

Research on the Impact of ESG Performance, Green Innovation Investment and Stock Price Crash Risk

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Abstract: With the development of national sustainable policies, the ESG performance of enterprises has increasingly attracted scholarly attention, leading to extensive research in the area. The study empirically examines the link between corporate ESG monetization and stock price crash risk by analyzing data from firms that are publicly traded on the A-share market in Shanghai and Shenzhen spanning 2011 to 2022. The results indicate that there is a negative correlation between the monetization of corporate ESG efforts and the probability of stock price crashes. Furthermore, through mechanism analysis, it is revealed that robust ESG performance mitigates the chances of notable declines in stock prices not only via investments in green innovation but also by alleviating financing constraints. In terms of heterogeneity testing, the influence of ESG performance on the probability of stock price crashes appears to be somewhat more conspicuous for state-owned enterprises (SOEs) in comparison to non-state-owned enterprises and analysts' focus.

Keywords: Stock price crash risk, Financing constraints, Green innovation investment.

1. Introduction

The issue of stock price crash has consistently been a critical concern that the financial investment industry and listed companies themselves are more concerned about, however, such risks are significantly influenced by macroeconomic conditions and industry-specific factors. For example, when the state proposes the "dual carbon" policy, for some enterprises driven by policy interests, such as energy companies, with the support of the policy, the stock price of the enterprise will develop in a positive direction, thereby reducing the possibility of a potential crash in its stock prices. In recent years, ESG research has gradually emerged around the world, and Chinese scholars have also followed the development trend to gain in-depth understanding and research on it. It is found that ESG plays a catalytic role in the transformation of Chinese enterprises, and further promotes their sustainable development of high quality over the medium and long term (Zhang Chen, Gu Chenkai et al., 2024) [1]. In the process of the literature review, it is found that fewer scholars will study the connection between the likelihood of stock price crash and ESG performance from the perspective of green innovation investment and financing limitations.

The likelihood of stock price crash is made up of many factors, so it is also more likely to be affected by subtle factors that lead to a completely out-of-control. In the green innovation investment and financing constraints sense, this paper explores the correlation between stock price crash risk and ESG performance. On one hand, in-depth research on how ESG performance has an influence on the possibility of stock price crash within the context; On the other hand, one can investigate how green innovation investment and financing constraints strengthen the connection between the probability of stock price drops and ESG performance. This study not only explores the relationship between stock market crash risk and ESG performance; It also provides new ideas for the problems that enterprise managers are concerned about.

2. Theoretical Analysis and Research Hypothesis

2.1. Stock Price Crash Risk and ESG Performance

Research on these two can be mainly categorized into internal governance and external supervision of companies. Corporate risk is a key factor related to the survival and development of enterprises, and enhanced ESG performance can increase its capacity to access resources from diverse channels, thereby maintaining the probability of decline in stock values (Tan Jinsong et al. 2022) [2]. Then, for the study of external supervision, scholar Sun Xiaoyi (2024) [3] analyzed in detail that firms with excellent ESG performance are better equipped to adjust to shifts in the external environment, reduce market impact, and effectively reduce stock price volatility. Another study by scholars Lin Lijie and Li Panpan (2023) [4] demonstrates that robust ESG performance could effectively enhance the supervision effect and reputation effect, thereby inhibiting the risk of stock price collapse.

Therefore, drawing on the analysis above, this research posits hypothesis 1.

H1: The effect of ESG performance on stock price crash risk is negatively correlated.

2.2. ESG Performance, Green Innovation Investment and Stock Price Crash Risk

During the new phase of economic development, ESG is an important concept for corporate operations under the guidance of sustainability. The implementation of sustainable practices within enterprises could effectively mitigate the chances of a decline in stock price plummet by bolstering ecological performance, diminishing asymmetries in informational access, and fostering heightened confidence among investors. (Zhou Kuo et al., 2022, Zhao Lingdi et al., 2022) [5, 6]. Under increasingly strict environmental

supervision, corporate green investment behavior is not only a fulfillment of environmental responsibility, but also a reduction in stock price volatility, and corporate green innovation can promote the improvement of stock returns (Liu Bai, Wang Xinzhu, 2021) [7]. However, the ESG performance of corporations will also capture the interest of environmentally-focused investors and the media, and the probability of a decline in stock price will also decrease under external scrutiny (Gao J et al., 2024) [8].

Therefore, drawing on the analysis above, hypothesis 2 is proposed.

H2: Driven by the impact of "green innovation investment", ESG performance shows an inverse correlation with the susceptibility of stock price collapses.

2.3. ESG Performance, Financing Constraints and Stock Price Crash Risk

Existing studies that the unpredictability of the external financing landscape will influence the likelihood of a precipitous drop in stock values, but the loose external financing environment can alleviate this problem (Bai Min et al., 2018) [9], and ESG performance may lower corporate financing costs by lowering the risk related to long-term stock prices and fostering investments in sustainable development (Liu Bai, Lu Jiarui, 2024) [10]. Promoting green innovation and other pathways to help achieve the sustainability of corporate earnings (Xi Longsheng, Zhao Hui, 2022, Hu Jie et al., 2023) [11, 12]. Furthermore, a notable inverse correlation has been observed between the overall ESG performance of the firms and individual performance, alongside the possibility of stock price collapse. Additionally, financing constraints have been identified to exert a detrimental moderating influence on the firm's ESG performance on stock price crash risk and its impact on the relationship between the two. (Dong Xianglan et al., 2023) [13].

Therefore, drawing on the analysis above, hypothesis 3 is proposed.

H3: Drive by the influence of "financing constraints", there exists an inverse relationship between ESG performance and stock price collapse.

3. Study Design

3.1. Selection of the Sample and Acquisition of Data Sources

This research is dedicated to every A-share listed firms in China from 2010 to 2022 as the focus of the research, which processes the samples are presented below: (1) exclude financial enterprises; (2) Excluding listed companies with non-normal transactions, including ST and ST* companies; (3) Exclusion of listed firms with incomplete data; (4) Perform data tailing processing of less than 1% and more than 99% of all variables. A total of 34572 observations were obtained. The ESG rating score comes from the Wonder Rating Indicator data, and the data for other model variables comes from the Guotaian database. In this paper, STATA18.0 software was used for statistical analysis.

3.2. Variable Definition

3.2.1. Explanatory variables

The explanatory variable pertains to the stock price collapse. This paper uses stock price volatility to assess the associated risks and utilizes the negative return skewness coefficient (NCSKEW) along with stock price return

volatility (DUVOL) as measures of that volatility. The process of calculation is as such:

Firstly, the model is constructed to calculate the residuals $\varepsilon_{i,t}$, the market-adjusted return of stock "i" during week "t" is representes as $W_{i,t}$, where $W_{i,t} = \ln(1 + \varepsilon_{i,t})$:

$$R_{i,t} = \alpha + \beta_{1,t} R_{m,t-2} + \beta_{2,t} R_{m,t-1} + \beta_{3,t} R_{m,t} + \beta_{4,t} R_{m,t+1} + \beta_{5,t} R_{m,t+2} + \varepsilon_{i,t} \quad (1)$$

Subsequently, the model was constructed to calculate the skewness measure of negative return and the volatility in stock return, respectively.

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

$$DUVOL = \ln\left\{\frac{[(n_u - 1) \sum_{\text{down}} R_d^2]}{[(n_d - 1) \sum_{\text{up}} R_u^2]}\right\} \quad (3)$$

The larger NCSKEW and DUVOL, the more severe the negative skew in the distribution of stock prices, the greater the up-and-down fluctuation ratio of stock returns, with a corresponding rise in the risk of market crashes.

3.2.2. Explanatory variables

The independent variable is the firms' ESG performance. This paper employs the ESG evaluation data from China Securities as the measurement standard for assessing corporate ESG performance. This dataset is notable for its relevance to Chinese market, covering a wide spectrum and exceptional timeliness. By integrating quarterly assessments with ongoing monitoring, this approach systematically computes the ESG scores of companies listed on all A-share over more than a decade, categorizing them into ratings that range from 'AAA' to 'C'. An elevated overall ESG score and rating signify enhanced ESG performance.

3.2.3. Intermediary variables

The intermediary variable is the investment and financing constraints of green innovation of enterprises. Green innovation investment not only enhance the environmental performance and social image of enterprises, but also strengthens the core competitiveness and market value of enterprises through technological innovation. Financing constraints have an impact on investment opportunities for firms, resulting in lower business performance.

3.2.4. Control variables

Building upon previous research, this research identified the mean weekly specific return rate (Ret), the standard deviation of the weekly specific return rate (Sigma), the total assets return (Roa), the annual turnover rate of stocks (ToverTIIY), the analyst attention (Analyst), the nature of equity (SOE), the number of years of listing (ListAge), the market-to-book value ratio(MB), the size of the enterprise (Size), whether it is losing money (Loss), the average age of management (Age), Number of Board Meetings (Dmeet).

3.3. Model Configuration

3.3.1. Benchmark regression model construction

To assess the influence of corporate ESG performance on stock price collapse, the fundamental regression model employed in this paper is set as:

$$RISK_{i,t+1} = \alpha_0 + \alpha_1 ESG_{i,t} + \alpha_2 \sum Controls_{i,t} + \alpha_3 \sum Year + \alpha_4 \sum Industry + \varepsilon_{i,t} \quad (4)$$

Among them, RISK refers to the potential of stock price collapse, quantified by the weekly stock returns exhibit a negative skew as calculated by the model and the range of its

increase and decrease. ESG is the explanatory variable, which is measured by the scoring data of CSI ESG.

3.3.2. Construction of mediating effect model

Drawing upon the existing research, this paper outlines the subsequent pathways to examine the mediating variables of green innovation investment and financing constraint mitigation:

$$\text{Risk} = \beta_0 + \beta_1 \text{ESG} + \beta_2 \sum \text{Control s} + \beta_3 \sum \text{Year} + \beta_4 \sum \text{Industry} + \gamma$$

$$\text{EP} = \gamma_0 + \gamma_1 \text{ESG} + \gamma_2 \sum \text{Control s} + \gamma_3 \sum \text{Year} + \gamma_4 \sum \text{Industry} + \gamma$$

$$\text{KZ} = \theta_0 + \theta_1 \text{ESG} + \theta_2 \sum \text{Controls} + \theta_3 \sum \text{Year} + \theta_4 \sum \text{Industry} + \gamma$$

$$\text{Risk} = \varphi_0 + \varphi_1 \text{ESG} + \varphi_2 \text{EP} + \varphi_3 \sum \text{Controls} + \varphi_4 \sum \text{Year} + \varphi_5 \sum \text{Industry} + \gamma$$

$$\text{Risk} = \omega_0 + \omega_1 \text{ESG} + \omega_2 \text{KZ} + \omega_3 \sum \text{Controls} + \omega_4 \sum \text{Year} + \omega_5 \sum \text{Industry} + \gamma$$

4. Empirical Testing and Result Analysis

4.1. Descriptive Statistics

The descriptive statistical summary for each variable listed in table1. The maximum value of NCSKEW reaches 5.0127, while the lowest value of -5.2497; for DUCOL, the maximum and minimum value is 2.3623 and -2.6766, respectively. The average values of NCSKEW (-0.3104) and DUVOL (-0.2066) indicating that the probability distribution of the two explanatory elements assessing the risk of crash is similar to the existing research results. The average value of the independent variable ESG was 73.2067, ranging from a low of 36.62 and a high of 92.93, indicating significant disparities in ESG performance persist among various companies.

Table 1. Descriptive statistics

Variable	Obs.	Mean	SD	Min	Max
NCSKEW	34572	-0.3104	0.7493	-5.2497	5.0127
DUVOL	34572	-0.2066	0.483	-2.6766	2.3623
ESG	34572	73.2067	5.2253	36.6200	92.9300
ToverTIY	34571	407.5104	302.5904	2.1642	2831.9210
Ret	34570	-0.0013	0.0012	-0.0246	-0.00004
Sigma	34570	0.0472	0.0195	0.0094	0.2122
Roa	34571	0.0414	0.0762	-1.3241	1.2848
Analyst	34572	1.3999	1.1971	0	4.3307
SOE	34564	0.3603	0.4801	0	1
ListAge	34572	2.1044	0.8640	0	3.4965
MB	34572	0.0021	0.0031	0.00002	0.3490
Size1	34572	22.2268	1.3303	15.5773	28.6365
Loss	34572	0.1124	0.3158	0	1
Age	34572	49.3620	3.2456	35.6000	62.8800
Dmeet	34572	2.1863	0.3862	0	4.0604

4.2. Basic Regression Results

Table 2 displays the findings from a regression analysis examining the relationship among corporate ESG performance and declines in stock prices. In column (1), the ESG coefficient is -0.004(***), and in column (2) reports the coefficient for ESG is 0.002 and correlates with the volatility of weekly returns at the level of 1%, and the control rate is by industry and year, which can indicate that the performance of publicly listed firms regarding in ESG notably diminished the likelihood of stock price crash. Suppose H1 is validated.

Table 2. Regression analysis

Variable	(1)	(2)
ESG	-0,004***	-0,002***
ToverTIY	-0,000***	-0,000***
Ret	70,162***	30,416***
Sigma	-5,293***	-4,071***
Roa	-0,173**	-0,156***
Analyst	0,080***	0,043***
SOE	-0,038***	-0,023***
ListAge	-0,041***	-0,031***
MB	7,212**	2,867**
Size1	-0,055***	-0,045***
Loss	0,081***	0,048***
Age	-0,006***	-0,003***
Dmeet	0,057***	0,033***
_cons	1,717***	1,268***
Industry	YES	YES
Year	YES	YES
N	34559	34559
R2	0.093	0.093
F	139.621	147.534

4.3. Influence Mechanism Test

4.3.1. Green innovation investment mechanism

The benchmark regression results suggested that ESG performance is significantly linked to reduction in the likelihood of a stock market collapse. Additionally, higher ESG performance in publicly listed companies is linked to a mitigating in the likelihood stock price collapse. In evaluating the likelihood of stock price crashes through NCSKEW, the regression coefficient associated with ESG is -0.004 (***). The coefficient for green innovation investment is 0.02, suggesting a notable positive relationship at the same confidence threshold. This implied that improve ESG performance can lead to increased levels of green innovation investment. The coefficient linking NCSKEW and ESG is -

0.004 (***)). Conversely, the coefficient for KCSKEW concerning EP is -0.001, indicating a complete mediating effect between green innovation investment and NCSKEW. Another metric, DUVOL, does the same, and concludes accordingly. In summary, firms exhibiting robust ESG performance could mitigate the likelihood of stock price

collapse by boosting investment in sustainable innovation. The mechanism of action is that green innovation investment can attract more investors who are concerned about sustainable development, increase market confidence, and thus stabilize stock prices. Hypothesis 2 is proven.

Table 3. Mechanism test: green innovation investment

Variable	(1) NCSKEW	(2) F.EP	(3) NCSKEW	(4) DUVOL	(5) F.EP	(6) DUVOL
F.EP			-0.001 (0.002)			-0.001 (0.001)
ESG	-0.004*** (0.001)	0.020*** (0.003)	-0.004*** (0.001)	-0.002*** (0.001)	0.020*** (0.003)	-0.002*** (0.001)
Constant	1.717*** (0.134)	-7.441*** (0.438)	1.707*** (0.147)	1.268*** (0.080)	-7.441*** (0.438)	1.317*** (0.092)
Industry	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Observations	34,559	29,336	29,336	34,559	29,336	29,336
R-squared	0.093	0.128	0.100	0.093	0.128	0.101

4.3.2. Financing constraint mitigation mechanism

In NCSKEW, the ESG regression coefficient is -0.004 (***)). The financing constraint coefficient is -0.035 (***)). The correlation between NCSKEW and ESG is -0.003 (***)). Since the correlation between NCSKEW and KZ is 0.007 (***)). A partial mediating effect exists between financing constraints and NCSKEW. Another measure, DUVOL exhibits an ESG regression coefficient is recorded at 0.002, also demonstrating a notable positive relationship at the same level of confidence. The coefficient of DUVOL and KZ was 0.003 (***)), similarly reflecting a notable positive correlation,

implying the presence of a partial mediating effect between financing constraints and DUVOL. In conclusion, improved ESG performance was associated with a reduced level of financing constraints encountered by the company. Firms that exhibit good ESG performance typically have better social reputations and lower financial risk, which makes them more popular in the financing market and able to access capital at a lower cost. The easing of financing constraints can help companies better grasp investment opportunities and improve operating performance. Furthermore, the decrease in financing costs can also reduce the financial risk of enterprises and further enhance market confidence. Hypothesis 3 is proven.

Table 4. Mechanism test: easing financing constraints

Variable	(1) NCSKEW	(2) F.KZ	(3) NCSKEW	(4) DUVOL	(5) F.KZ	(6) DUVOL
F.KZ			0.007*** (0.002)			0.003** (0.002)
ESG	-0.004*** (0.001)	-0.035*** (0.003)	-0.003*** (0.001)	-0.002*** (0.001)	-0.035*** (0.003)	-0.001** (0.001)
Constant	1.717*** (0.134)	-3.371*** (0.385)	1.936*** (0.157)	1.268*** (0.080)	-3.371*** (0.385)	1.393*** (0.100)
Observations	34,559	25,106	25,106	34,559	25,106	25,106
R-squared	0.093	0.383	0.104	0.093	0.383	0.105

4.3.3. Stability test

DUVOL (earnings volatility ratio) and NCSKEW (negative return skew coefficient) were used as explanatory variables, respectively, while the ESG composite score along with the ESG comprehensive rating assignment were employed to thoroughly examine how ESG performance influenced the likelihood of stock price collapse. In the table5 the results after substituting the variables are still significant, demonstrating that the effect of ESG performance on the possibility of stock price collapse is robust, regardless of whether the ESG composite score or the ESG composite rating is assigned.

Table 5. Regression results after substituting variables

	(1)	(2)
Explanatory variables	NCSKEW	DUVOL
ESG	-0.016*** (0.004)	-0.006** (0.003)
ToverTIY	-0.000*** (0.000)	-0.000*** (0.000)
Ret	70.728*** (15.547)	30.719*** (9.563)
Sigma	-5.230*** (0.971)	-4.037*** (0.597)
Roa	-0.179** (0.088)	-0.159*** (0.050)
Analyst	0.079*** (0.005)	0.042*** (0.003)
SOE	-0.039*** (0.010)	-0.024*** (0.007)
ListAge	-0.040*** (0.006)	-0.030*** (0.004)
MB	7.221** (3.067)	2.872** (1.186)
Size1	-0.056*** (0.005)	-0.046*** (0.003)
Loss	0.082*** (0.018)	0.049*** (0.011)
Age	-0.006*** (0.001)	-0.003*** (0.001)
Dmeet	0.057*** (0.011)	0.034*** (0.007)
Constant	1.502*** (0.125)	1.176*** (0.074)
Observations	34,559	34,559
R-squared	0.093	0.093

5. Heterogeneity Test

Distinguishing between state-owned enterprises (SOEs) and non-state-owned enterprises to investigate the differences in how ESG affects stock price collapse among various categories of firms. Specifically, the ESG coefficients of SOEs (-0.0042*** and -0.002**) are slightly smaller than those of non-SOEs (-0.0037*** and -0.002**), although both are statistically significant.

This finding suggests that the influence of ESG on mitigating the possibility of stock price collapse exists in both SOEs and non-SOEs, however, SOEs may have a slightly diminished capacity to alleviate this risk due to stringent regulation and higher social expectations. In addition, the performance of other control variables also showed some differences, such as the coefficient of market return (Ret) in SOEs is much higher than that in non-SOEs, while the total asset turnover ratio (ToverTIY) is significantly positive in SOEs and negative in non-SOEs, which may reflect the differences in operational efficiency and market response between different types of enterprises.

Table 6. The results of the heterogeneity test of equity nature

	NCSKEW	NCSKEW	DUVOL	DUVOL
Variable	(1) SOEs	(2) non-SOEs	(1) SOEs	(2) non-SOEs
ESG	- 0.0042*** (0.001)	- 0.0037*** (0.001)	-0.002** (0.001)	-0.002** (0.001)
ToverTIY	0.000** (0.000)	-0.000*** (0.000)	0.000 (0.000)	- 0.000*** (0.000)
Ret	41.028 (31.114)	108.544** * (19.165)	23.702 (18.607)	50.480** * (11.824)
Sigma	- 10.560*** (1.703)	-1.118 (1.246)	-6.424*** (1.015)	-1.778** (0.770)
Roa	-0.104 (0.173)	-0.214** (0.101)	-0.104 (0.108)	- 0.182*** (0.058)
Analyst	0.106*** (0.008)	0.061*** (0.006)	0.056*** (0.005)	0.033*** (0.004)
o.SOE	-	-	-	-
ListAge	-0.032*** (0.011)	-0.044*** (0.007)	-0.033*** (0.007)	- 0.030*** (0.005)
MB	15.556*** (3.983)	5.848** (2.808)	5.544** (2.521)	2.229** (1.081)
Size1	-0.064*** (0.008)	-0.045*** (0.007)	-0.047*** (0.005)	- 0.042*** (0.004)
Loss	0.114*** (0.028)	0.063*** (0.023)	0.069*** (0.017)	0.038*** (0.014)
Age	-0.006** (0.003)	-0.005*** (0.002)	-0.004** (0.002)	-0.002** (0.001)
Dmeet	0.064*** (0.018)	0.047*** (0.014)	0.035*** (0.011)	0.027*** (0.009)
Constant	1.919*** (0.206)	1.374*** (0.174)	1.371*** (0.133)	1.110*** (0.107)
Observations	12,453	22,105	12,453	22,105
R-squared	0.118	0.082	0.117	0.081

6. Conclusions of the Study

This research utilizes a dataset of A-share firms listed on Shanghai and Shenzhen from 2010 to 2022 to investigate the relationship and mechanisms among stock price collapse and ESG performance. The results indicate that a firm's performance ESG factors is essential in mitigating the possibility of stock price collapse. Further impact mechanism tests display that corporate ESG performance reduces the stock price collapse through "green innovation investment" and "financing constraints", specifically. The heterogeneity test revealed that non-state-owned firms were slightly affected by ESG performance compared to state-owned enterprises, a finding ascribed to the stringent regulatory oversight faced by state-owned entities. Among the analysts' attention, the mechanism of ESG performance will be more significant in companies with low analyst attention. After controlling for endogeneity and other issues, the conclusions of this paper still hold true.

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