by changes in the time span and remains robust.

Third, I altered the ESG rating agencies involved since they may assign different ESG scores to the same company, it can affect the calculation results of ESG rating disagreement. Because Huazheng and WIND started evaluating the company's ESG rating in 2018, to avoid impacting the research results, the analysis here covers a period from 2018 to 2022, totaling five years. In Table 9, the ESG rating disagreement data used in the regressions in columns (1) and (2) is calculated using data from Bloomberg, Huazheng and WIND, in columns (3) and (4) is calculated using data from WIND, Huazheng and SynTao Green Finance, in column (5)

	2010–2017		2013–2019		2015–2020	
	(1)	(2)	(3)	(4)	(5)	(6)
	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
ERD	0.031***	0.0179**	0.0313***	0.0185**	0.0444***	0.0271***
	(0.0111)	(0.0075)	(0.0113)	(0.0075)	(0.013)	(0.0086)
Control variables	YES	YES	YES	YES	YES	YES
_cons	−0.1225	0.793**	−0.8634	0.6513	−2.2168***	−0.7634
	(0.5912)	(0.4016)	(0.6238)	(0.4145)	(0.7721)	(0.5106)
Firm FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
R-squared	0.348	0.3545	0.3319	0.3349	0.3572	0.3581

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 8. Robustness test – altering the time intervals

	Bloomberg, Huazheng and WIND		WIND, Huazheng and SynTao		Bloomberg, Huazheng, SynTao and WIND	
	(1)	(2)	(3)	(4)	(5)	(6)
	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
ERD	0.108**	0.0642**	0.0675**	0.0481**	0.1104***	0.0633**
	(0.0483)	(0.0327)	(0.0337)	(0.0227)	(0.0392)	(0.0264)
Control variables	YES	YES	YES	YES	YES	YES
_cons	2.6636	0.7638	−1.7446	−0.9132	−1.8936	−0.9652
	(2.8117)	(1.905)	(1.7581)	(1.1826)	(1.7577)	(1.1831)
Firm FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
R-squared	0.3017	0.3172	0.2223	0.2050	0.2239	0.2055

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 9. Robustness test – altering the control variables

and (6) is calculated using data from Bloomberg, Huazheng, SynTao Green Finance and WIND.

From the regression result, we could see that all the coefficients of ERD are positive, and they are all significant at the 5% significance level. This means the differences in rating data from various rating agencies do not affect the main conclusions of this paper. The impact of ESG rating divergence on stock price crash risk remains positive.

Last, this paper examines the impact of current ESG rating disagreement on stock price crash risk, while the research of Dong *et al.* (2024) focuses on the impact of lagged one-period ESG rating disagreement on stock price crash risk. Despite using different rating agencies to calculate ERD compared to Dong *et al.* (2024), this paper aims to explore whether the conclusion of Dong *et al.* (2024) still holds in this context. Therefore, the ERD is lagged by one period to investigate its impact on NCSKEW and DUVOL.

In Table 10, after lagging the ESG rating divergence by one period, we can see that the impact of ESG rating disagreement on stock price crash risk becomes negative, which is consistent with conclusion of Dong *et al.* (2024). This means one standard deviation increase of lagged ERD would lead to −2.37% and −2.93% decrease in NCSKEW and DUVOL, respectively. This indicates that current ESG rating disagreements indeed affect investors' confidence in the company, leading to overreactions to changes and disclosures, which in turn increases the risk of a stock price crash. This is because high information opacity in the current period causes investors to have insufficient understanding of the company's information. However, after a lag period, investors would have gained a deeper understanding of the company, and their confidence in the company would have returned to normal levels. Moreover, because of the disagreement, investors will seek a more in-depth and comprehensive understanding of the company's information, resulting in fewer sell-offs and short-term selling behaviors, thereby reducing the risk of stock price crashes of the companies. Therefore, the coefficient for the lagged one-period ERD is negative.

4.5 Endogeneity test

Although the main finding indicates that disagreement in ESG ratings can increase the risk of stock price crash, the results may be influenced by endogeneity issues. To address these concerns, three approaches are utilized: incorporating industry fixed effects, introducing new control variables and the two-stage least squares method.

First, I used industry fixed effect instead of firm fixed effect since considering some of the omitted variables that vary over industries but not over time. In column (1) and (2), the

	(1) NCSKEW	(2) DUVOL
Lagged ERD	−0.0209**	−0.0173**
	(0.0104)	(0.007)
Control variables	YES	YES
_cons	−1.5739**	−0.6772
	(0.6408)	(0.4337)
Firm FEs	YES	YES
Year FEs	YES	YES
R-squared	0.297	0.3036

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 10. Robustness test – lagged ERD

regression model includes both firm fixed effects and year fixed effects. For column (3) and column (4), the regression model includes both industry fixed effects and year fixed effects.

In Table 11, it could be concluded that even though the significance of ERD has decreased from 1% level of significance to 5% level of significance, there are still positive and statistically significant coefficients (0.0153 for NCSKEW as dependent variable and 0.0099 for DUVOL as dependent variable) for ERD after changing firm fixed effects with industry fixed effects. After using industry fixed effects, the *R*-square also decrease and this means the explanation power of the model has decreased. But these results could support the main result that ESG rating disagreement would increase stock price crash risk.

Second, the new control variables are added to addressing endogeneity issues. The explanations for the new variables are as follows. Board is the natural logarithm of the number of board members, representing the size of the board of directors. TMTPay refers to the natural logarithm of the total management compensation. Employee represents the natural logarithm of the number of employees. Indep represents the proportion of independent directors. SOE is a dummy variable, where SOEs are represented as 1, and non-SOEs are represented as 0. Bank is a dummy variable indicating ownership of bank stocks, where holding bank stocks is represented as 1, and not holding bank stocks is represented as 0. The following regression incorporates the new control variables along with the existing control variables. In column (1) and (2), there is only the group of original control variables. In column (3) and (4), the control variables include both original and new control variables.

In Table 12, after adding control variables, the coefficients of ERD are 0.026 for column (3) and 0.0163 for column (4) and they are significant at the 1% level of significance. ESG rating disagreement remains statistically significant. ESG rating disagreement still plays an increasing role in stock price crash risk. After adding new control variables, the t-value of ERD increased slightly, and the model's explanatory power for NCSKEW and DUVOL also showed a modest improvement.

Last, the two-stage least squares regression is conducted. This study employs lagged ERD as the instrumental variable. The first column presents the first-stage regression results, and the second and third column shows the regression results for the second stage. In Table 13, in the first stage, the coefficient of lagged ERD is 0.0282 and it is significant at the 1% level of significance. This means the lagged ERD has negative effect on the independent variable.

	(1) NCSKEW	(2) DUVOL	(3) NCSKEW	(4) DUVOL
ERD	0.0256***	0.0163***	0.0153**	0.0099**
	(0.0089)	(0.0059)	(0.0076)	(0.005)
Control variables	YES	YES	YES	YES
_cons	−0.4851	0.3207	−0.2741**	0.3229***
	(0.3906)	(0.259)	(0.1353)	(0.1009)
Firm FEs	YES	YES	NO	NO
Industry FEs	NO	NO	YES	YES
Year FEs	YES	YES	YES	YES
Observations	16,782	16,782	16,782	16,782
R-squared	0.2757	0.2806	0.0899	0.1041

Note(s): Standard errors are in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Source(s): This table is created by the author

Table 11. Endogeneity test – industry fixed effect

	(1) NCSKEW	(2) DUVOL	(3) NCSKEW	(4) DUVOL
ERD	0.0256***	0.0163***	0.026***	0.0163***
	(0.0089)	(0.0059)	(0.009)	(0.006)
Original controls	YES	YES	YES	YES
Added new controls	No	No	YES	YES
_cons	−0.4851	0.3207	−0.3993	0.1891
	(0.3906)	(0.259)	(0.4696)	(0.3108)
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
Observations	16,782	16,782	16,782	16,782
R-squared	0.2757	0.2806	0.2782	0.2832

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 12.
Endogeneity test – altering the control variables

	(1) ERD	(2) NCSKEW	(3) DUVOL
lagged_ERD	0.0282***		
	(0.0099)		
ERD		0.3366**	0.2328**
		(0.1422)	(0.0963)
Control variables	YES	YES	YES
_cons	3.6005***	−3.8766**	−2.3059*
	(0.5016)	(1.7437)	(1.1833)
Firm FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.5099	0.0092	0.0147

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 13.
Endogeneity test – two-stage least squares

In the second stage, the coefficients of ERD of both column (2) and column (3) are positive and significant at the 5% level. This conclusion is consistent with the main regression results.

5. Additional tests

5.1 Industry heterogeneity

The statistical significance and extent of the impact of ESG rating disagreement on stock price crash risk may vary between heavily-polluted firms and lowly-polluted firms. To validate H5, firms in the sample were classified into heavily-polluted firms and lowly-polluted firms following the approach of Li *et al.* (2021).

From the result in Table 14, it is easily noticed that ESG rating disagreement is positive and statistically significant for heavily-polluted firms, which means one standard deviation increase of ERD would lead to 3.80 and 3.78% increase in NCSKEW and DUVOL, respectively. For heavily-polluted firms, ESG issues may have a greater impact on the operations and reputation of companies, but for non-heavily-polluted firms, ESG issues may be relatively less significant, resulting in ESG rating disagreement having a less significant impact on the stock price crash risk compared to the heavily-polluted firms. The conclusion is consistent with hypothesis H5.

	Heavily-polluted		Lowly-polluted	
	(1) NCSKEW	(2) DUVOL	(3) NCSKEW	(4) DUVOL
ERD	0.0342**	0.0227**	0.0203*	0.0123*
	(0.0152)	(0.0101)	(0.0111)	(0.0073)
Control variables	YES	YES	YES	YES
_cons	−1.8099**	−0.7186	−0.221	0.6068*
	(0.7838)	(0.5231)	(0.4826)	(0.3192)
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
R-squared	0.2678	0.2725	0.289	0.2929

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 14.
Additional tests – Industry heterogeneity

5.2 Ownership heterogeneity

SOEs are generally perceived as being better positioned to assume social and environmental responsibilities, disagreement in ESG ratings for SOEs are likely to draw more scrutiny (Gu *et al.*, 2019). The following regressions are conducted to test hypothesis H6.

The result in Table 15 validates hypothesis H6. For state-owned firms, ESG rating disagreement has the positive impact on the risk of stock price crash risk, and the effect is statistically significant at the 5% significance level, with the coefficients valuing at 0.0368 and 0.0249, respectively. This indicates that one standard deviation increase of ERD would lead to 4.09 and 4.13% increase in NCSKEW and DUVOL, respectively, in SOEs. ESG rating disagreement exerts a statistically significantly positive effect on the stock price crash risk for state-owned firms.

5.3 Coverage of star analysts

Star analysts are considered to make more accurate predictions and can bring greater returns to clients (Loh and Mian, 2006; Luo *et al.*, 2020). The star analysts mentioned in this paper refer to those selected by the New Fortune magazine as star analysts.

Based on whether there are star analysts among the analysts of the company, this paper divides the sample companies into star analyst group and non-star analyst group.

	State-owned		Privately-owned	
	(1) NCSKEW	(2) DUVOL	(3) NCSKEW	(4) DUVOL
ERD	0.0368**	0.0249***	0.0188	0.0106
	(0.0145)	(0.0094)	(0.0115)	(0.0077)
Control variables	YES	YES	YES	YES
_cons	0.8759	1.2187***	−2.0818***	−0.8533**
	(0.6839)	(0.4457)	(0.5197)	(0.348)
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
R-squared	0.2703	0.2824	0.2951	0.2949

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 15.
Additional tests – ownership heterogeneity

	Star analysts		Non-star analysts	
	(1)	(2)	(3)	(4)
	NCSKEW	DUVOL	NCSKEW	DUVOL
ERD	0.0311***	0.0173**	0.0062	0.009
	(0.0104)	(0.007)	(0.0233)	(0.0152)
Control variables	YES	YES	YES	YES
_cons	−0.9355**	0.0892	0.3579	0.6883
	(0.4688)	(0.3137)	(1.0181)	(0.6636)
Firm FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
R-squared	0.3139	0.3166	0.4433	0.447

Note(s): Standard errors are in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): This table is created by the author

Table 16.
Additional tests – coverage of star analysts

In Table 16, for the star analyst groups, the impact of ESG rating disagreement on the risk of stock price crash is positive and significant at the 5% level, which indicates that one standard deviation increase of ERD would lead to 3.46 and 2.87% increase in NCSKEW and DUVOL, respectively, in companies with star analysts. The regression results confirm hypothesis H7. For analysts with stronger information gathering and utilization abilities, ESG rating disagreement would create greater confusion.

6. Conclusion

This paper primarily explores the issue of whether ESG rating disagreement leads to the stock price crash risk and whether distraction of institutional investors, digital economic development level of the province and corporate intelligence maturity can play the moderating roles in this regard. The greater the ESG rating disagreement, the higher the opacity of the company. Investors are more likely to be confused by these divergent ESG signals and their assessment of the company's investment value may also be prone to changes, thereby increasing the stock price crash risk.

The conclusions drawn from the empirical research in this paper can be summarized as follows. First, ESG rating disagreement could increase the stock price crash risk. Second, the distraction of institutional investors, digital economic development level of the province and CIM would mitigate stock price crash risk by playing the moderating roles. Third, for heavily-polluted firms, state-owned firms and firms with star analysts, the impact of ESG rating disagreement on stock price crash risk is more statistically significant.

The finding provides the novel prospective that investors can reduce investment risks by appropriately reducing their focus on companies with confusing ESG information. Additionally, investors can choose to invest in companies with high levels of intelligence maturity and located in regions with advanced digital economic development.

The inadequacy of this paper lies in only measuring the distraction of investors through institutional investors, without considering whether the distraction of other investors. Further research will consider the moderating effects of the entire investor body and collect data in this regard. Moreover, there may be moderating effects of other variables which could have an impact on this process. Therefore, further research would include whether government intervention and geopolitics will also have moderating effects.

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