

# Corporate ESG Performance, Corporate Green Innovation Level and Stock Price Synchronicity

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**Abstract.** Corporate ESG ratings are crucial for China's enterprises pursuing green transformation and the "Dual Carbon" goal. Using a sample of China's A-share listed companies from 2009 to 2022, this study investigates the impact of ESG performance on stock price synchronization. It also explores the mediating role of substantive green innovation. Results show that good ESG performance positively influences stock price synchronization. Specifically, ESG performance promotes substantive green innovation, which enhances stock price synchronization. Additionally, the study finds significant effects in the eastern region and high-tech industries. This research supports firms in improving ESG performance and engaging in green innovation, contributing to stock price stability.

**Keywords:** ESG performance; corporate green innovation; stock price synchronization; A-share listed companies.

## 1. Introduction

China's 20th Party Congress emphasized the importance of high-quality development and urged enterprises to accelerate green transformation and fulfill their social and environmental responsibility for the dual-carbon goal. The 2023 Central Financial Work Conference prioritized "green finance" as a key focus, directing financial resources towards enterprises engaged in green innovation and development. In this thriving green economy and finance landscape, investors and the market favor enterprises with green awareness and innovation capabilities. Aligning with the ESG concept, enterprises are urged to actively assume social and environmental responsibilities for sustainable green development.

The introduction and development of ESG concepts and ESG ratings have not only prompted companies to make positive changes and progress, but also attracted the attention of many scholars. However, most of the current research on ESG focuses on the financial field and the field of corporate performance and value. Chunhua Tao and Xin Chen (2023)[1] focus on the impact of ESG on financial costs, and find that good ESG performance and higher ESG ratings can reduce corporate audit costs due to information asymmetry; Shuangjin Wang et al. (2022)[2] take China's industrial enterprises as an example, and further find that there is not a linear relationship between the ESG performance of an enterprise and its financial performance, but a U-shaped nonlinear relationship. Instead, it is a U-shaped nonlinear relationship. The study by Xiong Bai and Yifan Zhu et al. (2022)[3] explored the relationship between ESG performance and entrepreneurs and found that institutional. Investors prefer enterprises with good ESG performance, and the ESG practices of enterprises will likewise enhance their valuation in the capital market; Xinlan Wang et al. (2022)[4] conducted an empirical study using a sample of pharmaceutical enterprises and found that the good ESG performance of such enterprises can reduce their debt financing costs through stocks and thus enhance corporate performance.

With the booming development of green finance in China, more scholars have begun to pay attention to the impact of ESG and corporate green innovation behavior on the investment field, especially the impact of ESG on stock prices. Xuexin Liu (2023)[5] argued that firms with better ESG performance have higher stock returns, and that investor attention enhances the positive impact of firms' ESG performance on stock returns. Yang Tang and Xiaoli Shen(2023)[6] also suggest that the sentiment fluctuations of external investors can also be a path through which ESG performance affects stock price synchronization. Chunhua Xin et al. (2022)[7] found that firms' green innovation

behavior can improve capital market pricing efficiency and firms' stock price synchronization. Meanwhile, other scholars pay more attention to the impact of firms' ESG ratings on their green innovation behaviors. Bai Liu et al.(2022) [8] found that the issuance of ESG ratings only promotes innovation at the formalistic level, but substantially reduces the quality of green innovation, which can easily lead to "greenwashing behavior" and is difficult to be sustained. While Lifen He et al.(2023)[9] argue that corporate ESG fulfillment can indeed enhance the level of sustainable green innovation.

From the above existing research results, Current research on corporate ESG performance mainly focuses on finance, performance, and governance. This study adds to the research theme by examining the economic consequences of ESG levels in line with China's green economy development. Additionally, it explores the impact of ESG on investment through the lens of corporate green innovation, which is underrepresented in existing literature. Overall, this research provides valuable insights for listed companies to enhance their ESG performance, fulfill responsibilities, improve share price synchronization, and reduce financing risks caused by share price volatility.

### 1.1 Research Hypotheses

#### 1.2 Impact of ESG performance of listed companies on stock price synchronization

Stock price synchronization measures the correlation between a company's stock price changes and the overall market's average change. It is often quantified using the goodness-of-fit( $R^2$ ) between individual stock returns and the index return of the stock market(Morck et al., 2000)[10]. The literature has two main perspectives on the mechanism of stock price synchronization: the "information efficiency view" and the "noise base view."

The "information efficiency view" suggests that stock price synchronization, as measured by  $R^2$ , reflects the extent to which firm-specific information is incorporated into stock prices. Lower stock price synchronization indicates better integration and reflection of a firm's specific information.

Morck et al. (2000)[10] found that internal and idiosyncratic information in stock prices leads to heterogeneous fluctuations, resulting in reduced stock price synchronization. However, the relationship between information content and stock price synchronization is nonlinear, showing an inverted "U" shape (Lee and Liu, 2007)[11].

However, imperfect markets and information asymmetry make it challenging to fully incorporate firm-specific information into stock prices. Information asymmetry in ESG research refers to the unbalanced distribution of information between companies and external stakeholders, particularly in environmental, social responsibility, and corporate governance aspects. This affects stakeholder decision-making. External stakeholders may have limited access to comprehensive and accurate environmental information due to non-transparent reporting and disclosure by companies. Different stakeholder expectations and standards for CSR fulfillment can lead to inconsistent external assessments. Concealment and manipulation of corporate governance-related information by insiders exacerbate information asymmetry. Mitigating information asymmetry requires truthful and accurate information disclosure by directors and supervisors, as well as responsible corporate governance practices(Jianqiong Wang and Xiaorui Liao, 2022)[12].

The "noise-based view" suggests that the high volatility and low synchronization of stock prices in the capital market are due to the presence of significant "noise" in stock trading, which hampers investors' accurate judgment. Volatility beyond the scope explained by enterprise and market information is often attributed to irrational factors such as market noise(West, 1988)[13]. China's capital market, despite its development, is still dominated by noise compared to mature Western markets(Yongping Ren and Wei Li, 2018)[14]. In a noisy market, higher stock price synchronization indicates lower noise and higher information efficiency, enabling effective resource allocation(Hongjun Zhu et al., 2007)[15]. Noise traders, lacking professional knowledge and information discrimination abilities, make investment decisions based on subjective assumptions and trend-following rather than intrinsic stock value, leading to chasing trends and exacerbating volatility. The causes of noise can be attributed to subjective decision-making of noise traders with limited

information, speculators exploiting investor herd psychology by creating false information, and corporate agents failing to make diligent and timely investment decisions.

The third cause is information asymmetry resulting from the company's agents' failure to timely, truthfully, and accurately disclose information. Noise reduces the efficiency of resource allocation in the capital market and weakens the effectiveness of the stock market.

Based on the above theories of information asymmetry and noise trading, good ESG performance of listed companies addresses information asymmetry, reduces market noise, and improves stock price synchronization. It helps stakeholders understand corporate information, balances information distribution, and prevents irrational investor behavior. Additionally, it attracts financing, employees, and favorable purchase prices, fostering a competitive business environment and long-term development. Stakeholders' confidence in holding shares and investing in the company is enhanced, reducing abnormal fluctuations in share prices and improving synchronization. To summarize, the first research hypothesis of this paper is proposed:

H1: The better the ESG performance of listed companies, the higher the stock price synchronization.

### **1.3 The impact of listed companies' ESG performance on listed companies' green innovation behavior**

In triple bottom line theory, companies are expected to fulfill economic, environmental, and social responsibilities. ESG aligns with these requirements, urging listed companies to address environmental, social, and economic concerns. Green innovation is often pursued by listed companies to fulfill their triple bottom line obligations, as it reflects their environmental responsibility, social accountability, and active engagement with stakeholders (Bai Liu et al., 2022) [16].

Stakeholder theory suggests that stakeholders, including investors, employees, and suppliers, play a vital role in a company's operations and success. By actively addressing stakeholders' interests and fulfilling social responsibilities, companies can create a favorable environment for stable operations and reduce business risks. Investors generally prefer companies with better ESG performance (Fangzhao Zhou, 2020) [17]. The ESG performance of listed companies, particularly the environmental and social factors influenced by green innovation, can impact their market valuation (Pedersen, 2021) [18]. To attract financing and achieve higher market valuation, listed companies engage in green innovation to fulfill their environmental, social, and economic responsibilities.

In summary, the second research hypothesis of this paper is proposed:

H2: The better the ESG performance of listed companies, the more positive their green innovation behavior.

### **1.4 The impact of listed companies' green innovation behaviors on their stock price synchronization**

Corporate reputation is an intangible asset encompassing responsibility, reliability, integrity, and other traits. A good reputation satisfies stakeholder needs, attracts more resources, and enhances the social value of a company. Listed companies engage in green innovation to establish a positive social image and enhance corporate reputation. A good reputation reduces uncertainty and compels companies lacking green innovation to adopt such behaviors (Wandong Zhao, 2023) [5]. Green innovation and environmental information disclosure by listed companies alleviate information asymmetry, reduce equity capital costs, and enhance stakeholder confidence (Hongjun Wu, 2014) [19]. This improves financing stability, mitigates financial and operational risks, and reduces abnormal stock price fluctuations, thereby enhancing stock price synchronization.

In summary, the third research hypothesis of this paper is proposed:

H3: The green innovation behavior of listed companies plays a mediating role between their ESG performance and stock price synchronization.

## 2. Research Design

### 2.1 Sample Selection and Data Source

This study examines A-share listed companies in 2009 and 2022, excluding financial industry, ST enterprises, and samples with missing variables, resulting in 10,514 observations. ESG data is obtained from CSI A-share listed companies' ESG rating indicators and manually organized. Green patent applications and authorizations data are sourced from the CNRDS database, while other financial data come from the CSMAR database. To mitigate the impact of extreme values, all continuous random variables are adjusted by 1% upper and lower bounds. The data analysis is conducted using Stata 17.0.

### 2.2 Definition of Variables

#### 3.2.1 Explanatory Variables

ESG is a system of criteria for evaluating the ability and level of corporate sustainability, including three dimensions: environmental, social and governance. In this paper, the ESG rating indicators of A-share listed companies released by CSI are selected as the explanatory variables.

#### 3.2.2 Explained Variables

In this paper, share price synchronization of A-share listed companies is used as an explanatory variable, measured by the fitting coefficient of the regression model proposed by Hongjun Zhu (2007)[15]:

$$R_{it} = \alpha + \beta \times R_{mt} + \varepsilon \quad (1)$$

In model (1),  $R_{it}$  and  $R_{mt}$  are the returns of firm  $i$  on the  $t$  trading day of the study period and the return of market  $m$  on  $t$  trading day of the study period. According to the explanation of the meaning of stock price synchronization in the previous section, the larger  $R^2$  is, the less firm-specific information is contained in the company's stock price, and the greater the stock price synchronization is. Since the value range of  $R^2$  is (0,1), which does not meet the regression requirements of the least squares method, this paper refers to the practice of Hongjun Zhu et al. (2007) [15], and carries out the following logarithmic transformation on the stock price synchronicity of  $R^2$ , so that it meets the normal distribution:

$$Synch_{it} = LOG\left(\frac{R_{it}^2}{1-R_{it}^2}\right) \quad (2)$$

#### 3.2.3 Mediating Variables

This paper investigates the mediating role of listed companies' green innovation level in the relationship between their ESG performance and stock price synchronization. Due to the unavailability of data on green innovation input, we use the output of green innovation patents as a measure of A-share listed companies' green innovation level.

However, green innovation patents can be divided into two categories: green invention patents and green utility model patents. Zenan Zhang et al. (2022)[20] argued that the application of corporate green invention patents belongs to substantive green innovation, while the application of corporate green utility model patents belongs to strategic green innovation. It is generally believed that the innovativeness of green invention patents is higher than that of green utility model patents (Shaozhou Qi, 2018)[21] and it takes a long time for the authorization of enterprise green patents, and in the process of waiting for the authorization, the green invention patents previously applied for may have already had an impact on the level of green innovation of the enterprise (Wenjing Li and Manni Zheng, 2016)[22], therefore, this paper selects the number of independent applications for green invention patents of listed companies in A-share to measure the level of green innovation. invention patent independent applications of A-share listed companies to measure their green innovation level. Specifically, to make the data obey normal distribution, this paper takes the natural logarithm of the

number of green invention patent applications of enterprises after adding 1 to eliminate the problem of right-skewed distribution of green patent data.

### 3.2.4 Control Variables

In this paper, the following control variables are selected: firm size (Logsize) [23], equity balance (Balance), book-to-market ratio (Bm) [6], gearing ratio (Lev) [23], return on assets (ROA) [23], board size (Board) [6]. And time and firm fixed effects are added to the model to control for the effect of unobserved factors on the results.

The specific variable definitions and calculations are shown in Table 1.

Table1 Definition of variables

Variable Type	Variable Name	Variable Symbol	Variable Definition and Calculation
Explanatory Variables	ESG Rating Indicator	Hzesg	ESG Rating Indicators of CSI A-share Listed Companies
Explanatory Variables	Stock price synchronization	Synch	Calculated from model (1) and model (2)
Intermediary Control Variables	Level of green innovation	Loggreinvia	Take the natural logarithm of the number of independent applications for green invention patents of A-share listed companies plus 1.
	Logsize	Logsize	Natural logarithm of the net assets of A-share listed companies.
	Equity Balance	Balance	The sum of the shareholdings of the second to tenth largest shareholders of a listed A-share company divided by the percentage of shares held by the first largest shareholder
	Book-to-market ratio	Bm	Book value divided by total market capitalization of A-share listed companies.
	Garing ratio	Lev	Total assets at year-end divided by total liabilities at year-end for A-share listed companies
	Return on Assets	ROA	EBITDA divided by average total assets of A-share listed companies.
	Board Size	Board	The number of board members of A-share listed companies is obtained by taking the natural logarithm.

## 2.3 Model Construction

### 3.3.1 A model to measure the impact of ESG performance of listed companies on their stock price synchronisation

$$Synch_{i,t} = \beta_0 + \beta_1 Hzesg_{i,t-1} + \beta_2 Logsize_{i,t-1} + \beta_3 Ralance_{i,t-1} + \beta_4 Rm_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 Board_{i,t-1} + Year_t + Id_i + \varepsilon_{i,t} \quad (3)$$

To test H1, this paper constructs the model. To address endogeneity concerns, the study regresses the explanatory variables on lagged ESG rating data. This allows measuring the impact of previous year's ESG performance on the current year's stock price synchronization. Control variables are also based on lagged data, and the regression model includes year and company fixed effects.

### 3.3.2 A model to measure the ESG performance of listed companies on their level of green innovation

$$Loggreinvia_{i,t} = \beta_0 + \beta_1 Hzesg_{i,t-1} + \beta_2 Logsize_{i,t-1} + \beta_3 Ralance_{i,t-1} + \beta_4 Rm_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 Board_{i,t-1} + Year_t + Id_i + \varepsilon_{i,t} \quad (4)$$

To test H2, this paper constructs the model. To mitigate endogeneity problems, the explanatory variables are regressed on lagged ESG rating data, capturing the impact of previous year's ESG performance on the current year's green innovation level. Control variables are also derived from lagged data, and the regression model includes year and firm fixed effects.

### 3.3.3 A model to measure the impact of a company's green innovation level on the synchronization of its stock price

$$Synch_{i,t} = \beta_0 + \beta_1 Hzesg_{i,t-1} + \beta_2 Loggreimia_{i,t-1} + \beta_3 Logsize_{i,t-1} + \beta_4 Balance_{i,t-1} + \beta_5 Bm_{i,t-1} + \beta_6 Lev_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 Board_{i,t-1} + Year_t + Id_i + \varepsilon_{i,t} \tag{5}$$

To test H3, the model is constructed in this paper. To address endogeneity, the study regresses the explanatory variables on lagged green invention patent applications. This measures the impact of previous year's green innovation on current year's share price synchronization. Control variables are also lagged, and the model includes year and company fixed effects.

## 3. Empirical regression result

### 3.1 Descriptive Statistics

Table 2 displays descriptive statistics. Stock price synchronization (Synch) has a mean of 0.216 and a standard deviation of 0.874, indicating significant variation among Chinese enterprises. Green innovation level (Loggreinvia) has a mean of 0.593 and a standard deviation of 1.035, highlighting low overall development and substantial differences among companies.

Table2 Descriptive Statistics

Variables	(1) Observa-tions	(2) Mean	(3) Standard Deviation	(4) Min	(5) Max
Synch	10,514	-0.216	0.874	-2.965	1.520
Hzesg	10,514	73.947	4.842	57.75	84.25
Loggreinvia	10,514	0.593	1.035	0	6.805
Lev	10,514	0.481	0.191	0.065	0.888
ROA	10,514	0.063	0.058	0.178	0.259
Board	10,514	2.188	0.198	1.609	2.708
Balance	10,514	0.712	0.670	0.028	3.679
Bm	10,514	0.675	0.266	0.129	1.175
Logsize	10,514	3.168	0.057	0.057	3.304

### 3.2 Corporate ESG performance and stock price synchronization

Table 3 Regression results of the impact of corporate ESG performance on stock price synchronization

	(1) Synch	(2) Synch
Hzesg	0.010*** (4.52)	0.007*** (3.05)
_cons	-0.954*** (-6.05)	-15.35*** (-9.13)
N	9763	9763
F	20.47	21.49
R <sup>2</sup>	0.440	0.448

Table 3 displays the regression results for model (3). Both without control variables and with control variables, ESG performance of listed companies (Hzesg) shows a significant positive correlation with stock price synchronization (Synch) at the 1% level. This confirms that better ESG

performance improves stock price synchronization, supporting H1. Possible reasons include reducing information asymmetry, minimizing irrational trading, enhancing investor confidence, and improving the business environment, leading to a stabilizing effect on share prices.

### 3.3 ESG performance and green innovation level of enterprises

Table 4 Regression results of the impact of corporate ESG performance on the level of green innovation

	(1) Loggreinvia	(2) Loggreinvia
Hzesg	0.013*** (7.21)	0.011*** (5.87)
_cons	-0.369*** (-2.68)	-19.03*** (-10.79)
N	9763	9763
F	52.05	32.47
R <sup>2</sup>	0.724	0.731

The regression results of model (4) are presented in Table 4. In column (1), without control variables, ESG performance of listed companies (Hzesg) and green innovation level of listed companies (Loggreinvia) exhibit a significant positive correlation at the 1% level, with a coefficient of 0.013. In column (2), with control variables included, the positive correlation between ESG performance (Hzesg) and green innovation level (Loggreinvia) remains significant at the 1% level, with a coefficient of 0.013. This confirms that better ESG performance of listed companies significantly improves their green innovation level, supporting H2.

### 3.4 Mediation effect test

Table6 Mediation effect regression results of green innovation level

	(1) Synch	(2) Synch
Hzesg	0.009*** (4.21)	0.006*** (2.87)
Loggreinvia	0.042*** (3.35)	0.031** (2.40)
N	9763	9763
F	16.28	19.69
R <sup>2</sup>	0.440	0.448

From the results of Table 3 and Table 4, corporate Environmental, Social, and Governance (ESG) performance positively impacts both stock price synchronization and green innovation (Table 5). The level of green innovation acts as a mediator between ESG performance and stock price synchronization. Regression analyses reveal significant positive correlations between ESG performance (Hzesg) and stock price synchronization (Synch) (coefficient: 0.009) and between green innovation level (Loggreinvia) and stock price synchronization (coefficient: 0.042) in column (1), supporting the partial mediation effect. In column (2), after including control variables, ESG performance (Hzesg) remains significantly correlated with stock price synchronization (Synch) (coefficient: 0.006), and the level of green innovation (Loggreinvia) continues to be significantly correlated with stock price synchronization (Synch) (coefficient: 0.031). These findings provide further evidence of the partial mediating effect of green innovation. The active engagement of companies in green innovation enhances their social reputation, stakeholder confidence, and reduces financial and operational risks, resulting in increased stock price synchronization and reduced volatility. Hypothesis H3 is supported.

## 4. Further analysis

### 4.1 Regional heterogeneity

To investigate whether there is a degree of difference in the positive impact of listed companies' ESG performance on their stock price synchronization in different regions, this paper conducts regressions for the western, eastern and central regions, and the regression results are shown in Table 7. Column (1) shows the regression results in the eastern region of China and with control variables added, and column (2), Column (3) corresponds to the regression results for the central and western regions of China. As shown in Table 7, only the ESG performance (Hzesg) of listed companies in the eastern region of China is significantly and positively correlated with their stock price synchronization (Synch) at the 1% level, with a coefficient of 0.007, while the coefficients in the western and central regions of China are positive but not significant. This suggests that the hypothesis that better ESG performance of listed companies can significantly improve their stock price synchronization can only be verified in the eastern region of China, while the data from other regions can hardly support the hypothesis. The reason may be that enterprises in the eastern part of China started to develop earlier and have larger technology, and there are more enterprises in the maturity stage, and their awareness of improving ESG performance has been formed, while there are fewer mature enterprises in other regions, and their awareness of ESG concepts is weaker. Therefore, the impact of ESG performance on firms in the eastern region of China is more obvious.

Table7 Regression results of regional heterogeneity test

	(1) Eastern Region Synch	(2) Central Region Synch	(3) Western Region Synch
Hzesg	0.007*** (2.64)	0.007 (1.44)	0.004 (0.77)
_cons	-12.33*** (-5.90)	-20.40*** (-5.09)	-21.46*** (-4.94)
N	6350	1564	1848
F	11.75	4.760	7.866
R <sup>2</sup>	0.444	0.478	0.452

### 4.2 Industry Heterogeneity

This study examines the impact of ESG performance on stock price synchronization in different industry sectors, specifically high-tech and non-high-tech subgroups.

Table 8 displays the regression results for A-share listed companies in China's high-tech and non-high-tech industries. In the high-tech industry (column 1), the coefficient for ESG performance (Hzesg) is not statistically significant, while in the non-high-tech industry (column 2), the coefficient is significant at the 1% level, with a value of 0.016. These results indicate that the positive impact of ESG performance on stock price synchronization can only be observed for A-share listed companies in the non-high-tech industry. The data for companies in other industries do not support this hypothesis. The distinction may be attributed to the government's provision of more favorable policies to promote the scientific and technological development of non-high-tech enterprises. This encourages them to invest in research and gradually transition into high-tech industries. As these companies enhance their technological competitiveness, their scientific and technological achievements contribute to social benefits and social responsibility, leading to improved ESG performance. Thus, the influence of ESG performance on non-high-tech enterprises is more pronounced.

Table 8 Regression results of industry heterogeneity test

	(1) Synch	(2) Synch
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Hzesg	0.000 (0.10)	0.016*** (4.65)
_cons	-18.77*** (-8.61)	-15.19*** (-4.98)
N	5928	3830
F	16.16	10.26
R <sup>2</sup>	0.475	0.428

## 5. Robustness Test

To verify the reliability of the empirical results, this paper conducts robustness tests in the following three aspects.

### 5.1 Replacement of variables

#### 6.1.1 Replace the explanatory variables

The ESG performance of enterprises, characterized by Bloomberg ESG ratings, is used to test the model. The regression results are presented in column (1) of Table 9. The ESG performance of listed companies (Bloombergesg) and stock price synchronization (Synch) exhibit a significant positive correlation at the 10% level, with a coefficient of 0.002. This confirms the previous conclusion: better ESG performance of listed companies corresponds to higher stock price synchronization.

In conclusion, even after replacing the explanatory variables with Bloomberg ESG ratings, the original conclusion remains valid, indicating the robustness of the findings.

#### 6.1.2 Replacement of Mediating Variables

Using the number of green patents granted to A-share listed companies to recharacterize the level of green innovation (Loggreinvig), regression results in Table 9, column (2), confirm the previous findings. The ESG performance (Hzesg) remains significantly and positively correlated with stock price synchronization (Synch) at the 1% level (coefficient: 0.006). Additionally, the level of green innovation shows a significant positive correlation with stock price synchronization at the 10% level (coefficient: 0.030). These results support the robustness of the original conclusions.

Table 9 Robustness test - regression results with replacement of mediator variables and explanatory variables

	(1) Synch	(2) Synch
Hzesg		0.006*** (2.96)
Loggreinvig		0.030* (1.75)
Bloombergesg	0.002* (1.65)	
_cons	-15.10*** (-8.94)	-15.06*** (-8.92)
N	9763	9763
F	19.93	19.23
R <sup>2</sup>	0.447	0.448

### 5.2 Propensity Score Matching Method

To address potential sample selection issues, this study employs the propensity score matching method (PSM). Firstly, the samples are divided into high and low ESG score groups based on the mean value of the ESG rating data of each A-share listed company. Secondly, control variables are

used as covariates, and 1:1 nearest neighbor matching is conducted to match high ESG rating samples with low ESG rating samples that have the closest propensity score. This results in 5,257 samples in each group. Finally, the matched samples undergo main effects regression analysis, and the results are presented in Table 12.

The regression results in Table 12 indicate that the ESG performance of listed companies (Hzesg) is significantly and positively correlated with stock price synchronization (Synch) at the 10% level, with a coefficient of 0.034. Additionally, the ESG performance of listed companies (Hzesg) is significantly and positively correlated with the level of green innovation (Loggreinvia) at the 1% level, with a coefficient of 0.034. The ESG performance (Hzesg) and green innovation level (Loggreinvia) of listed companies exhibit a significant positive correlation at the 1% level, with a coefficient of 0.069. Furthermore, the ESG performance (Hzesg), green innovation level (Loggreinvia), and stock price synchronization (Synch) of listed companies are significantly and positively correlated at the 5% and 1% levels, with coefficients of 0.045 and 0.066, respectively.

These results indicate that even after addressing sample selection bias using the PSM model, the ESG performance and green innovation level of listed companies remain significantly correlated. Moreover, the ESG performance and green innovation level of companies still significantly impact their stock price synchronization, with the green innovation level playing a partial mediating role. The ESG performance of companies also significantly influences their green innovation level, providing support for the main and mediating effects as concluded in this study.

Table10 Robustness test regression results - endogeneity test regression results based on PSM methodology

	(1) Synch	(2) Loggreinvia	(3) Synch
Higesg	0.034* (1.81)	0.069*** (4.11)	0.045** (2.45)
Loggreinvia			0.066*** (5.41)
_cons	-15.14*** (-7.98)	-17.860*** (-8.82)	-14.609*** (-7.81)
N	9873	9895	9895
F	17.52	24.22	18.05
R <sup>2</sup>	0.482	0.741	0.485

## 6. Conclusion and Recommendation

This study examines the impact of corporate ESG performance on stock price synchronization and the mediating role of corporate green innovation level using regression analysis on a sample of listed companies from 2009 to 2022. The findings suggest that actively fulfilling ESG obligations enhances stock price synchronization for firms. Specifically, the study concludes that firms with higher ESG performance exhibit improved stock price synchronization, and the green innovation level of firms plays a positive mediating role in the relationship between ESG performance and stock price synchronization. Moreover, companies located in China's eastern region and those in non-high-tech industries are more influenced by ESG performance in terms of stock price synchronization. These conclusions hold even after substituting variables and employing the propensity score matching method. The empirical results provide evidence for listed companies to enhance their ESG levels, engage in green innovation, and reduce share price volatility risks.

Based on these findings, two recommendations are made. Firstly, companies are advised to strive for improved ESG performance by actively fulfilling environmental and social responsibilities and strengthening effective corporate governance. This study confirms that fulfilling environmental and social responsibilities and enhancing corporate governance positively impact stock price synchronization, helping companies mitigate financing risks associated with abnormal stock price

fluctuations. Secondly, companies are encouraged to actively engage in substantive green innovation activities and enhance their green innovation capabilities. In the context of sustainable development, green innovation is crucial for the long-term survival and decision-making of enterprises. This study confirms the positive impact of substantial green innovation activities on stock price synchronization, which can help companies reduce financing risks. Lastly, government agencies are urged to establish a unified ESG rating standard and disclosure system for enterprises. This system can encourage companies to fulfill their ESG responsibilities, promote ESG concepts in their operations, and provide policies or subsidies to incentivize green innovation.

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