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ESG activities and financial stability: The case of Korean financial firms

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ABSTRACT

This study explores the relationship between financial firms' environmental, social, and governance (ESG) activities and their financial stability measured by Altman's Z-score. Based on a dataset of listed financial institutions in Korea, our results indicate a positive association between stability and ESG activities. Overall ESG scores and those for the individual environmental, social, and governance pillars potentially enhance financial stability. The environmental pillar plays the most significant role in improving the stability of financial firms. The positive association between ESG activities and financial firms' stability is also seen in nonbanking sectors.

1. Introduction

Recent studies shed light on firm value, investment, and capital markets from the perspective of corporate environmental responsibility (CER), corporate social responsibility (CSR), and, more broadly, environmental, social, and governance (ESG) frameworks (Dhaliwal, Tsang, & Yang, 2011; Surroca, Tribó, & Waddock, 2010). They show that these ESG frameworks are linked to firm value (Bang, Ryu, & Yu, 2023; Cheng, Kim, & Ryu, 2024; Deng, Kang, & Low, 2013; Mishra, 2017; Nam, Bilgin, & Ryu, 2024), risk reduction (Albuquerque, Koskinen, & Zhang, 2019; Albuquerque, Koskinen, Yang, & Zhang, 2020; Boubaker, Cellier, Manita, & Saeed, 2020), and asset-pricing risk factors (Bang, Kang, & Ryu, 2024; Bang, Ryu, & Webb, 2023). Previous studies also suggest that engaging in ESG activities can positively impact a company's financial performance. They highlight the potential value of integrating ESG into corporate strategies (Friede, Busch, & Bassen, 2015; Husted, 2005; Malik, 2015) and the mitigation of financial risk from ESG activities (Boubaker, Cellier, Manita, & Saeed, 2020; Sassen, Hinze, & Hardeck, 2016). However, the relationship between ESG activities and financial performance remains a contentious issue (Bae, El Ghoul, Gong, & Guedhami, 2021; Demers, Hendrikse, Joos, & Lev, 2021). In this study, we reexamine the effects of ESG on financial stability using an influential emerging market dataset.

Existing research on ESG activities has focused on nonfinancial companies, leaving ESG activities in the financial sector largely unaddressed. Noting that the characteristics of financial firms somewhat differ from those of nonfinancial firms, Brogi and Lagasio (2019) suggest the importance of establishing socially responsible standards and principles to provide regulatory support, particularly in the banking sector. Our study tries to fill the gap in empirical research on ESG activities in the financial industry by analyzing the effects of ESG activities on financial firms. We explore the effects of overall ESG performance and three ESG pillars (i.e., environmental, social, and governance pillars) on the financial stability of listed financial firms in Korea, which is a leading emerging market.

We have several reasons for focusing on Korea and its financial institutions to address ESG-related issues. First, at present, Korea is planning to transition from a carbon-based economy to a decarbonization of the economy. The achievement of this goal has created increasing demand for green finance. Hence, the environmental pillar has become very important in the Korean market. As Korea begins to shift its economy away from carbon dependence and toward decarbonization, understanding of the importance of environmental factors in shaping financial plans and investment decisions has increased. This greater awareness is leading to a strong demand for green finance options that support sustainable projects lowering carbon emissions and encouraging environmentally friendly practices in different industries. Financial institutions and investors are increasingly prioritizing environmental

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criteria in their decision-making processes, reflecting a broader shift toward sustainability in Korea's economic landscape. Second, Korea's rapid economic growth has led to social conflict, showing the need for inclusive finance to address it. Third, governance in Korea's financial industry has been also identified as an important issue due to the ownership structure of chaebols and the need to comply with global standards. The chaebols are large Korean conglomerates controlled by some founders' family members, operating numerous subsidiaries in various industries (Baek, Kang, & Lee, 2006). They have played a major role in economic growth, but are criticized for transparency and fairness (Bae, Kang, & Kim, 2002). Since 2000, Korea has made a continuous effort to improve the governance of financial institutions, making them more competitive in global financial markets. In this context, Korea faces pressing ESG issues in the financial sector that require attention.

Our research focuses on financial firms listed on the Korea Exchange that have published ESG scores from Refinitiv. The study period is from 2013 to 2022; the period begins in 2013 because ESG ratings were scarce before that year. We employ fixed-effects regression models in our baseline analysis. To enhance robustness, we also conduct dynamic panel analysis. To mitigate the endogeneity issues inherent in this analysis, we carry out generalized method of moments (GMM) analyses with lagged instrumental variables. We also check the results of a panel Granger-causality test to look for potential reverse-causality relationships (Berger, Molyneux, & Wilson, 2020; Blundell & Bond, 1998). Our overall results suggest that ESG activities might enhance the financial stability of Korean financial institutions. Our baseline regression analyses imply that the environmental (Yang, Bae, & Ryu, 2022, 2024; Kim, Park, & Ryu, 2017), social (Park & Ryu, 2022; Ryu, Ryu, & Hwang, 2016), and governance (Kang, Bang, & Ryu, 2024; Ryu, Ryu, & Hwang, 2017) frameworks are each somewhat positively related to financial stability. The environmental pillar in particular seems to play the most significant role in enhancing financial stability in the Korean finance industry. Our results for nonbank financial intermediaries (NBFIs) are similar.

A possible interpretation of our empirical findings is that ESG activities play a crucial role in fostering risk management and sustainable growth by financial institutions. Evaluating and improving ESG practices can be essential for financial institutions to pursue long-term value creation and sustainable management (Broadstock, Chan, Cheng, & Wang, 2021; Zhou, Liu, & Luo, 2022). The environmental component has emerged as particularly significant. Environmentally focused ESG activities can help companies mitigate future risks associated with the natural environment and transition to more sustainable business models. When CSR is emphasized at a company, environmentally related ESG activities can enhance its reputation. Consequently, financial institutions increasingly focus on the environmental aspects of ESG activities to contribute to the long-term success and stability of companies.

The remainder of this paper is organized as follows. In Section 2, we offer an overview of the relevant literature, and in Section 3, we describe the data and methodologies used in this study. Section 4 presents the results of our analysis. Section 5 concludes the paper.

2. Literature review

Previous research indicates a positive association between a firm's ESG (including CER and CSR) activity and sustainable value. Jo, Kim, and Park (2015) argue that CER enhances operational performance by reducing a company's environmental costs. They suggest that pursuing environment-centered industrial policies will yield positive effects not only in the manufacturing sector but also in the financial services sector. Friede, Busch, and Bassen (2015) assert that firms that give precedence to ESG considerations and incorporate them into their business operations are more likely to achieve superior financial performance in the long run, which suggests that augmenting CSR can be advantageous for firms. El Ghoul, Guedhami, Kwok, and Mishra (2011) also reveal that companies prioritizing CSR initiatives often achieve higher profitability and market valuation. In a study on ESG activities and the financial performance of the banking sector, Buallay (2019) explores the correlation between ESG factors and banks' operational, financial, and market performance, as measured by the return on assets (ROA), the return on equity (ROE), and Tobin's Q, respectively, and finds a significantly positive correlation between ESG activities and overall performance.

Some studies analyze the indirect effects of ESG. Deng, Kang, and Low (2013) show that firms that prioritize ESG activities are less prone to financial distress than other firms. They suggest that ESG can build a positive social reputation, enhance customer loyalty, boost investor confidence, and improve access to financing. They highlight that ESG can elevate employee morale and productivity, resulting in better operational performance and financial stability. Malik (2015) shows a positive association between CSR and financial performance, attributing this to enhanced reputation and stakeholder attraction. Ferrell, Liang, and Renneboog (2016) argue that firms with strong CSR performance experience reduced managerial entrenchment, which positively affects firm value. Therefore, they suggest that CSR not only maximizes shareholder wealth but also meets important social expectations. Mishra (2017) posits that engaging in CSR activities can bolster a firm's reputation and brand image, thereby fostering customer loyalty and trust, and asserts that CSR initiatives can lead to cost savings, higher employee productivity, and better risk management, all of which contribute to superior financial performance.

Recent studies have established a positive correlation between sustainability and firm stability. Sassen, Hinze, and Hardeck (2016) explore the impact of sustainability on a firm's financial performance, showing that an increase in sustainability is inversely related to both total and unsystematic risk. They find that the environmental and social frameworks predominantly decrease three types of risk (i.e., total, systemic, and unsystematic), especially in environmentally vulnerable firms (Curcio, Gianfrancesco, & Vioto, 2023). They then propose that emphasizing a firm's social performance can reduce overall risk. Chiaramonte, Dreassi, Girardone, and Piserà (2022) examine ESG scores in European banking and find that higher overall ESG scores and individual pillar scores contribute to greater bank stability during periods of financial risk. They argue that a greater commitment to ESG practices in the banking sector has positive effects on both the environment and society, while also bolstering the industry's resilience during financial crises. This viewpoint is consistent with the findings by Gillan, Koch, and Starks (2021) and Sassen, Hinze, and Hardeck (2016). Meanwhile, Di Tommaso and Thornton (2020) debate the influence of the governance structure on the relationship between ESG scores and risk-taking by banks.

Our review of the existing literature motivates us to reexamine the potential link between the ESG framework and financial performance, providing empirical evidence on the role of ESG in establishing stability and sustainability, especially in emerging economies.

3. Data and methodology

Our sample encompasses 15 representative financial firms listed on the Korea Composite Stock Price Index (KOSPI) with available ESG scores in the Refinitiv database from 2013 to 2022.[1] We measure financial stability using Altman's Z-score (*Zscore*) and use it as the dependent variable. We calculate the Z-score, a measure of a firm's financial stability, which previous studies have used to assess risk in the financial sector, especially in emerging markets (Altman,

[1] These financial firms are BNK Financial Group, DB Insurance Co., DGB Financial Group, Hanwha Life Corp., Hana Financial Group, Hyundai Marine & Fire Insurance Group, Industrial Bank of Korea, KB Financial Group, Korea Investment Holdings, Mirae Asset Securities Co., NH Investment & Securities Co., Samsung Life Insurance Co., Samsung Fire & Marine Insurance, Samsung Securities Co., and Shinhan Financial Group Co.

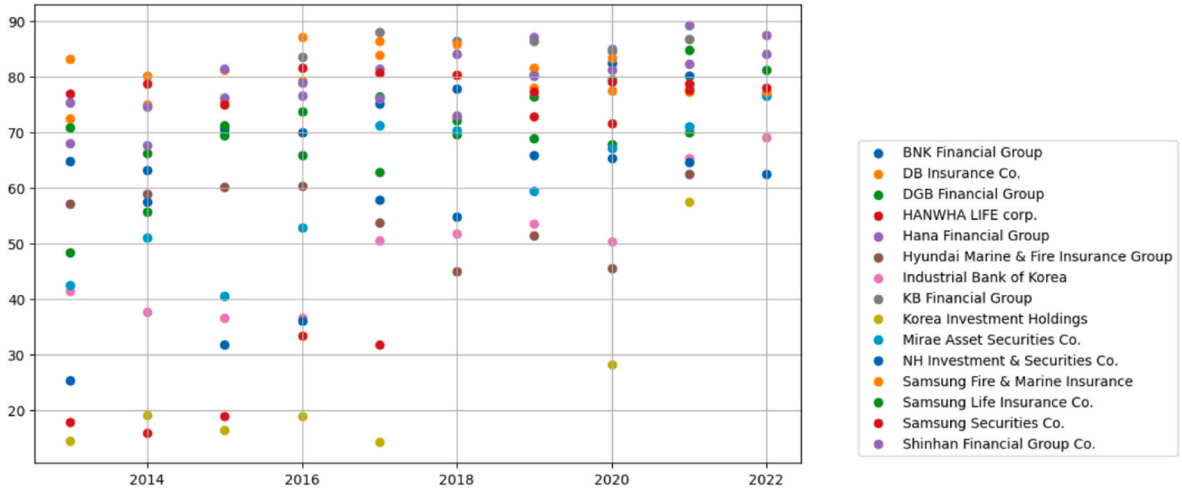


Fig. 1. ESG trends
Note: This figure shows the trends in ESG scores for the 15 financial firms.

Table 1
Summary statistics.

	Min	10th	Mean	Med	90th	Max	Std	Skew	Kurt	ADF
Dependent variables										
Zscore	0.086	0.120	0.217	0.165	0.466	0.564	0.132	1.413	3.355	0.000
Explanatory variables										
ESG	2.885	3.601	4.144	4.280	4.430	4.463	0.366	−1.949	6.424	0.000
E	2.880	3.438	4.151	4.337	4.456	4.507	0.421	−1.847	5.448	0.000
S	2.571	3.689	4.152	4.272	4.484	4.527	0.404	−2.129	7.272	0.000
G	3.089	3.656	4.160	4.282	4.451	4.564	0.348	−1.429	4.329	0.001
Control variables										
Debt	3.040	3.331	5.516	6.530	7.216	7.554	1.614	−0.486	1.352	0.010
Cash	−4.605	−1.171	0.095	0.351	1.384	1.944	1.250	−2.004	8.335	0.001
Oper	−1.43	2.745	7.573	6.16	19.57	20.76	4.814	0.734	2.799	0.000
Size	9.81e+08	2.21e+09	7.84e+09	4.87e+09	1.98e+10	2.36e+10	6.48e+09	1.090	2.888	0.000
Cap	4.97	6.99	9.486	8.62	13.13	17.58	2.646	1.233	4.007	0.000

Notes: This table presents the summary statistics of dependent, explanatory, and control variables. *Min*, 10th, *Mean*, *Med*, 90th, *Max*, *Std*, *Skew*, and *Kurt* indicate minimum, 10th percentile, mean, median, 90th percentile, maximum, standard deviation, skewness, and kurtosis, respectively. *ADF* shows the *p*-values based on augmented Dickey-Fuller tests.

Iwanicz-Drozdowska, Laitinen, & Suvas, 2017). Altman's Z-score model considers several financial ratios and variables—such as profitability, liquidity, leverage, solvency, and activity. We calculate the Zscore value of each financial firm by using five factors which are *i*) the ratio between cash and total assets; *ii*) the retained earnings divided by total assets; *iii*) the ratio of earnings before interest and tax (EBIT) to total assets; *iv*) the ratio of total equity to total liabilities; and *v*) the ratio of sales to total assets. The Zscore level serves as a predictive tool to assess the firm's financial soundness and default probability (Beltrame, Velliscig, Zorzi, & Polato, 2023). A higher *Zscore* level indicates a lower likelihood of bankruptcy, whereas a lower score suggests a greater risk of financial difficulty.

Our explanatory variables of interest are the scores for overall ESG (*ESG*) and individual ESG pillars (*E*, *S*, and *G*). *ESG*, *E*, *S*, and *G* denote the natural logarithm of the ESG, environmental, social, and governance scores. The ESG score is a composite of the ESG pillars. The environmental pillar is subdivided into emissions, innovation, and use of resources. The social pillar includes community involvement, human rights, good product stewardship, and human resource advancement.[2]

The governance pillar encompasses management, shareholders, and firm structure. Fig. 1 displays the pattern in ESG scores for 15 financial firms by year, showing an upward trend. In the early stages, ESG scores have a wider distribution, but over time, the distribution has narrowed, and variability has declined. This could be interpreted as financial firms increasing their ESG initiatives in response to growing interest in ESG.

Because firms with lower risk, higher performance, and larger assets tend to have higher ESG scores (Drempetic, Klein, & Zwergel, 2020), we use financial and accounting variables (*Debt*, *Cash*, *Oper*, *Size*, and *Cap*) to control for the potential effects of financial profitability, size, and other firm-specific characteristics (Kim, Ryu, & Yu, 2021, 2024; Kim, Ryu, & Yang, 2021). We follow Laeven, Ratnovski, and Tong (2016) in employing firm size and debt level as firm-level control variables. The debt level can measure risk and financial insolvency. *Debt* is the logarithm of the debt ratio, which is a financial metric for the proportion of a company's total assets financed by debt. It is calculated by dividing total debt by total assets. *Cash* is the logarithm of the composition of cash and cash equivalents, which indicates the proportion of a company's assets held in cash and cash equivalents relative to its total asset base. *Oper* means the operating profit margin, which represents the percentage of revenue that translates into operating profit. It is calculated by dividing operating profit by revenue. *Size* is the market capitalization, which refers to the total value of a company's stocks. Firm size typically shows an inverse relationship with risk and a positive correlation with

[2] Social issues can also include those related to ethics (Ko, Lee, Park, & Ryu, 2023), education (Kim & Ryu, 2023), and inequality (Nam, Frijns, & Ryu, 2024; Ryu & Nam, 2024).

Table 2
Pearson correlation.

	Zscore	ESG	E	S	G	Debt	Cash	Oper	Size
ESG	0.124								
E	0.157*	0.876***							
S	0.129	0.955***	0.843***						
G	0.110	0.869***	0.668***	0.721***					
Debt	0.404***	−0.148*	−0.067	−0.059	−0.268***				
Cash	0.382***	0.212**	0.257***	0.160	0.245**	0.328***			
Oper	−0.396***	0.164*	0.109	0.119	0.204**	−0.557***	−0.367***		
Size	−0.094	0.299***	0.279***	0.317***	0.215**	−0.185**	0.077	0.213**	
Cap	0.481***	0.057	0.141*	0.107	−0.058	0.349***	0.311***	−0.412***	0.026

Note: This table presents Pearson's pairwise correlations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

performance. *Cap* is the capital ratio, which measures a bank's financial strength, representing the proportion of a bank's capital relative to its risk-weighted assets. The data for the control variables come from DataGuide.

We conduct unit-root tests on the variables to check for stationarity. The augmented Dickey-Fuller (ADF) test results indicate stationarity. We winsorize the variables at the 10 percent and 90 percent levels to remove extreme values that could potentially skew the results and lead to a false conclusion. Table 1 presents the descriptive statistics for the variables used. The average ESG score in our sample is 4.144. The mean scores for the environmental, social, and governance pillars are 4.151, 4.152, and 4.160, respectively. Among the different pillars, the governance pillar has the highest mean due to regulation over the governance structure of financial institutions. Table 2 shows the correlation coefficients of the variables.

We employ a panel method with two-way fixed effects to identify the unique characteristics of each firm and their changes over time, serving as a baseline model. None of the models had collinearity concerns among the independent variables, as each had variance inflation factor (VIF) values below 10. We also apply the difference-GMM estimator and the panel Granger-causality test, each of which mitigates problems with endogeneity and reverse causality, respectively. Equation (1) shows the baseline panel regression model for evaluating the correlation between ESG activities and risk.

$$Zscore_{it} = \alpha + \beta \bullet ESG_{it}(or\ E_{it}, S_{it}, G_{it}) + \gamma \bullet X_{it} + \theta_t + \tau_i + \epsilon_{it} \quad (1)$$

where the dependent variable measures the risk (*Zscore*) of firm *i* at time *t*. Our main estimate is that of β, which captures the effect of the ESG score for firm *i* at time *t* (ESG_{it}). The explanatory variable is E_{it}, S_{it}, or G_{it}, which represent the environmental, social, or governance pillar for firm *i* at time *t*, respectively. The vector X_{it} represents a set of firm-level control variables. We control for the firm-fixed effect (τ_i) and the time-fixed effect (θ_t). We estimate the coefficients by employing the standard error estimation method proposed by Petersen (2008). We also perform subsample analyses of NBFIs, such as securities and insurance firms.

To examine the dynamic relationship between stability and ESG activities, we use a dynamic panel model, which uses lags of the dependent variables as instruments. We employ the difference-GMM estimation, following the approach by Arellano and Bond (1991), to address potential endogeneity in our dynamic panel analysis. These problems could stem from inaccuracies in measuring explanatory variables, the omission of certain variables, or reverse causality (Al-Malkawi & Javaid, 2018; Bénabou & Tirole, 2010; Liu & Hsu, 2006; Ullah, Akhtar, & Zaefarian, 2018). Equation (2) presents the dynamic panel model.

$$Zscore_{it} = \alpha + \gamma_1 \bullet Zscore_{it-1} + \gamma_2 \bullet Zscore_{it-2} + \beta_1 \bullet ESG_{it}(or\ E_{it}, S_{it}, G_{it}) + \delta \bullet X_{it} + \theta_t + \tau_i + \varepsilon_{it} \quad (2)$$

where *t* (=3, 4, …, *T*) denotes the period in years. θ_t and τ_i capture time-fixed and firm-fixed effects, respectively. The dependent variable is the *Zscore* for firm *i* at time *t*. We assume that the ESG variables and ε_{it} are not correlated. The key variables include $ESG_{it}(or\ E_{it}, S_{it}, G_{it})$, the firm-

Table 3
Impacts of scores for ESG and its pillars on financial stability.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ESG	0.056***							
	(4.84)							
E		0.021	0.024*		0.032***	0.040***		
		(1.51)	(1.72)		(3.11)	(4.30)		
S		0.018	0.023	0.034***			0.043***	
		(1.13)	(1.53)	(2.92)			(4.21)	
G		0.018		0.021	0.022*			0.040***
		(1.41)		(1.63)	(1.75)			(3.34)
Debt	0.047 (1.35)	0.038 (1.03)	0.023 (0.64)	0.044 (1.19)	0.044 (3.11)	0.026 (0.73)	0.027 (0.75)	0.075** (2.01)
Cash	0.013*** (4.26)	0.012*** (3.78)	0.013*** (4.06)	0.013*** (3.99)	0.011*** (3.60)	0.012*** (3.75)	0.014*** (4.36)	0.010*** (3.12)
Oper	0.005*** (3.69)	0.005*** (3.50)	0.005*** (3.45)	0.005*** (3.55)	0.005*** (3.40)	0.005*** (3.28)	0.005*** (3.50)	0.005*** (3.14)
Size	3.76e-12** (2.00)	3.50e-12* (1.82)	3.28e-12* (1.71)	3.87e-12** (2.02)	3.14e-12 (1.66)	2.72e-12 (1.43)	3.67e-12* (1.90)	3.28e-12 (1.64)
Cap	0.011*** (3.52)	0.010*** (3.10)	0.009*** (2.77)	0.010*** (3.10)	0.011*** (3.33)	0.009*** (2.89)	0.008*** (2.68)	0.013*** (3.76)
R^2	0.513	0.516	0.503	0.501	0.508	0.488	0.484	0.446
F-stat	232.54	219.36	227.19	216.79	219.45	228.81	221.73	197.01
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: This table presents the impacts of ESG and its pillar scores on stability (*Zscore*). Intercept terms are excluded to simplify and clarify the table. R^2 denotes the within *R*-squared to measure goodness of fit. *F*-stat denotes the *F*-statistic to measure the overall significance of each model, which tests the null hypothesis that all coefficients of the independent variables in the overall regression model are equal to zero. *p*-value denotes the statistical significance of the *F*-statistic. *t*-statistics are shown in parentheses. ***, **, and * statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4
Impacts of scores for ESG and its pillars on financial stability at NBFIs.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ESG	0.041***							
	(4.19)							
E		0.015	0.021		0.029**	0.037***		
		(0.85)	(1.26)		(2.33)	(4.06)		
S		0.016	0.018	0.026**			0.036***	
		(0.98)	(1.11)	(2.38)			(4.00)	
G		0.012		0.016	0.014			0.033***
		(0.95)		(1.33)	(1.08)			(3.37)
R^2	0.707	0.713	0.709	0.709	0.708	0.702	0.700	0.679
F-stat	485.78	452.01	482.71	459.63	453.35	448.44	480.06	424.31
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: This table presents the impacts of ESG and its pillar scores on the stability (*Zscore*) of nonbank financial intermediaries (NBFIs). Intercept terms are excluded to simplify and clarify the table. R^2 denotes the within R-squared to measure goodness of fit. *F*-stat denotes the F-statistic to measure the overall significance of each model, which tests the null hypothesis that all coefficients of the independent variables in the overall regression model are equal to zero. *p*-value denotes the statistical significance of the *F*-statistic. *t*-statistics are in parentheses. *** and ** denote statistical significance at the 1% and 5% levels, respectively.

level ESG scores. We perform an autocorrelation test to check the serial correlation structure in the error term.

To check for possible causality, we perform a panel Granger-causality test with two lags (Wooldridge, 2010).

$$Zscore_{it} = \alpha_t + \alpha_{11} \bullet Zscore_{it-1} + \alpha_{12} \bullet Zscore_{it-2} + \alpha_{21} \bullet ESG_{it-1}(or\ E_{it-1}, S_{it-1}, G_{it-1}) + \alpha_{22} \bullet ESG_{it-2}(or\ E_{it-2}, S_{it-2}, G_{it-2}) + u_{1i} + \epsilon_{1it} \quad (3)$$

$$ESG_{it}(or\ E_{it}, S_{it}, G_{it}) = \beta_t + \beta_{11} \bullet ESG_{it-1}(or\ E_{it-1}, S_{it-1}, G_{it-1}) + \beta_{12} \bullet ESG_{it-2}(or\ E_{it-2}, S_{it-2}, G_{it-2}) + \beta_{21} \bullet Zscore_{it-1} + \beta_{22} \bullet Zscore_{it-2} + u_{2i} + \epsilon_{2it} \quad (4)$$

4. Empirical results

We empirically examine the connection between ESG activities (measured by the Refinitiv ESG scores) and financial stability (measured by *Z*-score) at financial firms, using a two-way fixed effects panel regression analysis. The dynamic panel model follows the method outlined by Arellano and Bond (1991) to address endogeneity problems (Berger, Molyneux, & Wilson, 2020). We also confirm whether the data exhibit an autoregressive process, which is crucial for detecting serial correlation in the error terms in the models. We perform Granger-causality Wald tests to investigate whether previous values of one variable can causally predict the behavior of another variable over time. Our models use robust standard errors (Semykina & Wooldridge, 2010).

Table 3 presents the results of the fixed-effects panel regression analysis, in which the dependent variable represents financial risk, as in Equation (1). After the null observations are omitted, the number of firm-year observations becomes 105. In Column (1), the ESG score is aggregated, and the ESG coefficient shows positive statistical significance at the 1 percent level. Similarly, in Columns (5) and (6), our results show that the environmental pillar score has a positive and significant impact at the 1 percent level. The social pillar score has a positive and significant impact at the 1 percent level in Columns (4) and (7). In Columns (5) and (8), the governance pillar score also has a positive and significant relationship with financial stability.

Our findings indicate that environmental factors have a greater impact on financial stability than the others. Korea has many export-oriented companies, which enforce well-established environmental standards. Because many companies focus on global markets, strict compliance with environmental standards has become deeply embedded in the corporate environment. Financial institutions are not only closely linked to export-oriented businesses through policies such as green finance, which are intertwined with environmental politics, but also support Korean manufacturing. Therefore, the environmental pillar might have a significant influence on companies in Korea.

Baek, Kang, and Park (2004) note that, during the 1997 Asian financial crisis (Seo, Kim, & Ryu, 2019), the higher concentration of ownership among owner-managers or their affiliates within chaebols led to a greater decline in stock value than a company with a high concentration of foreign investors. Because Korea has these unique characteristics, it has consistently addressed issues related to concentration

Table 5
Impacts of scores for ESG and its pillars on stability: Difference-GMM.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ESG	0.007							
	(0.84)							
E		0.018***	0.019***		0.011***	0.013***		
		(3.32)	(3.66)		(2.56)	(2.81)		
S		−0.011*	−0.009	−0.000			0.004	
		(-1.68)	(-1.49)	(-0.02)			(0.60)	
G		0.006		0.009	0.004			0.008
		(0.83)		(1.22)	(0.48)			(1.20)
AR[1]	0.0380	0.0243	0.0318	0.0327	0.0241	0.0289	0.0478	0.0301
AR[2]	0.2056	0.2072	0.2457	0.1780	0.1931	0.2141	0.2158	0.1737
χ^2	718.59	5399.99	1046.26	768.52	620.15	612.80	786.13	690.24
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Using difference-GMM in a dynamic panel model, this table presents the impact of ESG and its pillars on financial stability (*Zscore*). Intercept terms are excluded to simplify and clarify the table. *AR[1](AR[2])* denotes the Arellano-Bond test for autocorrelation in the first-difference (second-difference) errors. χ^2 denotes the chi-squared statistic to measure the overall significance of each model. *p*-value denotes the statistical significance of the χ^2 statistic. *z*-statistics are in parentheses. *** and * statistical significance at the 1% and 10% levels, respectively.

Table 6
Granger-causality tests on the impact of ESG and its pillars on stability.

Null hypothesis	χ^2	*p*-value
The ESG score does not Granger-cause the Zscore.	5.832*	0.054
The Zscore does not Granger-cause the ESG score.	0.239	0.888
The environmental score does not Granger-cause the Zscore.	4.857*	0.088
The Zscore does not Granger-cause the environmental score.	1.533	0.465
The social score does not Granger-cause the Zscore.	4.943*	0.084
The Zscore does not Granger-cause the social score.	0.241	0.887
The governance score does not Granger-cause the Zscore.	4.452	0.108
The Zscore does not Granger-cause the governance score.	0.435	0.804

Note: χ^2 denotes the chi-squared statistic used in the Wald test. *p*-value denotes the statistical significance of the χ^2 statistic. The null hypothesis is "Excluded variable does not Granger-cause equation variable". * denotes statistical significance at the 10% level.

in governance, particularly since 2008, when it became a full member of the G20. Sustainability emerged as a more significant concern in this period as well (Choi, Park, & Yoo, 2007). Therefore, the governance pillar can have an impact on stability.

Moreover, interest in various social issues, such as labor rights, human rights, employment, and community development, has grown in Korea due to its rapid industrialization. An emphasis on social responsibility has increased as part of enhancing the country's international competitiveness. Therefore, the social pillar can influence the stability of businesses.

The governance aspects of banks and bank holding companies are regulated by the Bank of Korea, the Financial Supervisory Service (FSS), and the Bank for International Settlements (BIS). Korean banks comply with these regulations. However, NBFIs are subject to less regulation, primarily because they are somewhat exempt from central bank regulations. Hence, a more detailed study on NBFIs is needed because of their distinct characteristics, so we conduct a further subsample analysis using the baseline regression model. Table 4 presents the results of companies that are not banks or do not have a banking component using the full dataset (Ryu, Webb, & Yu, 2020; Ryu & Yu, 2020, 2021; Yu & Ryu, 2021). The number of firm-year observations is 78. The ESG coefficient has positive statistical significance at the 1 percent level in Column (1). The environmental pillar score has a positive and significant impact at the 5 percent and 1 percent level, respectively, in Columns (5) and (6). The social pillar score has a significantly positive relationship with financial stability at the 5 percent and 1 percent level, respectively, in Columns (4) and (7). In Column (8), the governance pillar score has a positively significant impact at the 1 percent level.

Although NBFIs operate within a regulatory framework that is less stringent than that of traditional banking institutions, it is evident that NBFI entities are notably susceptible to the influence of ESG considerations. This highlights the importance of conducting thorough assessments and implementing robust ESG strategies in the NBFI sector to effectively manage risks and capitalize on emerging opportunities based on sustainability principles.

Table 5 presents the results of the dynamic panel estimation in Equation (2) using difference-GMM. A statistically significant positive relationship is found between the environmental pillar and financial stability in Columns (2), (3), (5), and (6). Our findings indicate that environmental factors are significantly related to stability.

We conduct panel Granger-causality tests to check for potential causal links and investigate the lead-lag relationship between ESG scores and financial stability. Table 6 shows the results of the panel Granger-causality test, using Equations (3) and (4), on the relation between listed financial firms and stability. Rejection of the null hypothesis "Excluded variable does not Granger-cause equation variable" means that the excluded variable Granger-causes the equation variable (Granger, 1969). The ESG score Granger-causes the *Zscore*, the environmental score Granger-causes the *Zscore*, and the social score Granger-causes the *Zscore*. This means that incorporating overall ESG scores, environmental scores, and social scores when predicting the *Zscore* provides more information than relying on *Zscore* values alone.

5. Conclusion

This study explores the effects of ESG and individual ESG pillar scores on the stability of financial firms in Korea. We use firm-year observations from 2013 to 2022 for listed financial institutions with Refinitiv's ESG scores and analyze a panel regression with two-way fixed effects. We use the difference-GMM technique and the panel Granger-causality test to address concerns about endogeneity and reverse causality. Our results show that ESG activities might enhance the financial stability of financial firms, and the environmental pillar might have the most significant impact on the Korean financial sector.

CRediT authorship contribution statement

Seo Yun Choi: Conceptualization, Investigation, Writing – original draft. **Doojin Ryu:** Conceptualization, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft. **Wonhee You:** Data curation, Formal analysis, Methodology, Software, Visualization, Writing – review & editing.

Declaration of competing interest

-There is no conflict of interest.
-There is no competing interest.
-This paper is not under review by other journals.

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