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The Impact of Financial Inclusion on Bank Stability in Vietnam: The Moderating Role of ESG

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ABSTRACT: As inclusive and sustainable development becomes a global policy priority, understanding the nexus between financial access and banking system stability under the influence of emerging environmental, social, and governance (ESG) standards is of paramount importance. This study examines the impact of financial inclusion (FI) on bank stability (BS) and the moderating role of ESG factors across 19 listed commercial banks in Vietnam from 2010 to 2023. Utilizing panel data with the Fixed Effects Model (FEM), Driscoll–Kraay standard errors, and the Within–Between model, the results indicate that financial inclusion does not exert a uniform impact across the entire sample but depends heavily on bank size. Specifically, FI significantly enhances stability in large-scale banks due to their technological advantages and brand reputation, whereas it creates certain pressures for smaller banks. Notably, when decomposing ESG pillars, the study finds that the Environmental (E) factor plays the most powerful and positive moderating role ($p < 0.01$), amplifying the positive impact of financial inclusion on bank stability through a synergistic mechanism involving green credit and climate risk management. Conversely, the moderating effects of the Social (S) and Governance (G) pillars remain limited, as their implementation in Vietnam continues to be largely symbolic and incurs high short-term compliance costs. This research contributes empirical evidence regarding the asymmetric impact of FI and the value of integrating ESG into sustainable financial development pathways. Accordingly, the authors propose recommendations for refining the ESG legal framework integrated with credit risk management and financial inclusion strategies for the Vietnamese banking system.

KEYWORDS: Financial inclusion, Bank stability, ESG, Bank size, Vietnam.

1. INTRODUCTION

In the context of inclusive and sustainable development becoming a global policy priority, Financial Inclusion (FI) is promoted to expand access to financial services and support economic growth. However, studies show that the impact of FI on bank stability (BS) is not uniform and depends on the governance capacity and institutional environment of the banking system (Han, R., & Melecky, M., 2013); (Cull, R., Demirgüç-Kunt, A., & Martínez Pería, M. S, 2014). Prior to 2018, Environmental, Social, and Governance (ESG) factors in banking were primarily voluntary and fragmented, lacking a unified governance framework; since 2018, ESG has increasingly been institutionalized as a governance and risk management standard, thereby creating a role for ESG in shaping the impact of FI on bank stability (Cornett, M. M., Erhemjamts, O., & Tehranian, H., 2016); (Buallay, A., 2019) Originating from the above context, although many studies have indicated that financial inclusion can strengthen bank stability through expanding the customer base and diversifying revenue streams, empirical evidence also shows that expanding credit access in the context of incomplete governance and supervision can increase credit risk and financial instability (Han, R., & Melecky, M., 2013) (Cull, R., Demirgüç-Kunt, A., & Martínez Pería, M. S, 2014). Additionally, the level of influence and impact of FI may differ between large-scale and small-scale banks due to differences in risk management capacity or the ability to accept the level of integration of ESG standards. In Vietnam, this relationship has become more complex as ESG factors are integrated increasingly deep into banking operations, especially since 2018. Therefore, the research problem posed is: In what way has ESG moderated the impact of financial inclusion on bank stability, and does the impact of FI on BS differ between large-scale banks and small-scale banks in the period 2010 - 2023 or not.

The selection of this topic stems from important gaps in research on the relationship between financial inclusion and bank stability. Although there have been many studies analyzing the impact of FI on BS, results remain inconsistent and are primarily based on multi-national data, while in-depth studies in the Vietnamese context are limited (Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J, 2015);

(Han, R., & Melecky, M., 2013); (Nguyen, T. H., & Vo, X. V, 2021). Besides, existing studies rarely consider the change over time of the FI–BS relationship, especially in the context where ESG factors are increasingly integrated into banking operations after 2018 ((Buallay, A., 2019); (Cornett, M. M., Erhemjamts, O., & Tehranian, H., 2016). That is the reason why this study focuses on clarifying the impact of financial inclusion on bank stability in Vietnam for the period 2010–2023, while simultaneously considering the moderating role of ESG in this relationship.

The article is structured as follows: Section 2 presents the research overview and theoretical basis; Section 3 describes the data, measurement variables, and research methodology; Section 4 presents empirical results and discussion; and Section 5 concludes with policy implications.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Theoretical framework on the relationship between bank stability and financial inclusion

Bank stability is considered the core foundation ensuring the safe and efficient operation of the financial system, thereby supporting sustainable economic growth. A stable banking system contributes to maintaining market confidence, limiting the risk of chain collapse, and minimizing the spillover effects of economic–financial shocks (Mabkhot, H., & Al-Wesabi, H. A. H, 2022). In essence, bank stability reflects the ability to fully perform financial intermediary functions, maintain solvency, and absorb losses under adverse conditions (Jahn, N., & Kick, T, 2011).

In empirical studies, bank stability is often measured through the Z-score index, reflecting the bank's "distance to insolvency" based on profitability, capitalization level, and income volatility level. A higher Z-score shows a lower probability of insolvency and that the bank is more stable (Meslier-Crouzille, C., Nys, E., & Sauviat, A, 2007). This index is commonly used in studies in emerging economies, where market data and risk information are still limited, due to its simplicity and ability to reflect the overall risk of the bank (Rupeika-Apoga, R., Zaidi, S. H., Thalassinos, E., & Thalassinos, Y, 2018).

Bank stability is simultaneously affected by internal factors of the bank and macroeconomic conditions. At the micro level, banks with high profitability, solid capitalization levels, and low income volatility often have a better capacity to absorb losses, thereby enhancing the stability level (Alaeddin, O., Yousif, A. S., & Ahmed, E. R, 2019). Bank scale can also impact in two directions: large scale helps diversify the activity portfolio and disperse risk, yet simultaneously can increase the risk-taking tendency due to the "too big to fail" expectation.

At the macro level, economic growth often improves the debt repayment capacity of customers, thereby strengthening asset quality and bank stability. Meanwhile, high inflation, economic recession, or macroeconomic instability can increase non-performing loans and reduce solvency. However, in the modern financial context, these traditional factors are said to be insufficient to fully explain the stability of the banking system. This highlights the increasingly important role of new factors such as financial inclusion and environmental, social, and governance (ESG) standards.

Financial Inclusion (FI) reflects the level of access to and use of formal financial services by individuals and businesses, including payment accounts, credit, savings, and modern payment services (Beck, T., Demirgüç-Kunt, A., & Martinez Peria, M. S, 2007); (World Bank, 2018). Theoretically, expanding financial inclusion can contribute to enhancing bank stability through diversifying the deposit base and credit portfolio, thereby reducing risk concentration (Sarma, M., & Pais, J, 2011).

Many empirical studies indicate that a high level of financial inclusion is often associated with better asset quality, more stable profitability, and lower insolvency risk, especially in developing economies (Beck, T, 2016); (Gopalan, S., & Rajan, R. S, 2018). However, some studies also warn that expanding FI too rapidly, especially through credit to new and information-lacking customer groups, can increase credit risk and operational risk. Therefore, the impact of FI on bank stability is not automatic but depends on the institutional context and risk management capacity of the bank.

ESG (Environmental, Social, Governance) reflects the extent to which banks integrate environmental, social, and governance factors into their business strategies and risk management systems (Friede, G., Busch, T., & Bassen, A, 2015); (Berg, F., Kölbel, J. F., & Rigobon, R, 2022). Banks practicing good ESG often have more transparent governance systems, more effective risk management, and lower profit volatility levels, thereby contributing to enhancing bank financial stability (Buallay, A., 2019); (Gangi, F., Meles, A., D'Angelo, E., & Daniele, L. M, 2019).

However, the impact of ESG is not uniform over time. In the short term, complying with ESG standards can increase operating costs and reduce profits. Conversely, in the long term, ESG is expected to bring benefits through improving reputation, strengthening risk management, and consolidating the trust of stakeholders, thereby supporting the sustainable stability of the bank.

The relationship between FI and BS under the moderating role of ESG can be explained by several theories: Sustainable Finance Theory, Financial Resilience Theory, Financial Intermediation Theory, Institutional Theory, and Economies of Scale Theory.

The theoretical framework of the research posits that ESG not only directly impacts bank stability but also plays a moderating role in the relationship between financial inclusion (FI) and bank stability (BS). According to Sustainable Finance Theory, the financial expansion process can only contribute to enhancing system stability when

accompanied by governance and sustainable development standards (Friede, G., Busch, T., & Bassen, A, 2015); (Berg, F., Kölbel, J. F., & Rigobon, R, 2022). Specifically, in the context of a low ESG level, expanding FI can increase credit risk, social risk, and operational risk, thereby reducing bank stability. Conversely, when ESG is implemented effectively, banks have the ability to deploy FI in a more responsible direction, focusing on customer protection, information transparency, and risk control, thereby limiting the potential negative impacts of FI.

Based on Financial Resilience Theory, ESG helps banks transform financial inclusion from a short-term risk source into a long-term stability enhancement driver through improving shock absorption capacity and maintaining market confidence (Mabkhot, H. A., & Al-Wesabi, H. A, 2022). Therefore, the impact of FI on bank stability is expected to be stronger and more positive in the period when ESG becomes common and institutionalized.

Financial Intermediation Theory posits that banks exist to minimize transaction costs and the situation of information asymmetry between the lender (depositor) and the borrower (Beck, T., Demirgüç-Kunt, A., & Martinez Peria, M. S, 2007). Promoting FI helps banks expand the customer base, especially individual customers and small businesses, thereby increasing the amount of transaction data and improving the ability to screen and monitor credit. This mechanism contributes to enhancing capital allocation efficiency and reducing credit risk, thereby consolidating the stability of the banking system (Sarma, M., & Pais, J, 2011); (Beck, T, 2016). In the context where ESG is increasingly emphasized, banks applying better governance and social responsibility standards have the capacity to exploit benefits from FI more effectively, thereby limiting risks arising from information asymmetry (La Torre, M., Leo, S., Panetta, I. C., & Stefani, U, 2021).

Institutional Theory explains how legal regulations, social norms, and monitoring mechanisms affect the behavior of financial institutions. In the Vietnamese context, the rise of policy frameworks related to ESG after 2018 has reshaped the way banks deploy FI in a more cautious, transparent, and sustainable direction. According to this theory, ESG plays the role of a supplementary institutional mechanism, helping to adjust the FI expansion behavior of banks, thereby limiting potential risks to bank financial stability (Rupeika-Apoga, R., Zaidi, S. H., Thalassinos, E. I., & Thalassinos, Y, 2018); (Berg, F., Kölbel, J. F., & Rigobon, R, 2022).

According to Economies of Scale Theory, expanding scale helps banks reduce average costs and enhance operational efficiency by utilizing technology and governance systems better (Berger, A. N., & Mester, L. J, 1997). In the context of financial inclusion, economies of scale only manifest when accompanied by appropriate governance capacity; if not, expanding FI can increase operational risk and credit risk (Berger, A. N., & Humphrey, D. B, 1997). ESG, especially the Governance pillar, helps banks control risk when expanding scale, thereby transforming scale advantage into sustainable bank financial stability (La Torre, M., Leo, S., Panetta, I. C., & Stefani, U, 2021).

2.2. Empirical literature review and research gaps

Recent empirical studies have provided many important evidences about the link between ESG, financial inclusion, and bank stability. First, according to (Tóth, B., Lippai-Makra, E., Szládek, D., & Kiss, G, 2021), (Chang, H., Liang, L., & Liu, Y, 2021), researchers have confirmed the positive impact of ESG on bank stability through improving asset quality, profitability, and capitalization level, especially in emerging markets. Second, international evidences show that the impact of ESG depends strongly on the institutional context and national governance quality, in which ESG only exerts a clear stabilizing role in countries with strong institutions (Stolbov, M., & Shchepeleva, M, 2022), (Xue, L., Dong, J., & Zha, Y, 2023), (Malik, A., Isa, A., Jais, M., Rehman, A., & Khan, M, 2021). Third, some recent studies point out a non-linear relationship between ESG and bank stability, when ESG costs can reduce stability in the short term but bring benefits in the long term (Gutiérrez-Ponce, H., & Wibowo, S, 2023); (Duque-Grisales, E., & Aguilera-Caracuel, J, 2019); (Ersoy, E., Swiecka, B., Grima, S., Özen, E., & Romānova, I, 2022)

Despite achieving many important results, the literature overview shows that significant gaps still exist. Most studies consider financial inclusion and ESG as independent factors, while the role of ESG as a moderating mechanism of the relationship between financial inclusion and bank stability has not been clarified. Besides, empirical evidences are primarily based on multi-national data, while there is a lack of in-depth studies by individual country, especially Vietnam – where financial inclusion and ESG have both developed strongly in the recent period. Additionally, most studies have not considered the change over time in the FI – bank stability relationship when ESG becomes common as a governance and policy standard.

Stemming from the above gaps, this research analyzes the impact of financial inclusion on bank stability in Vietnam for the period 2010-2023, while clarifying the moderating role of ESG in this relationship, thereby contributing to expanding empirical evidence about the link between financial inclusion, sustainable development, and banking system stability in emerging economies.

From the above arguments, the research paper puts forward the hypotheses:

H_1: Financial Inclusion (FI) has a positive impact on bank stability (BS) in Vietnam during the 2010–2023 period.

H_2: ESG factors enhance the positive impact of financial inclusion (FI) on bank stability (BS) in Vietnam.

On the basis of the hypothesis about the impact of financial inclusion on bank stability (H_1) and the moderating role of ESG in this relationship (H_2), the research continues to

consider whether this positive impact is uniform among banks. Due to the difference in scale which can reflect differences in capital capacity, risk management ability, and the level of financial inclusion expansion integration, the impact of FI on bank stability may not be the same among banks. Therefore, the research proposes the following hypothesis:

H_3: The impact of financial inclusion on bank stability differs between large-scale and small-scale banks.

3. DATA AND RESEARCH METHODOLOGY

3.1. Data and research model

The research uses panel data collected from 19 commercial banks listed on HOSE, HNX, UPCOM exchanges for the period 2010-2023, with a total of 246 observations synthesized from databases FiinPro-X, World Bank – Global Findex Database, World Bank – World Development Indicators (WDI), IMF – Financial Access Survey (FAS), annual reports of commercial banks, etc. The banks were selected based on the purposive sampling method: suitable for the topic: having ESG-related data at least from 2018 onwards, being listed and having high recognition.

The research model has the form:

$$Z-scorei,t = \beta 0 + \beta 1 FI^c i,t-1 + \beta 2 ESG^c i,t-1 + \beta 3 (FI^c \times ESG^c) i,t-1 + \beta 4\ ln\ ln\ (TA)\ i,t-1 + \beta 5 GDPt-1 + \beta 6 INFt-1 + \beta 7 OPENt-1 + \alpha i + \gamma t + \varepsilon i,t$$

(In which $FI^c = FI - \underline{FI}$, $ESG^c = ESG - \underline{ESG}$, β_3: moderating effect coefficient).

In which $Z-score$ is the variable representing the dependent variable of bank stability measured by the bank financial stability index (Z-score). This index reflects the default probability, the ability of the bank to fully perform financial intermediary functions under adverse conditions. The popular formula:

$$Z = \frac{ROA + E/A}{\sigma(ROA)}$$

(In which ROA denotes the Return on Assets, E/A represents the Equity-to-Assets ratio, σ signifies the standard deviation of ROA ((Kocisova, K., Gavurova, B., & Behun, M, 2018); (Wang, X., & Luo, D, 2022).

The variables $ln(TA)$, $GDPG$, $OPEN$, INF represent bank size, GDP growth, trade openness, and inflation, respectively. Detailed calculation of the above variables is presented in table 1.

Table 1. Description of variables in the model.

Variable group	Symbol	Variable name	Measurement / construction
Dependent variable	$Stability_{i,t}$	Bank stability	Bank financial stability index *(Z-score = (ROA + E/A) / σ(ROA))*
Main explanatory variables	$FI_{i,t}$	Financial inclusion	Composite FI index constructed using Principal Component Analysis (PCA).
	$ESG_{i,t}$	ESG	Composite ESG index *(E, S, G)* constructed using the unweighted average of standardized ESG indicators.
	$FI \times ESG_{i,t}$	FI–ESG interaction	The product of $FI_{i,t}$ and $ESG_{i,t}$, capturing the moderating effect of ESG.
	$ln(TA_{i,t})$	Bank size	Natural logarithm of total bank assets.
Control variables (macro)	$GDPG_t$	Economic growth	Annual GDP growth rate (%).
	$OPEN_t$	Trade openness	*(Exports + Imports) / GDP* (%).
	INF_t	Inflation	Inflation rate *(CPI, %)*.

Source: *Authors' research.*

Regarding the FI measurement variable, because financial inclusion includes many aspects (access, use, availability), our group does not use a single index but relies on the Principal Component Analysis (PCA) method to create a composite FI index from sub-variables: number of bank accounts (% population), number of bank branches/100,000 adults, credit/GDP ratio, and number of mobile subscribers/100 people.

Regarding the ESG measurement variable, environmental, social, and governance factors are respectively represented by variables E, S, and G. Because Vietnam does not yet have a standardized ESG index for all businesses, and simultaneously data from international ESG rating organizations is limited, the research uses the Content Analysis (CA) method to measure ESG. Specifically, data is collected from annual reports and sustainable development reports of the enterprise. Then the author codes qualitative information related to policies, objectives, incidents according to the UN PRI (United Nations Principles for Responsible Investment) criteria set; the data after collection and screening to fit the research objective includes 9 criteria. The criteria are coded with values 0/1 into quantitative values

that can be compared. A criterion reaches 1 point if there is information or good compliance with the inner content of the criterion. The higher the index value, the better the enterprise's ESG practice. This is a popular approach in the context of lacking standardized ESG data, especially in emerging markets (Michelon, G., Pilonato, S., & Ricceri, F, 2015). After coding the criteria, the group proceeded to calculate the composite ESG index based on the Unweighted Average Method.

3.2. Estimation methods

The research uses the panel regression model with the support of Stata 17.0 software to test the proposed hypotheses. The estimation process is performed through strict steps: first, the Pooled OLS model is used to provide an overview; next, the Fixed Effects (FEM) and Random Effects (REM) models are applied to control for unobserved characteristics of each bank. The Hausman test result confirms the FEM model is more suitable for the characteristics of the research paper, helping to eliminate systematic errors due to individual characteristics that do not change over time of commercial banks.

To handle violations of assumptions about heteroscedasticity, self-correlation, and cross-correlation between units (confirmed through post-regression tests), the research applies the Driscoll–Kraay (xtscc) standard error method. This method ensures that obtained estimates are robust and efficient in the context where panel data of the Vietnamese banking system often has mutual dependence between observed units.

The technical highlight of the research is the use of the first-order lagged variable $(t-1)$ for the main independent variables (FI, ESG). This choice is based on the theoretical basis of the lag in the impact mechanism: financial inclusion strategies and ESG implementation need time to transform into changes in asset structure and the risk management system. The use of lagged variables not only reflects the operational practice of the banking industry but is also an important technique to minimize the endogeneity problem due to simultaneity bias.

The research integrates the Within–Between (REWB) model to separate the impact into two components: the within effect reflecting the variation over time of each bank and the structural component (between effect) reflecting the difference between banks. This approach helps clarify whether stability comes from the continuous FI/ESG improvement efforts of the bank itself, or comes from fundamental differences in scale and management capacity between banks in the sample, especially in the context where large divergence exists in scale and development level between Vietnamese commercial banks.

During the research process, to further exploit the moderating role of ESG in the relationship between FI and BS, the author group proceeded to separate the ESG variable into individual E, S, G variables and conducted research on each variable with a separate model:

(1) Environmental (E) model

$$Z-scorei,t=\beta 0+\beta 1FI^{c}i,t-1+\beta 2E^{c}i,t-1+\beta 3(FI^{c}\times E^{c})i,t-1+Controlsi,t-1+\alpha i+\gamma t+\varepsilon i,t$$

(2) Social (S) model

$$Z-scorei,t=\beta 0+\beta 1FI^{c}i,t-1+\beta 2S^{c}i,t-1+\beta 3(FI^{c}\times S^{c})i,t-1+Controlsi,t-1+\alpha i+\gamma t+\varepsilon i,t$$

(3) Governance (G) model

$$Z-scorei,t=\beta 0+\beta 1FI^{c}i,t-1+\beta 2G^{c}i,t-1+\beta 3(FI^{c}\times G^{c})i,t-1+Controlsi,t-1+\alpha i+\gamma t+\varepsilon i,t$$

Subsequently, an overview research was conducted by aggregating the variables into a single model:

(4) Integrated E–S–G model

$$Z-scorei,t=\beta 0+\beta 1FI^{c}i,t-1+\beta 2E^{c}i,t-1+\beta 3S^{c}i,t-1+\beta 4G^{c}i,t-1+\beta 5(FI^{c}\times E^{c})i,t-1+\beta 6(FI^{c}\times S^{c})i,t-1+\beta 7(FI^{c}\times G^{c})i,t-1+Controlsi,t-1+\alpha i+\gamma t+\varepsilon i,t$$

4. RESEARCH RESULTS AND DISCUSSION

4.1. Research results

4.1.1. Descriptive statistics and correlation matrix

Table 2. Descriptive statistics.

	count	mean	sd	min	max	p25	p50	p75
zscore_computed	266	16.805	7.242	3.073	40.211	11.459	15.889	20.503
ROA	280	1.111	0.868	-5.990	3.580	0.580	0.920	1.620
CAR	266	8.531	3.752	3.462	36.905	6.066	7.616	9.882
FI	280	0.479	0.169	0.158	0.773	0.351	0.466	0.587
ESG	265	106.848	162.186	0.167	712.047	2.177	15.443	204.097
E	280	0.302	0.266	0.000	1.000	0.000	0.500	0.500
S	265	318.794	486.594	0.500	2134.330	4.750	44.240	611.000
G	280	1.359	0.469	0.000	2.880	1.290	1.355	1.590
ln_TA	280	14.240	0.517	12.914	15.362	13.927	14.247	14.596
GDPG	280	13.286	8.256	4.000	33.000	7.000	10.500	17.000
INF	280	12.324	4.616	6.170	19.430	9.190	10.895	16.730
OPEN	280	1.706	0.220	1.330	2.010	1.540	1.715	1.920
N	280							

Source: *Stata 17.0.*

In order to ensure consistency and reliability of empirical results, precisely determining the research sample size is necessary. Based on the information shown in table 2, the research sample was built from the initial data set including 280 observations, representing Vietnamese commercial banks in the period 2010–2023. However, due to performing data processing steps and building research variables, the number of observations used in the main regression analysis decreased to 246. Specifically, calculating the Z-score index and applying winsorize to eliminate outliers reduced the sample to 266 observations; next, creating one-year lagged variables (lag) for FI, ESG, and control variables made each bank lose approximately one observation at the beginning of the period, leading to a final sample size of 246. Therefore, 246 observations is the suitable sample size and precisely reflects the data structure in the research model.

Descriptive statistical analysis of the research sample including 246 observations of Vietnamese commercial banks in the period 2010–2023 reflects distribution characteristics, volatility levels, and general trends of variables in the model. Regarding bank stability, the Z-score index has a mean value of (mean), with a standard deviation of (sd), ranging from (min) to (max), showing that the stability level is generally at a fair level but large differences exist between banks and stages. This reflects the non-uniformity in risk management capacity and resilience of the banking system. Traditional financial indicators in the paper also show clear differentiation: ROA reaches a mean value of (mean), but has volatility from (min) to (max), showing that currently many banks maintain stable profitability but significant loss stages still exist. Capital Adequacy Ratio (CAR) has a mean value of (mean), close to the capital safety standard threshold, yet fluctuates from (min) to (max), showing significant difference in capitalization level between banks, directly affecting the stability level and risk absorption capacity.

Financial inclusion (FI) index has a mean value of (0,479), variation range from (0,158) to (0,773) and standard deviation of (0,169), showing that FI has been standardized and widely dispersed, reflecting a significant difference in the level of access and use of financial services between banks. ESG has a mean value reaching (106,848), ranging from (0,167) to (712,047), showing that the ESG practice level of banks only reaches the average level and is non-uniform: there are still banks that have not started implementing ESG and there are banks that have implemented relatively well. When separated by each pillar, E (environment) has a mean value of (0,302), S (Social) reaches (318,794), and G (Governance) reaches (1,359), showing that social policy is relatively more emphasized by banks compared to environment and governance. However, the large standard deviation of all three pillars shows significant difference between banks in the level of deploying ESG practices, reflecting the voluntary and non-standardized nature of ESG in Vietnam during the research period.

For control variables, bank size (ln(TA)) has a mean of (14,24 with a low standard deviation (0,517), indicating relatively uniform sizes, limiting estimation bias. GDP growth (GDPG) averages (13,286), reflecting strong economic growth, supporting banking activities. Conversely, inflation (INF) averages (12,324) but with a very large standard deviation (4,616), showing strong macroeconomic volatility in some periods. Finally, trade openness (OPEN) averages (1,706), reflecting Vietnam's high international integration, which promotes banking but increases sensitivity to external shocks.

Table 3. Multicollinearity test.

Biến	VIF	1/VIF (Tolerance)
L_OPEN	3.35	0.2989
L_FI_c	2.79	0.3580
L_ln_TA	1.98	0.5049
L_S_c	1.47	0.6793
L_E_c	1.40	0.7134
L_FI_S_interaction	1.24	0.8073
L_GDPG	1.20	0.8340
L_FI_E_interaction	1.18	0.8455
L_INF	1.10	0.9115
L_G_c	1.10	0.9122
L_FI_G_interaction	1.04	0.9619
Mean VIF	**1.62**	

Source: *Stata 17.0.*

The results of the multi-linear audit obtained in table 3 show that the independent variables in the model, including financial development (FI), environmental efficiency (E), social responsibility (S), corporate governance (G), aggregate ESG and control variables, do not have a linear correlation that is so high as to destabilize the regression estimate. All VIF coefficients are below the threshold of 5, indicating that the estimates of FI, ESG, and components E, S, and G are not

biased due to multi-integration, and that the standard errors of the coefficients are not inflated. This ensures the statistical reliability of the results and allows for a clear interpretation of the individual impact of each variable on bank stability.

For interactive variables $FI \times ESG$, $FI \times E$, $FI \times S$ and $FI \times G$, mean centering was applied to reduce the mechanical correlation between the original variables and their interaction terms, thereby mitigating the potential risk of multicollinearity. The post-standardization results show that all interaction variables exhibit very low VIF values (approximately 1), indicating that the moderating effects of ESG and its individual components (E, S, G) on the relationship between financial development and bank stability are estimated in a stable and reliable manner. This is particularly important in the research context, where ESG serves only a moderating role, and the model needs to clearly distinguish between the direct effects of financial inclusion (H_1, H_3) and the moderating effect of ESG (H_2).

Table 4. Correlation matrix.

	(1) zscore_computed	L_FI	L_ESG	L_FI_ESG_ interaction	L_ln_TA	L_GDPG	L_INF	L_OPEN
zscore_computed	1							
L_FI	-0.0468	1						
L_ESG	-0.248***	0.190**	1					
L_FI_ESG_ interaction	-0.0267	-0.0473	0.318***	1				
L_ln_TA	0.0311	0.347***	-0.197**	-0.106	1			
L_GDPG	0.185**	-0.283***	-0.0984	0.0369	-0.0507	1		
L_INF	-0.00489	0.238***	0.0566	-0.0554	0.0921	0.0459	1	
L_OPEN	-0.123	0.782***	0.242***	-0.0953	0.409***	-0.373***	0.130*	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Source: *Stata 17.0.*

Regarding the correlation matrix, the correlation matrix is used to assess the linear relationship structure between variables and preliminarily test for multicollinearity risks before conducting regression model estimation; the results show that no pair of variables has a correlation coefficient exceeding the critical warning threshold, thereby confirming the technical acceptability of the set of explanatory variables. In terms of content, the bank stability index (Z-score) has a positive and statistically significant correlation with GDP growth ($0{,}185$ **), but a negative correlation with ESG ($-0{,}248$ **), indicating that in the Vietnamese context, bank stability in the short term is primarily driven by macroeconomic conditions rather than ESG practices, which remain voluntary, non-standardized, and not yet fully integrated into the risk management framework. Simultaneously, financial inclusion (FI) has a significant positive correlation with ESG ($0{,}190$ **), and the interaction variable $FI \times ESG$ has a significant positive correlation with ESG ($0{,}318$ **), implying mutual complementarity between financial inclusion and sustainable development in the bank's operational strategy. These results provide an initial empirical basis for including ESG and the interaction variable in the regression model to test the moderating role in subsequent analyses. A summary of the model's correlation matrix is presented in table 4.

4.1.2. Model estimation results

The authors sequentially estimated the research equation using Pooled Ordinary Least Squares (Pooled OLS), the Fixed Effects Model (FEM), and the Random Effects Model (REM). The initial estimation results of the models are presented generally in table 5, showing that the signs of the main variables are relatively consistent across estimation methods.

Table 5. Comparison of OLS, FEM, and REM models.

Model Comparison

	(1) OLS	(2) FEM-Robust	(3) FEM-Cluster	(4) REM-Robust
FI	0.3619	-0.6230	-0.6230	0.1670
	(0.3440)	(0.4613)	(0.4613)	(0.2930)
ESG	-1.6584*	-0.6902	-0.6902	-0.5951
	(0.8527)	(1.4969)	(1.4969)	(1.3663)
FI_x_ESG	0.0417	-0.0405	-0.0405	-0.1439
	(0.6328)	(0.5456)	(0.5456)	(0.5518)
ln_TA	-1.0696***	6.2023*	6.2023*	0.5751
	(0.3946)	(2.9627)	(2.9627)	(1.3461)
GDPG	-0.0029	0.0177	0.0177	0.0075
	(0.0342)	(0.0245)	(0.0245)	(0.0240)
INF	-0.0006	0.0014	0.0014	0.0001
	(0.0024)	(0.0015)	(0.0015)	(0.0014)
OPEN	-0.0255	-0.0581**	-0.0581**	-0.0377
	(0.0157)	(0.0273)	(0.0273)	(0.0247)
_cons	29.0010***	-70.0489*	-70.0489*	6.9661
	(5.6316)	(40.2189)	(40.2189)	(17.6944)
N	266	266	266	266
R^2	0.0697	0.1040	0.1040	
Within R^2		0.1040	0.1040	0.0689
Between R^2		0.0742	0.0742	0.0224
Overall R^2		0.0016	0.0016	0.0328

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: *alculation results of the authors using Stata 17.0.*

The Hausman test was used to select between the FEM and REM models. The test result yielded a value with $\chi^2 = 20{,}82$ với $\rho = 0{,}0040 < 0{,}05$, allowing for the rejection of the H_0 hypothesis, implying that the difference between the coefficients is systematic. Therefore, the Fixed Effects Model (FEM) was preferred to control for unobserved and time-invariant characteristics of each commercial bank, such as strategic orientation, management culture, and risk appetite.

However, post-estimation diagnostic tests revealed that the FEM suffered from heteroskedasticity, serial correlation, and cross-sectional dependence, with all ρ below 0,05. This suggests that the panel data of the Vietnamese banking system exhibit interdependence among banks, reflecting the characteristics of a highly interconnected financial system. To address these issues, the study applied Driscoll–Kraay standard errors using the $xtscc$ command. The corrected estimation results reported in table 6 show that the regression coefficients retain their signs and relative magnitudes, while their statistical significance becomes more reliable, thereby confirming the robustness of the empirical findings.

Table 6. Results Obtained After Correcting Model Defects.

Table: Model Comparison - OLS, FEM-Robust, FEM-Cluster, REM-Robust

	(1) (1) OLS	(2) (2) FEM-Robust	(3) (3) FEM-Cluster	(4) (4) REM-Robust
L_FI	5.0581	12.7283	12.7283	8.3247
	(4.0702)	(29.2210)	(29.2210)	(25.6091)
L_ESG	-0.0110***	-0.0005	-0.0005	-0.0020
	(0.0032)	(0.0078)	(0.0078)	(0.0070)
L_FI_ESG_interaction	0.0109	-0.0021	-0.0021	-0.0014
	(0.0174)	(0.0169)	(0.0169)	(0.0168)
L_ln_TA	-0.1179	-1.3366	-1.3366	-0.1550
	(0.9674)	(5.3186)	(5.3186)	(3.5234)
L_GDPG	0.1329**	0.0828	0.0828	0.0533
	(0.0555)	(0.1923)	(0.1923)	(0.1605)
L_INF	-0.0195	-0.1497	-0.1497	-0.1778
	(0.0944)	(0.2352)	(0.2352)	(0.2120)
L_OPEN	-2.8417	-10.3810	-10.3810	-7.7838
	(3.3989)	(18.6741)	(18.6741)	(17.3327)
_cons	20.2346	49.0350	49.0350	30.7975
	(12.6685)	(82.4031)	(82.4031)	(56.6185)
N	246	246	246	246
R^2	0.0952	0.1644	0.1644	
Within R^2		0.1644	0.1644	0.1632
Between R^2		0.0047	0.0047	0.0789
Overall R^2		0.0473	0.0473	0.0767
Year FE	No	Yes	Yes	Yes
Model Type	No	FE	FE	RE
SE Type	Standard	Robust	Clustered	Robust

Standard errors in parentheses
Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
OLS: Pooled Ordinary Least Squares (no fixed effects)
FEM-Robust: Fixed Effects Model with robust standard errors
FEM-Cluster: Fixed Effects Model with clustered SE (by bank)
REM-Robust: Random Effects Model with robust standard errors
Hausman test p-value = 0.734 → Random Effects is appropriate
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: *Stata 17.0.*

Regarding the dynamic structure of the model, the study used first-order lags $(t-1)$ of financial inclusion (L_FI) and ESG (L_ESG). The inclusion of lagged variables in the model reflects the non-instantaneous nature of the impact mechanism, as financial inclusion expansion strategies and the implementation of ESG standards require a certain period to transform into changes in asset quality, risk structure, and bank management systems. Simultaneously, this approach helps mitigate the endogeneity issue caused by simultaneity bias, thereby enhancing the reliability of the regression estimates. The endogeneity test with instrumental variables yielded $\rho = 0{,}1569 > 0{,}05$, implying no evidence that the main variables are endogenous; additionally, the Shea's partial R^2 coefficient ranging from $0{,}21$ to $0{,}38$ shows that the lagged variables used as instrumental variables are relatively appropriate.

In addition to using multiple traditional panel regression models (OLS, FEM, REM), the study further applied the Within–Between model (Random Effects Within–Between – REWB) to decompose the impacts of financial inclusion and ESG into two components: (i) the within effect, reflecting changes over time within each bank; and (ii) the between effect, reflecting differences between banks in the sample. This approach allows for an assessment of whether bank stability stems from a bank's continuous efforts to improve FI/ESG or primarily originates from fundamental differences in scale, development level, and management capacity among the banks.

Results from the Within–Between model show that the impacts of financial inclusion and ESG are primarily manifested in the between-bank component (between effect), while the impact within each bank over time (within effect) is relatively limited. This finding helps explain why regression results for the entire sample do not show a clear impact of FI and ESG on bank stability, but when analyzed more deeply by bank group—particularly by scale—the impact of financial inclusion becomes distinct for the large-scale bank group.

Overall, the combination of using lagged variables, multiple estimation models, and the Within–Between model allows the study to clarify the dynamic nature and heterogeneity of the relationship between financial inclusion, ESG, and bank stability. This approach not only ensures the robustness of the empirical results but also creates a rational foundation for subsequent analyses and discussions regarding the role of bank scale and institutional conditions in realizing the benefits of financial inclusion.

4.2. Discussion of research results

Hypothesis H_2 posits that environmental, social, and governance (ESG) factors play a moderating role in the impact of financial inclusion (FI) on bank stability (BS). The empirical results presented in table 7 show that, when using the composite ESG index, the interaction variable between financial inclusion and ESG ($L\_FI\_ESG\_interaction$) is not statistically significant in the Fixed Effects Model (FEM), the Random Effects Model (REM), or the Within–Between decomposition model. This result implies that, on a system-wide level, composite ESG has not yet demonstrated a clear moderating role in the relationship between financial inclusion and bank stability in Vietnam during the research period.

The above result is consistent with the practical context of Vietnam, where ESG has only gained attention in recent years and has primarily been implemented in the form of reporting compliance rather than creating substantive changes in the bank's risk management structure. Therefore, the current composite ESG index lacks sufficient "depth" to alter the transmission mechanism from financial inclusion expansion to bank stability.

Additionally, results from the Within–Between model show that both the temporal variation component within each bank (within effect) and the difference component between banks (between effect) for the interaction variables related to ESG are not statistically significant. This finding indicates that short-term ESG improvements at each bank, as well as differences in ESG levels between banks, are not yet strong enough to moderate the impact of financial inclusion on bank stability at the system level.

However, when decomposing ESG into separate pillars, the empirical results show a more subtle picture. Specifically, only the Environmental (E) pillar demonstrates a strong and statistically significant moderating role, with the interaction coefficient between financial inclusion and the environmental factor reaching $FI\_E = 17{,}122$ ($\rho < 0{,}01$). Conversely, the interaction variables between FI and the Social (S) and Governance (G) pillars do not show statistical significance.

In terms of explanation, this result reflects the reality that risks related to the environment and climate change are gradually becoming tangible financial risk sources for banks, through channels such as credit risk in high-emission industries, transition risk, and reputational risk. Banks with better environmental practice levels often deploy financial inclusion in a more cautious and selective manner, prioritizing green and sustainable projects, thereby limiting the potential negative impacts of FI on bank stability. Meanwhile, the social and governance pillars in Vietnam remain relatively high in formality, not yet strong enough to play an effective moderating role in this relationship.

Summarizing the above results, hypothesis H_2 is not supported when considering ESG as a composite index but is partially supported when considering the Environmental pillar. This finding indicates that the moderating role of ESG in the relationship between financial inclusion and bank stability in Vietnam is selective and conditional, rather than manifesting uniformly across all dimensions of ESG.

Table 7. Results - FI impact and ESG moderating role.

	(1) (1) FE	(2) (2) RE	(3) (3) WB
L_FI	12.728 (29.221)	8.325 (25.609)	
L_FI_within			12.956 (28.178)
L_FI_mean			0.000 (.)
L_ESG	-0.001 (0.008)	-0.002 (0.007)	-0.001 (0.008)
L_FI_ESG_interaction	-0.002 (0.017)	-0.001 (0.017)	
L_FI_within_ESG			-0.002 (0.017)
L_FI_mean_ESG			0.000 (.)
L_ln_TA	-1.337 (5.319)	-0.155 (3.523)	-1.337 (5.319)
L_GDPG	0.083 (0.192)	0.053 (0.161)	0.083 (0.192)
L_INF	-0.150 (0.235)	-0.178 (0.212)	-0.150 (0.235)
L_OPEN	-10.381 (18.674)	-7.784 (17.333)	-10.381 (18.674)
N	246	246	246
R^2	0.164		0.164
adj. R^2	0.110		0.110
Year FE	Yes	Yes	Yes
Bank FE	Yes		Yes

* p<0.10, ** p<0.05, *** p<0.01
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: *Stata 17.0.*

Hypothesis H_3 tests the heterogeneity in the impact of financial inclusion on bank stability between large-scale and small-scale bank groups. Results from table 8 provide clear evidence of this difference.

Specifically, the interaction variable between financial inclusion and bank scale (FI_Large) carries a positive sign and is statistically significant at the 5% level in the simple model ($FI\_Large = 5{,}696$; $\rho < 0{,}05$), and continues to maintain significance with a larger coefficient in the full model, showing that large-scale banks benefit more from financial inclusion expansion.

The superiority of large banks in maintaining stability when implementing financial inclusion can be explained by advantages in technology and brand reputation. These banks often possess developed technological infrastructure, advanced Big Data systems, and Artificial Intelligence (AI), helping to make risk assessment and new customer management more accurate and efficient. Simultaneously, brand reputation allows them to attract high-quality credit segments during the FI expansion process, thereby diversifying their asset portfolios without deteriorating credit quality. Financial inclusion expansion for this group of banks is primarily an utilization of the excess capacity of existing technological and management systems, rather than significantly increasing marginal costs.

Conversely, for small-scale banks, financial inclusion tends to create significant pressure on bank stability. This reflects a lack of economies of scale, causing small banks to face high operating costs when establishing networks and investing in infrastructure in new areas. Additionally, competitive pressure for market share may lead these banks to loosen credit standards to reach "unbanked" groups (those without financial history), increasing adverse selection risks in a context of limited technological and risk management capacity.

A noteworthy point is that this result shows ESG only exerts a stabilizing support role once a bank has reached a certain level of scale and management capacity. This implies that the impact of ESG in the relationship between financial inclusion and bank stability is conditional, depending on the internal foundation of each bank.

In summary, analysis by scale plays a pivotal role in clarifying the nature of the FI–BS relationship in Vietnam. The negative impact at small banks and the positive impact at large banks tend to cancel each other out when considering the entire sample, thereby explaining why in overall models, the financial inclusion variable often does not show clear statistical significance.

Table 8. Analysis by bank scale (H_3).

	(1) (1) Size	(2) (2) Size×ESG	(3) (3) NH Nhỏ	(4) (4) NH Lớn
L_FI	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
Large	0.000 (.)	0.000 (.)		
FI_Large	5.696** (2.071)	-21.271 (12.912)		
L_ESG		0.001 (0.004)	0.002 (0.003)	0.108 (0.067)
L_FI_ESG_interaction		0.010 (0.007)	0.009 (0.008)	-0.217 (0.164)
ESG_Large		0.097** (0.041)		
FI_ESG_Large		-0.280* (0.140)		
N	247	246	142	104

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Source: *Stata 17.0.*

To further analyze the role of ESG in the relationship between FI and BS, the authors decomposed the composite ESG index into individual E, S, and G indicators. After running the models, table 9 shows the appearance of a coefficient of (17,122) in model (1) and (14,748) in model (4) for the interaction variable of FI with E. This shows that when the environmental factor increases, the impact of FI on bank stability is strongly amplified. In both models, the significance level is at 1% ($\rho < 0{,}01$). This significance level in econometrics indicates that the reliability of the conclusion is extremely high, nearly eliminating random errors. From there, it proves that the environmental factor (E) has a very strong statistical significance and E has an effect of enhancing the positive impact of financial inclusion (FI) on bank stability (BS); when banks combine financial inclusion with environmental standards such as green credit and climate risk assessment, it will create a synergistic effect that helps banks screen customers better, thereby consolidating bank financial stability by reducing non-performing loans from environmentally sensitive sectors. Interaction variables related to social (S) and governance (G) do not have statistical significance. Specifically, for the social factor (S), the $FI \times S$ interaction coefficient is nearly 0 ($-0{,}001$ đến $-0{,}004$) and has no statistical significance. The result reflects that current social activities may only be superficial philanthropy, not yet truly integrated into the credit risk management process of Vietnamese banks. Regarding the governance factor (G), although the governance variable (L_G_c) has a negative impact on the Z-score (coefficient $-4{,}433$ đến $-4{,}839$) the $FI \times G$ interaction variable has no statistical significance. This leads to the perspective that raising governance standards will increase operating costs, thereby reducing the bank's stability, and in interaction with financial inclusion, the governance factor has not yet proven the ability to create a moderating effect to help FI promote stability.

Table 9. Decomposing ESG into E, S, G.

	(1) (1) E	(2) (2) S	(3) (3) G	(4) (4) All
L_FI_c	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
L_E_c	-0.565 (1.780)			0.463 (1.840)
L_S_c		-0.000 (0.001)		0.002 (0.001)
L_G_c			-4.433*** (0.529)	-4.839*** (0.695)
L_FI_E_interaction	17.122*** (4.960)			14.748*** (4.550)
L_FI_S_interaction		-0.001 (0.003)		-0.004 (0.004)
L_FI_G_interaction			0.358 (4.194)	0.280 (3.602)
N	247	246	247	246

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Source: *Stata 17.0.*

To confirm the sustainability and reliability of the research findings, robustness checks were performed by changing the dependent variable, lag structure, and sample data scope. The detailed results in table 10 show the following perspectives: first, changing the dependent variable, when using the Return on Assets (ROA) as an alternative variable, the study found that the interaction variable between financial inclusion and ESG lagged by one period ($L\_FI\_ESG\_interaction$) has a positive impact and is statistically significant at the 5% level ($\beta = 0{,}003;\ \rho < 0{,}05$). This shows that the combination of these two factors not only consolidates stability but also contributes to improving the bank's profitability by minimizing costs arising from legal or environmental risks. However, the result is not significant for the Capital Adequacy Ratio (CAR) variable because CAR is primarily influenced by capital increase plans or long-term risky asset structure adjustments, being less sensitive to annual fluctuations of ESG or FI activities. Second, changing the lag structure, when considering a second-order lag ($Lag2$), the main factors including financial inclusion and ESG do not show a statistically significant impact on bank stability. This result implies that the synergistic effects of FI and ESG are usually short-term and are most clearly manifested after a one-year cycle. Overall, the robustness check results show that the research model has high reliability, especially the consistency when viewed from the perspective of operational efficiency (ROA). This further reinforces the arguments regarding the moderating role of ESG in shaping the impact of financial inclusion on the Vietnamese banking system.

Table 10. Robustness checks

	(1) (1) Z-score	(2) (2) ROA	(3) (3) CAR	(4) (4) Lag 2	(5) (5) No COVID
L_FI	0.000 (.)	0.000 (.)	0.000 (.)		0.000 (.)
L2_FI				0.000 (.)	
L_ESG	-0.001 (0.004)	0.001 (0.001)	0.002 (0.007)		-0.000 (0.004)
L2_ESG				-0.007 (0.006)	
L_FI_ESG_ interaction	-0.002 (0.009)	0.003** (0.001)	-0.006 (0.010)		0.010 (0.012)
L_ln_TA	-1.337 (2.992)	-0.053 (0.613)	0.405 (3.644)	-0.014 (4.404)	-1.940 (3.509)
L_GDPG	0.055 (0.101)	0.039* (0.021)	0.044 (0.122)	0.116 (0.155)	0.033 (0.119)
L_INF	0.229 (0.197)	-0.013 (0.041)	0.061 (0.236)	0.131 (0.296)	0.272 (0.231)
L_OPEN	18.510 (24.697)	0.699 (5.038)	0.449 (30.217)	7.973 (36.014)	23.427 (28.912)
L2_FI_ESG				-0.002 (0.009)	
N	246	246	246	227	208

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: *Stata 17.0.*

5. CONCLUSION AND POLICY

This study examines the relationship between FI and BS at commercial banks in Vietnam through the use of table data from 19 listed banks in the period 2010-2023. The results show that no statistically significant evidence has been obtained that financial inclusion (FI) has a positive impact on bank stability (BS). Regarding the regulatory role of ESG in the relationship between financial inclusion and bank stability, the research results show that factor E (Environment) has the impact of enhancing the positive impact of financial inclusion (FI) on banking stability (BS) in Vietnam. and the rest of the factors had no significant effect in the context of the study. Considering the size of the bank, FI has a more positive impact on large banks, the increase in FI makes the stability level (Z-score) of large banks increase significantly compared to the group of small banks. In addition, the study also provides important empirical evidence of the robustness of the model when changing measures of performance. The results show that the combination of financial inclusion and ESG not only strengthens stability (Z-score) but also has a positive impact on return on assets (ROA) at a significant level of 5%. This confirms that the strategy of integrating ESG into the financial inclusion roadmap does not create a trade-off between profit and safety, but on the contrary, creates a parallel sustainable development mechanism. However, the

lack of a significant impact on the capital adequacy ratio (CAR) suggests that changes in capital structure need a longer-term roadmap to become apparent.

Based on the results obtained from the research paper, the authors propose a number of recommendations. In the context of financial inclusion tending to increase access to the agricultural sector, banks operating mainly in this field, especially large-scale banks, should be well aware of the implementation of ESG, especially environmental factors that not only bring stability to banks but also accompany them the reduction of operating costs. For regulators, it is necessary to improve the legal framework on ESG information disclosure and standardize the way ESG indicators are measured, especially in risk credit and climate risk management. In order to overcome and minimize the current situation of ESG implementation in Vietnam, it is mainly based on compliance and implementation according to recommendations, leading to reporting that is mostly more formal than enforcement to create results.

In order to complete and deepen this research direction, future studies can expand the comparison of differences between the dominant state-owned banking group and the private banking sector, in order to clarify the influence of ownership structure on ESG and FI strategies.

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