The Impact of Environmental, Social, and Governance Disclosure Quality on Stock Price Volatility in Heavily Polluted Industries - Based on Chinese Listed Companies

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Abstract. Facing natural disasters caused by the destruction of ecosystems, the world is paying increasing attention to the protection of ecosystems. Meanwhile, investors are particularly concerned about enterprises' environmental, social, and governance (ESG) performance, which is considered to be crucial to long-term development and value improvement. Currently, access to ESG information relies mainly on proactive disclosure by companies. Although China attaches great importance to corporate ESG disclosure, the quality of many companies' ESG disclosures remains poor, especially in heavily polluted industries. As China's financial market matures, more and more investors may utilize stock price volatility to assess investment risk and then make investment decisions. Therefore, this paper aims to examine the impact of ESG disclosure quality on stock price volatility in heavily polluted industries. Taking listed companies in China's heavily polluted industries as the research object, this paper explores the impact of ESG disclosure quality on stock price volatility in heavily polluted industries by building a two-way fixed-effects regression model. This paper chooses Bloomberg Data Terminal's scores on ESG disclosure quality of companies and takes 2012 to 2020 as the research interval. Ultimately, this paper launches the study based on 693 data from 77 sample companies. After regression analysis and robustness test, the following conclusion is drawn: ESG disclosure quality and stock price volatility of heavily polluted companies show a positive correlation.

Keywords: ESG disclosure quality, stock price volatility, heavily polluted industries.

1. Introduction

1.1. Research Background

After a series of disasters caused by various types of environmental damage, the world is paying more attention to the protection of the ecological environment. In such an era when green environmental protection is greatly welcomed, investors are increasingly concerned about ESG practices of enterprises. Investors' awareness of companies' green practices comes greatly from companies' proactive disclosure, so the quality of ESG disclosure is important for investors' investment decisions.

Ministry of Ecology and Environment (MEE) of China promulgated "Guidelines for Environmental Information Disclosure by Listed Companies" (the Disclosure Guidelines) in 2010, which shows China's emphasis on ESG disclosure by companies. However, many companies still disclose ESG information in an untimely, inaccurate, and non-transparent manner, exacerbating the losses investors suffer from information asymmetry. Because the environmental risks and social impacts of highly polluting industries are prominent, investors will especially focus on their ESG disclosure. Therefore, heavily polluted industries should pay more attention to ESG disclosure quality, thus alleviating the informational asymmetry. For investors, stock price volatility is an important indicator of investment risk, and higher stock price volatility implies greater investment uncertainty. Investors may use stock price volatility to determine the allocation between different stocks to strike a balance between expected risk and expected return. Therefore, in order to better assist investors in making rational investment decisions, it is necessary to explore how the quality of ESG disclosure affects stock price volatility based on highly polluting listed companies in China.

1.2. Literature Review

Currently, research on the affected objects of ESG disclosure quality mainly focuses on risk management, firm value, investment efficiency, investment scale, stock price crash risk, audit fees, and so on. In 2016, Sassen et al. illustrated the logistic transmission relationship between the level of ESG disclosure and enterprise risk management, showing that higher levels of ESG disclosure are associated with more effective enterprise risk management [1]. In 2018, Ellen et al. concluded that the level of ESG disclosure positively affects measures of corporate value, based on an analysis of Bloomberg ESG disclosure scores for 47 developed and emerging countries and territories [2]. In 2022, Hui Wen et al. found that high-quality ESG disclosure is conducive to sustaining investors' incentives to invest in ESG based on long-term financial returns as well as facilitating the expansion of the scale of ESG investment [3]. Also, this year, the studies by Nejla et al. and Paulo et al respectively proposed that ESG disclosure can reduce informational asymmetry, which in turn improves investment efficiency or mitigates the risk of stock price crashes [4,5]. In 2023, Kaimeng Zhang et al. based on the deep pocket theory, risk premium theory, and cost-benefit principle found that the higher the quality of ESG disclosure, the higher the audit fees required by firms [6].

Presently, studies on the influential factors of stock price volatility focus on the company's transparency, green investment, dividend policy, development stage of the country, economic policy uncertainty, and investor sentiment. In 2014, by analyzing the relevant data of Chinese listed companies, Xin Qingquan et al. concluded that higher corporate transparency is associated with lower stock price volatility [7]. In 2022, Zhao Lingdi et al. used the control function method and sensitivity analysis to empirically analyze the relationship between corporate green investment and stock price volatility, resulting in a negative correlation [8]. In 2023, N. Narsa Goud analyzed 260 non-financial listed companies in India using fixed effects modeling and concluded that higher dividend payouts are accompanied by lower stock price volatility, while higher dividend yields are followed by higher stock price volatility [9]. By analyzing the data related to global energy sector firms from developing and developed nations, Singh Kuldeep et al., in 2023, concluded that there is a correlation between the impact of ESG on the energy sector firms' share price volatility and the development stage of the country [10]. In addition, Maria et al. assessed the performance of economic policy uncertainty (EPU) indices by using the GARCH-MIDAS model and found that the US economic policy uncertainty index and the economic policy uncertainty index for the UK are powerful predictors of stock market volatility in Pakistan [11]. In 2024, Peng Liu et al. took climate risk aversion in agribusiness as an example and concluded that risk aversion of firms effectively suppresses stock price volatility by influencing investor sentiment and customer stability [12].

To summarize, in terms of ESG disclosure quality, most studies focus on the relationship between ESG disclosure quality and financial management, investment management, and sustainable development, while fewer studies focus on the impact of ESG disclosure quality on stock price volatility. In terms of stock price volatility, previous studies mainly focus on the relationship between stock price volatility and company operations, national economic environment, and investor sentiment. Although there are various research directions, there is still a lack of research that considers ESG disclosure quality as an influential factor in stock price volatility. Furthermore, most of the few existing studies on the impact of ESG disclosure quality on stock price volatility focus on a generalized analysis with a sample of all industries, lacking relevant studies for heavily polluted industries.

Therefore, on the basis of previous investigations, this paper will broaden the impact scope of ESG disclosure quality and further explore the influential factors of stock price volatility. At the same time, this paper will also detail the research perspective by focusing on highly polluting industries.

1.3. Research Significance

First, this paper broadens the influential path of ESG disclosure quality by studying the effect of its impact on stock price volatility. Second, by analyzing the impact of ESG disclosure quality on stock price volatility, this paper further explores the influential factors of stock price volatility. From

the research perspective, distinguishing from the previous generalized research on the overall industry sample, this paper narrows the research perspective to the heavily polluted industries. Moreover, this paper selects Bloomberg's score on the ESG disclosure quality of Chinese firms to view China from a foreign perspective and apply a more internationalized evaluation standard. This paper explores the impact of ESG disclosure quality on stock price volatility over a longer research interval by conducting regression analysis on relevant data from 2012 to 2020 and measuring the annual stock price volatility of each company with the annual standard deviation of daily closing prices.

1.4. Relevant Concepts

Since this paper aims to explore the impact of ESG disclosure quality on stock price volatility in heavily polluted industries, understanding and clarifying the concepts of ESG disclosure quality, stock price volatility, and heavily polluted industries can lay the foundation for the development of the research.

ESG disclosure quality refers to the quality of information disclosed by companies in three areas: environment (E), society (S), and corporate governance (G), including comprehensiveness, timeliness, accuracy, consistency, correlation, and so on.

Stock price volatility is defined as the range of stock price changes due to variations in supply and demand over a trading period. It is typically measured by the annual standard deviation of closing prices on trading days, the annual standard deviation of individual stock returns rate, or the GARCH model.

Heavily polluted industries are those that may cause serious pollution to the environment. In China, the criteria for recognizing highly polluting industries are "Guidelines for Industry Classification of Listed Companies" (the Guidelines) revised by China Securities Regulatory Commission (CSRC) in 2012, "Management List of Industry Classifications for Environmental Verification of Listed Companies" (the Management List) and "Guidelines for Environmental Information Disclosure by Listed Companies" formulated by MEE in 2008 and 2010 respectively [13].

1.5. Theoretical Foundation

1.5.1 Efficient Market Theory

Efficient Market Theory was developed in 1970 by Eugene Fama, which concluded that in an efficient capital market, stock prices always completely reflect all publicly available information. ESG disclosure can provide investors with more information to help them reduce investment risks [7]. It can also improve the efficiency of the capital market for a higher-quality development of the economy.

1.5.2 Asymmetric Information Theory

Asymmetric Information Theory was developed by G.Akerlof, M.Spence, and J.E.Stigliz in the 1970s, which suggests that there are differences in the information possessed by various trading parties in economic activities. Generally, it is believed that investors with higher levels of information access are easier to profit in the market. The higher the quality of ESG disclosure, the lower the level of information asymmetry [4]. Then, there will be a higher level of information access, which can help investors better avoid problems such as adverse selection and moral hazard.

1.5.3 Sustainable Development Theory

Sustainable Development Theory suggests that development should satisfy the needs of the present generation without encroaching on the needs of future generations. Companies with stronger sustainability are likely to have fewer risks in their future development, thus they are preferred by investors, which in turn may result in a lower stock price volatility [8]. ESG is the reflection of Sustainable Development Theory. Through ESG information disclosed by companies, investors can learn about companies' practices in sustainable development in order to make investment decisions.

1.6. Research Methodology

1.6.1 Literature Review Method

The development of the research and the hypothesis in this paper is based on extensive reading of the relevant literature on ESG disclosure quality, stock price volatility, and heavily polluted industries.

1.6.2 Quantitative Analysis Method

Based on 693 pieces of relevant data from 77 sample companies, this paper develops a two-way fixed-effects regression model with fixed year and stock code to quantitatively analyze the impact of ESG disclosure quality on stock price volatility in highly polluting industries.

2. Model Develop

2.1. Research Hypothesis

First, high-quality ESG disclosure improves corporate transparency and reduces information asymmetry [4]. Previous research suggests that the more transparent a company is, the lower the volatility of its stock price [7]. So, high-quality ESG disclosure may reduce stock price volatility.

Second, ESG performance shows a positive correlation with firms' financial performance, enterprise value, and financial indicators' performance [14-16]. This means that better ESG performance translates into better financial performance. Investors may strengthen their confidence in the firm because of its favorable financial performance, and then adopt more stable investment strategies, which ultimately reduce the stock price volatility. A study pointed out that good ESG performance can suppress an increase in a company's share price volatility [17]. Based on the findings above and the possible isotropic correlation between ESG performance and ESG disclosure quality, it can be inferred that ESG disclosure quality and stock price volatility may be negatively correlated.

On the basis of the above, the following hypothesis is made in this paper:

H1: Higher quality of ESG disclosure of listed companies in heavily polluted industries is associated with lower stock price volatility.

2.2. Sample Selection and Data Sources

This paper focuses on the listed companies in China's heavily polluted industry from 2012 to 2020 as the initial research sample. The reason for selecting 2012 as the beginning year is that the CSRC revised the Guidelines in 2012. The data for the indicator used in this paper to measure ESG disclosure quality is from Bloomberg Data Terminal, the list of listed companies in the heavily polluted industries is obtained from the Guidelines revised by CSRC in 2012, the Management List and the Disclosure Guidelines formulated by MEE in 2008 and 2010 respectively, and the company financial data is derived from CSMAR database and RESSET database.

In order to make the data reasonable and effective, this paper applies Excel and Stata17.0 to screen the sample data under the following conditions: (1)remove companies not on the list of listed companies in heavily polluted industries; (2)remove data with absence or anomalies; (3)remove companies in the financial sector, which is defined by CSMAR database, because their capital structure is different from that of other companies; (4)remove ST, PT, and *ST companies because their continuous losses mean that there are too many problems which may affect the regression results.

After the screening process described above, the total number of eligible sample companies is 77, and the number of samples within the research period is 693.

2.3. Selection and Measurement of Variables

2.3.1 Explained Variable

The explained variable used in this paper during the empirical analysis is stock price volatility (SP_VOL). Since the stock price is an easily available and generally recognized indicator of stock market risk, this paper will calculate stock price volatility based on stock price [18]. This is indicated below:

$$SP\_VOL_{ij} = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}[\ price_{it} - E(\ price_{it}\ )]^2} \quad (1)$$

In the equation above, SP_VOL_{ij} is the standard deviation of the firm's annual closing price, $price_{\mathrm{it}}$ is the firm's daily closing price (RMB/share), i denotes the firm, j denotes the year, and t denotes the date.

2.3.2 Explanatory Variable

The explanatory variable utilized in the empirical analysis is ESG disclosure quality (BG_ESG). Bloomberg Data Terminal sets an indicator that varies in the range of [0,100] for the ESG disclosure of Chinese listed companies [19]. A higher score on this indicator means a higher quality of corporate ESG disclosure [19]. Therefore, this paper will use the Bloomberg ESG Index to measure ESG disclosure quality.

2.3.3 Control Variable

The control variables utilized in the empirical analysis include return on total assets (ROE), total asset turnover (TAT), asset liability ratio (DAR), book-to-market (BM), enterprise size (ES), enterprise age (EA), beta coefficient (BETA), stock turnover rate (TR), ownership concentration (OC) [8] (Table 1).

Table 1. Description of main variables

Types of variables	Name of variables	Symbols of variables	Meaning of variables
explained variable	stock price volatility	SP_VOL	the standard deviation of the firm's annual closing price
explanatory variable	ESG disclosure quality	BG_ESG	Bloomberg ESG Index
control variable	return on total assets	ROE	net profit / total assets
	total asset turnover	TAT	assessing the efficiency of an enterprise's asset operations
	asset liability ratio	DAR	liabilities / assets
	book-to-market	BM	ownership interest / market value
	enterprise size	ES	natural logarithm of total assets at year-end
	enterprise age	EA	time to market
	beta coefficient	BETA	assessing the systemic risk of the stock
	stock turnover rate	TR	assessing the liquidity of the stock
	ownership concentration	OC	shareholding of top ten shareholders

2.4. Regression Model Construction

To investigate the impact of ESG disclosure quality on stock price volatility in heavily polluted industries, this paper constructs the following model:

$$SP\_VOL = \beta_0 + \beta_1 \times BG_{ESG} + \beta_2 \times ROE + \beta_3 \times TAT + \beta_4 \times DAR + \beta_5 \times BM + \beta_6 \times ES + \beta_7 \times EA + \beta_8 \times BETA + \beta_9 \times TR + \beta_{10} \times OC + \varepsilon \quad (2)$$

3. Results

3.1. Analysis of Descriptive Statistics

The descriptive statistics of the variables are shown in Table 2, from which it can be seen that the explanatory variable BG_ESG has a mean value of 27.806, a standard deviation of 7.477, a minimum value of 11.236 and a maximum value of 53.385. This shows that the ESG disclosure quality of Chinese listed companies in heavily polluted industries is at a medium level generally, and the ESG disclosure quality of different companies varies greatly. The explained variable SP_VOL has a mean of 2.136 and a standard deviation of 3.435, with a minimum value of 0.127 and a maximum value of 44.552. This shows that the variable has a high degree of variability, thus extreme values need to be excluded to ensure uniformity in the distribution of the data. In the data processing of control variables, Table 2 shows that the standard deviation of TR is larger compared to other control variables, which is 282.069, much larger than 1. It shows that the data of this variable fluctuates a lot, with the maximum value of 2022.666 and the minimum value of 14.929, so that there is a large difference in TR among the heavily polluted companies. OC, the control variable, has a standard deviation of 15.728, with a maximum value of 82.07 and a minimum value of 3.62, which is the second most volatile variable after TR. However, the standard deviations of all control variables except for TR and OC are within 10, so overall, the data meets the needs of the research in this paper.

Table 2. Descriptive statistics results

Variable	Obs	Mean	Std. dev.	Min	Max
BG_ESG	693	27.806	7.477	11.236	53.385
SP_VOL	693	2.136	3.435	0.127	44.552
SR_VOL	661	0.026	0.008	0.009	0.056
DAR	693	0.502	0.210	0.068	2.290
ROE	693	0.035	0.109	-2.071	0.590
BM	693	1.265	2.325	-0.810	30.015
ES	693	23.307	1.267	20.326	26.209
EA	693	19.196	5.013	10.000	28.000
BETA	693	0.978	0.246	-0.078	1.878
TR	692	386.878	282.069	14.929	2022.666
TAT	693	0.653	0.435	0.022	2.645
OC	693	36.167	15.728	3.620	82.070

3.2. Analysis of Correlation

3.2.1 VIF Test

The Variance Inflation Factor (VIF) test is useful for detecting multicollinearity. From Table 3, it can be seen that the variable with the largest VIF is the control variable ES, with a VIF value of 2.4, and the variable with the smallest VIF is the control variable TAT, with a VIF value of 1.04. The average VIF value is 1.42. It can be concluded that there is no serious multicollinearity problem among the variables as the VIF values of all variables are much less than 10.

Table 3. Multicollinearity test results

Variable	VIF	1/VIF
ES	2.400	0.416
DAR	2.340	0.427
ROE	1.540	0.651
EA	1.290	0.775
BM	1.230	0.811
OC	1.170	0.857
SP_VOL	1.080	0.923
TR	1.070	0.936
BETA	1.050	0.957
TAT	1.040	0.962
Mean VIF	1.420	

3.2.2 Correlation Analysis Results

From Table 4, in the overall correlation analysis, the explained variable SP_VOL shows a positive correlation with the explanatory variable BG_ESG. The correlation coefficient of the two variables is 0.025. It can be seen that the two variables are weakly correlated and that there is no problem of multicollinearity.

Among the control variables, there is a negative correlation between the explanatory variable BG_ESG and the control variables ROE, BETA, TR, and OC. This indicates that as the ESG disclosure quality of listed firms in the highly polluting industries increases, the firm's ROE, BETA, TR, and OC will decrease. However, the explanatory variable BG_ESG shows a positive correlation at a 0.1% level of significance with the control variables BM and ES. At the same time, it shows a positive correlation with the control variables DAR, EA, and TAT. This indicates that as the ESG disclosure quality of a firm increases, BM, ES, DAR, EA, and TAT of that firm also increase.

Table 4. Correlation analysis results (Pearson's correlation coefficients)

	BG_ESG	SP_VOL	DAR	ROE	BM	ES	EA	BETA	TR	TAT	OC
BG_ESG	1										
SP_VOL	0.025	1									
DAR	0.044	-0.198***	1								
ROE	-0.006	0.210***	-0.510***	1							
BM	0.195***	0.086**	0.091**	0.052	1						
ES	0.277***	-0.053	0.581***	-0.094**	0.379***	1					
EA	0.012	-0.086**	0.188***	-0.116***	0.152***	0.422***	1				
BETA	-0.042	-0.024	-0.056	0.023	-0.103***	-0.144***	-0.127***	1			
TR	-0.035	0.022	-0.074*	-0.037	-0.075**	-0.188***	-0.083**	0.134***	1		
TAT	0.051	0.020	0.007	0.043	-0.056	0.035	0.080**	-0.004	-0.096**	1	
OC	-0.001	-0.100***	0.188***	-0.068*	0.180***	0.315***	0.248***	-0.056	-0.135***	0.124***	1

*** p<0.01, ** p<0.05, * p<0.1

3.3. Analysis of Regression Results

This regression uses a two-way fixed-effects model, which is a regression with the gradual addition of control variables while fixing the stock code (id) and year (year). Table 5 presents the regression

results of the two-way fixed-effects model for the impact of ESG disclosure quality on the stock price volatility of listed firms in China's heavily polluted industries. Overall, after adding all control variables, the regression result of the relationship between the explanatory variable BG_ESG and the explained variable SP_VOL shows a positive correlation at the 0.1% significance level. Moreover, there are high levels of the absolute value of the regression coefficient which is 0.197, and R-square which is 0.7. This regression result indicates that the higher the ESG disclosure quality of listed firms in the heavily polluted industries, the higher the share price volatility of the firms. This regression result is contrary to the research hypothesis of this paper.

This paper suggests four reasons why the regression results are opposite to the hypothesis:

First, there is a difference between ESG performance and ESG disclosure quality. ESG performance focuses on the specific effectiveness of enterprises in environmental protection, social responsibility and governance structure. The better a company's ESG performance, the more favorable its corporate image and investment attractiveness will be. While ESG disclosure quality focuses on how companies report their ESG performance to investors, including the frequency, transparency, accuracy, and comprehensiveness of information disclosure. Because of the definitional differences between ESG performance and ESG disclosure quality, the paper's arbitrary utilization of the correlation between the two in the hypothesis derivation stage may render the hypothesis untenable.

Second, high-quality ESG disclosure may expose the poor ESG performance and potential risks of heavily polluted companies. Heavily polluted industries are more likely to have significant environmental and social impacts from their corporate operations, therefore these industries themselves suffer more from environmental stewardship and social responsibility concerns. Moreover, these industries are more prone to environmental, social, and corporate governance risks. In this context, high-quality ESG disclosure can make the poor ESG performance of heavily polluted firms transparent and expose the potential risks inherent in these firms. Thus, high quality ESG information disclosure by heavily polluting firms may increase investors' worries about the firms' potential future costs and risks. Investors may lose confidence in the firm's long-term sustainability, which in turn leads to investors selling their shares and bringing about stock price volatility. At the same time, speculative capital, which profits from short-term fluctuations in share prices, may step in, thereby increasing stock price volatility.

Third, high-quality ESG disclosure may bring financial pressure on heavily polluted firms. Favorable ESG performance can help firms improve their market image as well as attract investors' interest. For heavily polluted firms, it takes a lot of resources to improve ESG performance while improving ESG disclosure quality. Because heavily polluted companies need to transform their production processes and products to reduce their environmental impact and improve their social responsibility performance, they face significant initial investment and operating costs. Moreover, a previous study noted that the higher the ESG disclosure quality of a company, the higher the auditing cost required [6]. These inputs may affect the profitability and cash flow of a heavily polluted company in the short term. For investors concerned with short-term financial performance, this may reduce their interest in the firm's stock. On the other hand, for investors concerned about long-term sustainability, it may increase their expectations of potential future costs and risks, as it is in a period of transition with high uncertainty. As a result, investors' confidence in the firm may weaken, which consequently prompts investors to reduce their investment in the heavily polluted firm and increase the volatility of the stock price.

Fourth, high-quality ESG disclosure may increase the sensitivity of heavily polluting firms to policies and regulations. In the face of increasing political and environmental regulation, companies with high environmental impacts not only need to invest significant resources to comply with existing regulations, but also need to be prepared for changes in policy and regulation. Any changes in environmental policies or social responsibility regulations may force heavily polluted companies to make compliance adjustments. Also, investors will pay close attention to changes in environmental policies and social responsibility regulations and their potential impacts on enterprises. So, when

there are changes in relevant policies and regulations, ESG-related practices of heavily polluted companies need to be adjusted, and uncertainty about the future of the companies increases. At the same time, investors will reassess the long-term value of heavily polluted companies and the attractiveness of their stocks, which may ultimately increase the volatility of stock prices.

Table 5. Regression results

Variable	Coefficient	Std. err.	t	P>|t|	VIF
Constant	-17.756	27.992	-0.630	0.526	1.420
SP_VOL	0.197***	0.053	3.740	0.000	1.080
DAR	-0.814	1.899	-0.430	0.668	2.340
ROE	1.489	1.960	0.760	0.448	1.540
BM	0.029	0.070	0.410	0.680	1.230
ES	-1.088**	0.531	-2.050	0.041	2.400
EA	2.558	0.888	2.880	0.004	1.290
BETA	0.017	0.645	0.030	0.980	1.050
TR	0.000	0.001	0.290	0.775	1.070
TAT	0.835	0.484	1.730	0.085	1.040
OC	-0.046**	0.021	-2.220	0.027	1.170
ID	Fixed	Fixed	Fixed	Fixed	Fixed
YEAR	Fixed	Fixed	Fixed	Fixed	Fixed
N		692			
R^2		0.701			
adj. R^2		0.653			
F		16.230			

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

3.4. Analysis of Robustness

This paper tests the robustness by replacing the computation of the explained variable SP_VOL with the standard deviation of the firm's annual stock return considering reinvestment of cash dividends [18]. This is indicated below:

$$SR\_VOL_{ij} = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}[\ retrun_{it} - E(\ retrun_{it}\ )]^2} \quad (3)$$

In the equation above, SR_VOL_{ij} is the standard deviation of the firm's annual stock return considering reinvestment of cash dividends, $retrun_{it}$ is the company's daily stock returns considering reinvestment of cash dividends, i denotes the firm, j denotes the year, and t denotes the date.

From Table 2, the mean value of the replaced explained variable SR_VOL is 0.026, the standard deviation is 0.008, the minimum value is 0.009, and the maximum value is 0.056. This shows that the variation of this variable is small, and the stability of data distribution is quite good.

From Table 6, it can be seen that after adding all the control variables, the replaced explained variable SR_VOL shows a positive correlation with the explanatory variable BG_ESG which is significant at the 1% level. This is consistent with the results of the fixed effects model for the originally explained variable SP_VOL.

Therefore, the model of this paper after replacing the explained variable successfully passes the robustness test. This indicates that the empirical regression results in this paper are robust.

Table 6. Regression results with replacement of explained variable

Variable	Coefficient	Std. err.	t	P>|t|	VIF
Constant	-32.605***	7.166	-4.550	0.000	1.420
SR_VOL	71.245**	33.537	2.120	0.034	1.070
DAR	-10.318***	1.963	-5.260	0.000	2.330
ROE	-8.688***	3.010	-2.890	0.004	1.500
BM	0.313**	0.127	2.460	0.014	1.230
ES	3.022***	0.336	9.010	0.000	2.480
EA	-0.263***	0.064	-4.090	0.000	1.290
BETA	-0.803	1.151	-0.700	0.485	1.050
TR	0.000	0.001	0.230	0.818	1.070
TAT	1.320**	0.626	2.110	0.036	1.040
OC	-0.051***	0.019	-2.680	0.007	1.170
ID	Fixed	Fixed	Fixed	Fixed	Fixed
YEAR	Fixed	Fixed	Fixed	Fixed	Fixed
N		660			
R^2		0.156			
adj. R^2		0.143			
F		11.990			

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

3.5. Research Limitations and Prospects

Relying on the relevant academic literature, this paper explores the impact of ESG disclosure quality on stock price volatility in highly polluting industries by constructing a two-way fixed-effects model. However, the research in this paper still has some limitations.

First, the control variables in this paper are not sufficient. Because there are many factors affecting stock price volatility at the macro and micro levels, it is difficult to comprehensively cover all possible influential factors. So, although this paper utilizes multiple control variables, it still fails to include all the factors influencing stock price volatility. Subsequent studies could include more control variables, especially at the macro level. This will improve the reliability of the regression model, and ultimately enable a more accurate assessment of the impact of ESG disclosure quality on stock price volatility.

Second, the sample size of this paper is small. Since Bloomberg does not grade all Chinese heavily polluted firms on their ESG disclosure quality, coupled with the fact that a small number of firms in those industries proactively disclose ESG information, the number of sample firms involved in this paper is small. This may affect the accuracy of the regression results. More sample companies could be included in the follow-up studies.

Third, the industry categorization in this paper is general. Based on China's definition of heavily polluted industries, this paper focuses on all heavily polluted industries and discusses the impact of ESG disclosure quality on stock price volatility in a general industry categorization. However, there are differences among the sub-industries included in the heavily polluted industries. So, the lack of detailed categorization of highly polluting industries may affect the rigorousness of the research conclusions. Follow-up studies could classify the sub-industries in the heavily polluted industries based on the characteristics of each sub-industry.

4. Conclusion

On the basis of efficient market theory, information mismatch theory and sustainable development theory, this paper takes Chinese listed companies in the heavily polluted industries that meet the requirements in the period of 2012-2020 as the research objects and explores the impact of ESG disclosure quality on stock price volatility in the heavily polluted industries. First, this paper conducts descriptive statistics and correlation tests on relevant data, then conducts regression test on hypotheses and robustness tests on regression results. Finally, this paper draws the following conclusions:

There is a significant positive correlation between ESG disclosure quality and stock price volatility in heavily polluted industries, which means that the higher ESG disclosure quality in heavily polluted industries, the more volatile the stock price is.

This paper aims to enable market regulators to understand the impact of ESG disclosure quality on stock price volatility in heavily polluted industries, and then take more reasonable measures to strengthen the regulation of ESG disclosure in heavily polluted industries, which will ultimately reduce the possibility of excessive volatility in the financial market and promote the stable operation of the financial market. From the perspective of corporate managers, corporate managers in highly polluting industries should recognize the possible impact mechanism of ESG disclosure quality on stock price volatility, and then optimize ESG-related financing plans and investment decisions, increasing practices in environmental protection, social responsibility, and corporate governance. Moreover, investors should be clear about the importance of ESG disclosure and the impact mechanism of disclosure quality on stock price volatility in the heavily polluted industries, so that they can pay more attention to the quality of ESG disclosure when making investment decisions and adopt a more robust investment strategy for heavily polluted firms with higher quality of ESG disclosure.

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