IMPACTS OF ESG DISCLOSURE INTENSITY ON TRADE CREDIT: INTERNATIONAL EVIDENCE

TÁC ĐỘNG CỦA MỨC ĐỘ CÔNG BỐ THÔNG TIN ESG ĐẾN TÍN DỤNG THƯƠNG MẠI: BẰNG CHỨNG QUỐC TẾ

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(Received: May 15, 2026; Revised: September 28, 2026; Accepted: October 15, 2026)

DOI: 10.31130/ud-jst.2026.24(10).349E

Abstract - This study examines the relationship between ESG disclosure intensity and trade credit using firm-level data from 72 countries over the period 2009–2023. The empirical evidence reveals a U-shaped relationship between ESG disclosure intensity and trade credit. ESG disclosure intensity initially has a negative association with trade credit, but as disclosure intensity increases, its effect becomes more positive for both trade credit received from suppliers and trade credit granted to customers. These findings remain robust across alternative specifications and institutional settings. Among the ESG pillars, environmental and governance disclosures exhibit more pronounced and consistent effects than social disclosures. Overall, this study extends the literature on the nonlinear relationship between ESG disclosure intensity and trade credit and provides a more comprehensive understanding of the implications of ESG disclosure for firms' trade credit management.

Key words - ESG disclosure intensity; trade credit; information transparency

Tóm tắt - Nghiên cứu xem xét mối quan hệ giữa mức độ công bố thông tin ESG và tín dụng thương mại dựa trên dữ liệu doanh nghiệp tại 72 quốc gia trong giai đoạn 2009-2023. Kết quả cho thấy mối quan hệ phi tuyến dạng chữ U. Mức độ công bố ESG ban đầu tác động nghịch chiều đến tín dụng thương mại, nhưng khi mức độ công bố gia tăng, tác động trở nên tích cực hơn đối với cả tín dụng thương mại nhận từ nhà cung cấp và tín dụng thương mại cấp cho khách hàng. Kết quả vẫn duy trì khi sử dụng các mô hình thay thế và xem xét các bối cảnh thể chế khác nhau. Trong các khía cạnh ESG, công bố thông tin môi trường và quản trị có tác động rõ rệt và nhất quán hơn so với khía cạnh xã hội. Nghiên cứu bổ sung bằng chứng về mối quan hệ phi tuyến giữa công bố ESG và tín dụng thương mại, đồng thời giúp hiểu rõ hơn hàm ý của công bố thông tin ESG đối với hoạt động quản trị tín dụng thương mại của doanh nghiệp.

Từ khóa - Mức độ công bố thông tin ESG; tín dụng thương mại; minh bạch thông tin

1. Introduction

In the modern economy, corporate objectives have shifted from profit maximization toward sustainable development and social responsibility. Environmental, social, and governance (ESG) disclosure has become a strategic tool for enhancing transparency, strengthening stakeholder trust, and facilitating access to financing. While prior studies have extensively examined the effects of ESG disclosure intensity on firm performance and bank financing costs, its role in trade credit – a crucial source of short-term financing – requires deeper investigation. ESG disclosures communicate firms' sustainability practices [1], helping mitigate information asymmetry by providing stakeholders with greater transparency regarding corporate performance and sustainability activities [2]. By disclosing sustainability-related activities, firms can enhance governance quality and promote sustainable business practices [3]. In this context, trade credit, a financing arrangement based on deferred payments between buyers and suppliers [4], serves as an important channel through which the informational and relational effects of ESG disclosure intensity materialize, as it depends heavily on trust and long-term relationships [3], [5].

Although a growing body of literature has examined the relationship between ESG disclosure and corporate financing, several important research gaps remain. First, while trade credit is an important source of short-term financing for firms [4], prior studies predominantly examine the effects of ESG disclosure intensity on cost of debt and firm performance, leaving its implications for trade credit remain relatively underexplored [6], [7]. Second, existing studies are largely conducted within single-country contexts, particularly in China and the United States [8], [9], [10], limiting the generalizability of findings across countries with different institutional and legal environments. Third, many previous studies measure trade credit using only a single proxy, such as trade payables or trade receivables, thereby failing to capture the multidimensional nature of trade credit activities. In addition, although prior literature suggests that ESG disclosure reduces information asymmetry and strengthens stakeholder trust [3], [11], limited attention has been paid to the potential nonlinear relationship between ESG disclosure and trade credit, and existing findings remain inconclusive [7], [12].

To bridge the aforementioned gaps, this study contributes to literature in several ways. First, it extends the emerging literature on the nonlinear relationship between ESG disclosure intensity and trade credit by providing international evidence from firms across 72 countries. Second, by examining both trade credit received from suppliers and trade credit granted to customers, the study offers a more comprehensive understanding of how ESG disclosure influences different dimensions of trade credit

management. Third, this research strengthens the credibility and generalizability of the empirical evidence through a series of robustness and heterogeneity analyses, including lagged ESG specifications, dynamic System GMM estimation, and subsample analyses across developed and developing countries. Finally, by decomposing ESG disclosure intensity into its individual dimensions, the study provides more nuanced evidence on the heterogeneous effects of individual ESG dimensions on trade credit.

2. Literature review

To explain why ESG disclosures may influence trade credit decisions of business partners, this study draws on signaling theory and stakeholder theory. Under signaling theory, firms operating under information asymmetry use disclosure practices to communicate their underlying quality to external counterparties [13]. Such sustainability reporting signals firms' quality and sustainability orientation, leading suppliers and customers to perceive transparent ESG disclosure as a sign of financial stability, reliability, and lower opportunistic risk, thereby fostering trade credit relationships and payment behavior [14]. While signaling theory explains the informational role of ESG disclosure, stakeholder theory emphasizes the relational dimension of firm-stakeholder interactions. From a stakeholder theory perspective, a firm's long-term success depends on its ability to maintain mutually beneficial relationships with stakeholders, including employees, investors, suppliers, and government agencies [15]. Firms with strong sustainable commitments are more likely to strengthen corporate reputation and social capital by honoring contractual obligations, treating business partners fairly, and investing in long-term relationships [16]. Additionally, firms with stronger social capital and corporate social responsibility (CSR) tend to receive continued supplier support through maintained or expanded trade credit limits, while also bolstering customer trust and improving payment compliance, particularly during periods of uncertainty or financial distress [17], [18]. Therefore, transparent ESG disclosure may influence both trade credit received from suppliers and trade credit extended to customers through enhanced stakeholder trust and reduced information asymmetry.

There is strong evidence that ESG transparency shapes broad access to external financing. High-quality ESG disclosures reduce information asymmetry, which lowers the risk premium demanded by external capital providers and improves stock liquidity [19]. These positive impacts are often reinforced by internal corporate transformations, such as green innovation, thereby enhancing long-term asset productivity and reassuring capital markets [20]. Consequently, firms with superior ESG transparency secure better access to traditional finance, which indirectly reshapes their operating liquidity and reliance on alternative funding channels like trade credit [19], [20].

Within supply chain relationships, trade credit transactions are highly sensitive to partner default risks, making transparent ESG disclosures a critical proxy for corporate reliability [21]. Firms can secure more trade credit and build stronger supplier confidence by enhancing ESG transparency to reduce information and operational risks [11], [22]. Evidence suggests that partners prioritize trade credit for socially responsible firms because they are perceived as more reliable and creditworthy, which optimizes working capital efficiency across the supply chain [7], [10], [23]. However, despite the generally positive association between ESG disclosure and trade credit reported in earlier literature, the relationship may not necessarily be linear. For instance, early sustainability efforts can temporarily lower trade credit due to high setup costs. In contrast, once these practices pass a certain level, they signal strong corporate responsibility and help the firm gain more credit [10]. Conversely, excessive ESG investment may signal an over-allocation of internal resources or suggest managerial agency issues, which can alter stakeholder perceptions and reduce the perceived need for external trade credit [12], [24]. Although prior studies have documented nonlinear relationships between CSR or ESG-related measures and trade credit [10], [24], the existing literature remains limited in several respects. First, the empirical evidence is confined to single-country settings, making it unclear whether the documented nonlinear relationship generalizes to a broader international context characterized by diverse institutional environments. Second, previous studies examine trade credit as a single financing construct, without distinguishing between trade credit received from suppliers and trade credit granted to customers. Third, little is known about whether the nonlinear relationship varies across the individual dimensions of ESG disclosure intensity. These gaps motivate this study to provide a broader examination of the nonlinear association between ESG disclosure intensity and trade credit by incorporating cross-country evidence, distinguishing between payables and receivables credit, and examining heterogeneity across the three ESG dimensions.

Building on these arguments, this study proposes that ESG disclosure intensity and trade credit follow a U-shaped curve, driven by shifting cost-benefit dynamics across different stages of maturity. At initial stages of ESG implementation, the relationship is dominated by net compliance costs and risk exposure. Starting a strong ESG reporting system requires high upfront costs, administrative effort, and operational changes. This can temporarily squeeze cash flow and worry trade partners about liquidity [10]. Furthermore, early-stage, incomplete disclosures can trigger an 'exposure effect' by revealing compliance gaps or supply chain weaknesses. Instead of reassuring commercial counterparties, these limited disclosures actually raise perceived operational risks, leading suppliers to tighten credit terms and customers to demand stricter guarantees [14]. However, once ESG disclosure intensity matures and accumulates credibility, the balance shifts from costs to benefits. Beyond this turning point, partners increasingly perceive ESG initiatives as a genuine commitment to sustainability rather than superficial greenwashing [25]. High-quality ESG disclosure significantly lowers information asymmetry, signaling robust risk-management capabilities and high

creditworthiness [13], and strengthens stakeholder trust [14] - [17]. Consequently, suppliers and customers become more willing to engage in trade credit relationships, enabling firms to obtain more favorable trade credit terms. Accordingly, the following hypothesis is proposed:

H1: ESG disclosure intensity exhibits a U-shaped relationship with a firm's overall trade credit engagement.

Because trade credit consists of both accounts payable and accounts receivable, the overall relationship proposed in H1 may operate through these two distinct dimensions. Accordingly, H2 and H3 examine whether the proposed U-shaped relationship holds separately for supplier-side and customer-side trade credit. From the supplier's perspective, extending trade credit is a direct investment in the buyer's operational capacity. Suppliers actively monitor and favor buyers with strong sustainability records to reduce transaction monitoring costs and mitigate opportunistic behavior [13], [14], [26]. This trust encourages suppliers to offer more generous credit terms and higher trade credit financing limits [27]. However, a supplier's willingness to extend credit may follow a nonlinear path, because early ESG reporting requires high upfront costs that can temporarily strain a firm's liquidity [10]. Accordingly, we propose:

H2: The U-shaped relationship proposed in H1 is expected to hold for supplier-side trade credit.

From the firm's perspective, customer-side trade credit is a strategic instrument for strengthening customer relationships and stimulating sales. High-quality ESG disclosure enhances corporate transparency and customer trust, enabling firms to extend trade credit with greater confidence [15], [16], [28]. However, in the early stages of ESG implementation, substantial investment and disclosure costs may constrain liquidity and limit firms' ability to offer trade credit. As ESG disclosure matures and its financial and reputational benefits materialize, firms gain greater financial flexibility to extend customer financing. Accordingly, the following hypothesis is proposed:

H3: The U-shaped relationship proposed in H1 is expected to hold for customer-side trade credit.

3. Data and methodology

3.1. Data sample

The dataset for this study is obtained from the Refinitiv Eikon database and covers the period from 2009 to 2023. All continuous variables are winsorized at the 1% and 99% levels to reduce the influence of outliers. After data processing, the final sample consists of 8,308 listed firms and 55,113 firm-year observations across 72 countries. Firms in banking, finance, real estate, and insurance industries are excluded due to their distinct regulatory and reporting characteristics.

Trade credit is measured using two proxies: accounts payable scaled by cost of goods sold (AP/COGS), representing trade credit received from suppliers, and accounts receivable scaled by sales (AR/SALES), representing trade credit extended to customers. The main independent variable is ESG disclosure intensity, operationalized using the Refinitiv ESG score. In this study, ESG disclosure intensity refers to the extent of information firms disclose about their ESG-related activities and outcomes. The Refinitiv ESG score is constructed using ESG-related information obtained from firms' publicly available disclosures and provides a continuous score covering the three ESG dimensions. The underlying ESG data are organized into ESG metrics and aggregated into theme-level and overall ESG scores. Company disclosure is a core element of the Refinitiv scoring methodology, and the reporting of material ESG information is incorporated into the scoring process. Accordingly, the Refinitiv ESG score is used in this study as a proxy for ESG disclosure intensity. To mitigate omitted variable bias, the model includes a set of firm-level control variables commonly used in the literature on corporate finance and working capital management. Firm size (firmsize) is measured as the natural logarithm of total assets. Leverage (lev) is defined as total debt divided by total assets. Liquidity (liq) is measured as the ratio of current assets to current liabilities. Asset tangibility (tangib) is calculated as net property, plant, and equipment scaled by total assets. Sales growth (growth) captures the annual percentage change in firm sales. Tobin's Q is defined as the ratio of the market value of equity plus the book value of debt to total assets, and its natural logarithm is used in the regression analysis, denoted as ln(tobinq). These variables control for firm characteristics that may systematically influence trade credit decisions.

3.2. Research methodology

To investigate the relationship between ESG disclosure intensity and trade credit, this study estimates the following baseline panel regression model:

$$TC_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 ESG_{i,t}^2 + \gamma Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

where, $TC_{i,t}$ denotes the trade credit of firm i in year t. In this study, AP/COGS represents trade credit received from suppliers, while AR/SALES captures trade credit extended to customers. The key explanatory variable, $ESG_{i,t}$, is the standardized (z-score) ESG disclosure intensity. To capture a potential nonlinear (U-shaped) relationship, the squared standardized ESG disclosure intensity ($ESG_{i,t}^2$) is included in the regression model. Standardizing ESG disclosure intensity prior to constructing the quadratic term reduces multicollinearity between the linear and squared terms and facilitates coefficient interpretation. The coefficient β_1 captures the linear effect of ESG disclosure intensity on trade credit, while β_2 captures the curvature of the relationship. Moreover, the baseline analysis employs firm fixed-effects (FE) panel regressions to control for unobserved firm-specific heterogeneity. Firm fixed effects account for time-invariant firm characteristics, while country-year fixed effects are included to absorb time-varying macroeconomic conditions, institutional changes, and other country-specific shocks that may simultaneously affect firms within the same country in a given year. In addition, robust standard errors clustered at the firm

level are employed to address potential heteroskedasticity and within-firm serial correlation.

Following the baseline analysis, several additional tests are conducted to strengthen the robustness of the empirical findings. First, the baseline models are re-estimated using one-period lagged ESG disclosure intensity and its squared term to address concerns about reverse causality by examining whether prior ESG disclosure is associated with subsequent trade credit management. In addition, a two-step System GMM estimator is employed to account for the dynamic nature of trade credit management and potential endogeneity. Specifically, the lagged dependent variable and ESG disclosure variables are treated as endogenous and instrumented using their own lagged values. Secondly, the overall ESG score is decomposed into its three individual pillars, together with their squared terms, to examine whether the observed relationship differs across ESG pillars. Finally, subsample analyses are conducted for firms in developed and developing countries to explore whether the investigated relationship varies across different institutional environments. Consistent results across these additional analyses provide further support for the robustness of the baseline findings.

4. Results and discussion

4.1. Descriptive statistics

Table 1. *Descriptive statistics*

VARIABLES	Count	Mean	SD	Min	Max
AP/COGS	55,113	0.221	0.225	0.011	1.996
AR/SALES	55,113	0.199	0.185	0.006	1.647
esg	55,113	48.160	18.647	0.830	95.100
environmental	55,113	54.895	24.665	0.095	99.515
social	55,113	61.665	20.024	0.345	98.524
governance	55,113	62.457	18.558	0.120	99.530
firmsize	55,113	16.622	2.615	10.868	23.743
lev	55,113	0.264	0.179	0.000	0.828
liq	55,113	1.879	1.542	0.306	13.585
tangib	55,113	0.700	0.173	0.072	0.965
growth	55,113	0.089	0.266	-0.605	1.693
ln(tobinq)	55,113	0.695	0.464	0.058	2.337

Table 1 presents summary statistics for the key variables. Firms exhibit moderate reliance on trade credit, with mean AP/COGS and AR/SALES of 0.221 and 0.199, respectively, suggesting that firms both depend on supplier financing and extend credit to customers. ESG disclosure intensity averages 48.16, reflecting a moderate level of sustainability disclosure among sample firms. Among the three ESG dimensions, governance disclosure has the highest average score (62.46), followed by social disclosure (61.67) and environmental disclosure (54.90), suggesting uneven disclosure practices across ESG pillars. Regarding firm characteristics, the sample firms are relatively large, moderately leveraged, maintain strong liquidity, and exhibit high asset tangibility. Overall, the observed variation in trade credit, ESG disclosure intensity, and firm characteristics support the validity of the subsequent empirical analysis. The correlation coefficients among the variables in the baseline model are generally below the commonly accepted threshold of 0.75 and all VIF values are below 10, with a mean VIF of 1.22, indicating that multicollinearity is not a serious concern in the regression models (Appendix 1). These initial results provide preliminary support for the empirical specification.

4.2. Baseline results

Table 2. *Baseline results*

VARIABLES	(1) AP/COGS	(2) AR/SALES
ESG	-0.00612***	-0.00621***
	(0.002)	(0.001)
ESG^2	0.00301***	0.00253***
	(0.001)	(0.001)
firmsize	0.01545***	0.02067***
	(0.005)	(0.004)
lev	-0.01237	0.04881***
	(0.013)	(0.012)
liq	-0.01106***	-0.00019
	(0.001)	(0.002)
tangib	-0.06241***	-0.23512***
	(0.015)	(0.025)
growth	-0.02201***	-0.05113***
	(0.004)	(0.005)
ln(tobinq)	0.00319	-0.01597***
	(0.005)	(0.004)
Constant	0.03444	0.01586
	(0.086)	(0.071)
Observations	55,113	55,113
Number of ID	8,308	8,308
R-squared	0.0805	0.0891
Firm FE	YES	YES
Country-Year FE	YES	YES
Cluster SE (Firm)	YES	YES
Turning point (z-score)	1.017	1.225
Approximate ESG score	67.14	71.00
ESG range (z-score)	-2.127 to 2.643	-2.127 to 2.643
Observations below turning point (%)	41,950 (76.11%)	45,336 (82.26%)
Observations above turning point (%)	13,163 (23.89%)	9,777 (17.74%)
Observations within ±0.2 of turning point (%)	6,829 (12.39%)	6,114 (11.09%)
Lind-Mehlum U-test (t)	1.91	1.92
Lind-Mehlum U-test (p-value)	0.028	0.027

*Notes: All test statistics and significance levels are calculated based on cluster-robust standard errors at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The Lind-Mehlum U-test is employed to examine the existence of a U-shaped relationship.*

Table 2 shows the baseline regression results on the relationship between ESG disclosure intensity and trade credit. In Columns 1 and 2, ESG disclosure intensity (ESG) is negatively and significantly associated with both AP/COGS and AR/SALES at the 1% level, indicating that greater ESG transparency reduces both trade credit received from suppliers and trade credit extended to customers. However, the squared term of ESG disclosure intensity (ESG^2) is positive and significant in both models, supporting a nonlinear (U-shaped) relationship between ESG disclosure intensity and trade credit. These findings support H1, H2, and H3.

The negative linear coefficients and positive quadratic coefficients, together with the statistically significant Lind-Mehlum U-tests, provide statistical support for a U-shaped relationship between ESG disclosure intensity and trade credit. The estimated turning points are 1.017 for AP/COGS and 1.225 for AR/SALES, corresponding to approximate ESG disclosure scores of 67.14 and 71.00, respectively. Both turning points fall within the observed standardized ESG range of -2.127 to 2.643. For AP/COGS, 41,950 observations (76.11%) fall below the turning point and 13,163 (23.89%) above it. For AR/SALES, the corresponding figures are 45,336 (82.26%) and 9,777 (17.74%), respectively. These distributions confirm that the estimated turning points are observed within the range of ESG disclosure intensity in the sample, with observations on both sides of each threshold.

This nonlinear pattern indicates that the relationship between ESG disclosure intensity and trade credit varies across different levels of disclosure. Below the estimated turning points, greater ESG disclosure intensity is associated with a reduction in trade credit. However, once ESG disclosure intensity exceeds the turning points, the marginal effects become positive, indicating that the potential benefits of more extensive ESG disclosure for trade-credit relationships become more evident at higher levels of ESG disclosure intensity. One possible explanation is that more extensive ESG disclosure may provide greater transparency and credibility, potentially reducing information asymmetry and supporting more stable business relationships. In this context, suppliers may be more willing to extend trade credit, while customers may be more inclined to maintain commercial relationships with firms providing more comprehensive ESG information. The higher turning point for AR/SALES than for AP/COGS indicates that the transition from a negative to a positive marginal effect occurs at a higher level of ESG disclosure for trade credit granted than for trade credit received. Overall, these findings are consistent with the arguments of signaling theory and stakeholder theory.

Regarding the control variables, firm size is positively associated with both trade credit proxies, suggesting that larger firms engage more actively in trade credit activities. Leverage is positively related to AR/SALES, while liquidity is negatively associated with AP/COGS, indicating that firms with stronger liquidity rely less on supplier financing. In addition, asset tangibility, sales growth, and the natural logarithm of Tobin's Q generally exhibit negative relationships with trade credit. Overall, these findings are consistent with the arguments presented in prior studies such as [10] and [17].

4.3. Robustness checks: Lagged ESG effects on trade credit and system GMM

Table 3 reports the robustness tests using lagged ESG disclosure intensity and the two-step System GMM estimator. Panel A presents the results using one-period lagged ESG disclosure intensity and its squared term. The coefficients on lagged ESG disclosure intensity remain significantly negative, while the squared terms remain significantly positive across both the AP/COGS and AR/SALES models. These findings are consistent with the baseline results and suggest that the nonlinear association persists when the potential delayed effect of ESG disclosure is taken into account.

Table 3. *Estimates using lagged ESG disclosure intensity and dynamic system GMM*

Panel A: Lagged ESG disclosure intensity		
	(1)	(2)
VARIABLES	AP/COGS	AR/SALES
L.ESG	-0.00547***	-0.00424***
	(0.002)	(0.001)
L.ESG^2	0.00278***	0.00171***
	(0.001)	(0.001)
Control variables	Included	Included
Constant	0.04861	0.03263
	(0.086)	(0.069)
Observations	54,756	54,756
Number of ID	8,258	8,258
R-squared	0.0809	0.0897
Firm FE	YES	YES
Country-Year FE	YES	YES
Cluster SE (Firm)	YES	YES
Panel B: Dynamic system GMM estimation		
	(1)	(2)
VARIABLES	AP/COGS	AR/SALES
L.AP/COGS	0.669***	
	(0.051)	
L.AR/SALES		0.801***
		(0.047)
ESG	-0.00444*	-0.00490***
	(0.003)	(0.002)
ESG^2	0.00389*	0.00358*
	(0.002)	(0.002)
Control variables	Included	Included
Year FE	YES	YES
Constant	0.0871***	0.120***
	(0.015)	(0.021)
Estimator	System GMM	System GMM
Observations	51,812	53,038
Number of ID	7,951	8,139
Number of instruments	32	32
Arellano–Bond AR(1) (p-value)	0.000	0.000
Arellano–Bond AR(2) (p-value)	0.950	0.180
Hansen test (p-value)	0.108	0.104

*Notes: Panel A reports robustness tests using one-period lagged ESG disclosure intensity and its squared term, estimated with firm and country-year fixed effects. Panel B reports two-step System GMM estimations to address dynamic persistence and potential endogeneity. Year fixed effects are included instead of country-year fixed effects to avoid instrument proliferation in the System GMM estimation. Model validity is assessed using the Arellano-Bond AR(1) and AR(2) tests, the Hansen test, and the number of instruments. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

Additionally, Panel B reports the results from the dynamic System GMM estimation, in which the lagged dependent variable and ESG disclosure variables are treated as endogenous and instrumented using their own lagged values. The lagged dependent variables are positive and highly significant, indicating persistence in trade credit

management over time and supporting the use of a dynamic specification. The coefficients on ESG disclosure intensity remain negative, whereas the squared terms remain positive and statistically significant, providing additional support for the robustness of the nonlinear relationship after accounting for potential endogeneity. Furthermore, the Arellano-Bond AR(1) tests are significant, whereas the AR(2) tests are insignificant, indicating no evidence of second-order serial correlation. The Hansen tests do not reject the null hypothesis of instrument validity. In addition, the models use 32 instruments, reducing concerns about instrument proliferation. Overall, these results provide further evidence that the baseline findings are robust to alternative specifications and potential endogeneity.

4.4. Developed versus developing countries

Table 4. *ESG disclosure intensity and trade credit across developed and developing countries*

	Developed countries		Developing countries	
	(1)	(2)	(1)	(2)
VARIABLES	AP/COGS	AR/SALES	AP/COGS	AR/SALES
ESG	-0.00807***	-0.00495***	0.00115	-0.00983***
	(0.002)	(0.002)	(0.005)	(0.004)
ESG^2	0.00357***	0.00190**	0.00086	0.00442**
	(0.001)	(0.001)	(0.003)	(0.002)
Control variables	Included	Included	Included	Included
Constant	0.02606	0.04333	0.05869	-0.05989
	(0.096)	(0.080)	(0.188)	(0.146)
Observations	42,082	42,082	13,031	13,031
Number of ID	5,650	5,650	2,658	2,658
R-squared	0.0501	0.0778	0.1510	0.1211
Firm FE	YES	YES	YES	YES
Country-Year FE	YES	YES	YES	YES
Cluster SE (Firm)	YES	YES	YES	YES

*Notes: This table reports the heterogeneity analysis for developed and developing countries. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

Table 4 provides the heterogeneity analysis across developed and developing countries. For developed countries, the coefficients on ESG disclosure intensity are significantly negative, while those on the squared term are significantly positive in both the AP/COGS and AR/SALES models. These findings are consistent with the baseline and robustness results, confirming the nonlinear relationship between ESG disclosure intensity and trade credit management. For developing countries, the nonlinear relationship remains significant in the AR/SALES model but becomes insignificant in the AP/COGS model. This finding suggests that the influence of ESG disclosure intensity on trade credit received is more pronounced in stronger institutional environments, whereas its effect on trade credit granted remains relatively robust across different levels of economic development. Thus, the baseline findings remain robust, although the strength of the relationship varies across institutional settings.

4.5. Alternative measures of trade credit

As reported in Table 5, this study employs alternative measures of supplier-side and customer-side trade credit, namely accounts payable scaled by total assets (AP/TA) and accounts receivable scaled by total assets (AR/TA), respectively. The results show that the coefficients on ESG disclosure intensity remain significantly negative for both alternative measures, while the coefficients on the squared ESG disclosure intensity terms are positive, consistent with the signs observed in the baseline models, although these quadratic terms are not statistically significant. These results should be considered in the context of the different denominators used to construct the trade credit measures. The baseline measures, AR/SALES and AP/COGS, relate trade credit to firms' operating activities, as sales and cost of goods sold are closely related to the operating flows underlying accounts receivable and accounts payable, respectively. Meanwhile, AR/TA and AP/TA measure trade credit relative to firms' total assets, thereby capturing a different dimension of trade credit.

Table 5. *Alternative measures of trade credit*

	(1)	(2)
VARIABLES	AP/TA	AR/TA
ESG	-0.00083*	-0.00135**
	(0.0005)	(0.0006)
ESG^2	0.00009	0.00046
	(0.0003)	(0.0004)
Control variables	Included	Included
Constant	0.10100***	0.12683***
	(0.002)	(0.002)
Observations	55,113	55,113
Number of ID	8,308	8,308
R-squared	0.1032	0.0756
Firm FE	YES	YES
Country-Year	YES	YES
Cluster SE (Firm)	YES	YES

*Notes: This table reports fixed-effects regression results using alternative measures of supplier-side and customer-side trade credit. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

4.6. Individual ESG Dimensions and Trade Credit

Table 6 exhibits the mechanism analysis examining the relationship between individual ESG dimensions and trade credit. In Columns 1 and 2, environmental disclosure intensity (Env) is negatively associated with both AP/COGS and AR/SALES, while Env^2 is positive and significant, confirming a nonlinear relationship. Similarly, Columns 3 and 4 indicate that social disclosure (Soc) is negatively related to both trade credit proxies. However, the squared term (Soc^2) is significant only for AP/COGS, suggesting that the nonlinear effect of social disclosure is primarily reflected in trade credit received from suppliers. In Columns 5 and 6, governance disclosure (Gov) is also negatively and significantly associated with both trade credit measures, whereas Gov^2 remains positive and significant, providing further evidence of a nonlinear relationship. In summary, the results indicate that the nonlinear relationship between ESG disclosure intensity and trade credit is not driven by a single ESG dimension. Environmental and governance disclosures exhibit consistent nonlinear associations with both trade credit received from suppliers and trade credit granted to

customers, whereas the nonlinear effect of social disclosure is evident only for trade credit received from suppliers. These findings suggest that the three ESG dimensions influence trade credit management through different channels and with varying degrees of importance across trade credit measures. Overall, the results provide additional support for the baseline findings by showing that the nonlinear relationship remains robust across the individual ESG dimensions while highlighting the heterogeneous roles of ESG disclosures in firms' trade credit management.

Table 6. *Individual components of ESG and trade credit*

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	AP/COGS	AR/SALES	AP/COGS	AR/SALES	AP/COGS	AR/SALES
Env	-0.00453**	-0.00526***				
	(0.002)	(0.001)				
Env^2	0.00243**	0.00179*				
	(0.001)	(0.001)				
Soc			-0.00350*	-0.00283**		
			(0.002)	(0.001)		
Soc^2			0.00177*	0.00133		
			(0.001)	(0.001)		
Gov					-0.00554**	-0.00659***
					(0.002)	(0.002)
Gov^2					0.00448***	0.00268**
					(0.002)	(0.001)
Control variables	Included	Included	Included	Included	Included	Included
Constant	0.03177	0.01162	0.04093	0.02444	0.03783	0.01589
	(0.086)	(0.071)	(0.086)	(0.071)	(0.087)	(0.071)
Observations	55,113	55,113	55,113	55,113	55,113	55,113
Number of ID	8,308	8,308	8,308	8,308	8,308	8,308
R-squared	0.08060	0.08930	0.0803	0.0885	0.0805	0.0889
Firm FE	YES	YES	YES	YES	YES	YES
Country-Year FE	YES	YES	YES	YES	YES	YES
Clustered SE (Firm)	YES	YES	YES	YES	YES	YES

*Notes: All specifications include control variables, firm and country-year fixed effects, and firm-clustered standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

5. Conclusion

This study investigates the relationship between ESG disclosure intensity and trade credit behavior. We examine both the overall ESG score and its three individual pillars. The data consists of firm-level observations from 72 countries between 2009 and 2023. The findings indicate a significant U-shaped relationship between ESG disclosure intensity and trade credit. Specifically, ESG disclosure intensity is initially negatively associated with both trade credit received from suppliers and trade credit extended to customers. Beyond the respective turning points, the marginal effect becomes positive, indicating that the association between ESG disclosure intensity and trade credit varies across different levels of ESG disclosure. Among these ESG dimensions, the environmental and governance dimensions exhibit more pronounced and consistent effects across trade credit measures.

This research contributes to literature in several ways. First, it extends the literature on the economic consequences of ESG by providing international evidence that the association between ESG disclosure intensity and trade credit is nonlinear, whereas prior studies have primarily focused on single-country settings. Second, by examining both trade credit received from suppliers and trade credit granted to customers, the study provides a more comprehensive understanding of how ESG disclosure intensity is associated with different dimensions of trade credit management. Third, the study strengthens the credibility of the empirical evidence through a comprehensive set of robustness and heterogeneity analyses, including lagged ESG specifications, dynamic System GMM estimation, and subsample analyses across developed and developing countries. Finally, by decomposing the overall ESG score into its three individual components, the study demonstrates that the three ESG dimensions exhibit heterogeneous nonlinear associations with trade credit, providing more nuanced evidence on the heterogeneous roles of different ESG dimensions in firms' financing decisions.

The findings also provide various practical implications for firms, suppliers, and policymakers. For firms, the results suggest that ESG disclosure intensity should not be viewed solely as a compliance or reputational activity. Firms seeking to strengthen their access to supplier financing should consider the level and consistency of their ESG-related transparency, as greater ESG disclosure intensity may reduce information asymmetry and enhance suppliers' confidence in the firm. At the same time, firms that extend trade credit to customers should recognize ESG disclosure intensity as an additional source of information when assessing the credibility and reliability of business partners. For suppliers, the level of ESG-related transparency can provide supplementary information for evaluating customers' creditworthiness and determining appropriate trade credit terms, particularly when there is insufficient financial information or significant information asymmetry. For policymakers, the findings support the development of clearer and more comparable frameworks for ESG information, enabling trading partners to better assess firms' ESG practices. Such policies may enhance the informational value and comparability of ESG information and facilitate more efficient trade credit allocation. Importantly, these implications should be interpreted in light of the nonlinear relationship between ESG disclosure intensity and trade credit, indicating that the association between the two variables varies across different levels of ESG disclosure intensity.

At the same time, these findings should be interpreted in light of some limitations. Although lagged ESG measures and System GMM estimations help mitigate potential endogeneity concerns, some degree of residual endogeneity may remain. In addition, despite controlling for country-year fixed effects, the effects of ESG disclosure intensity on trade credit may vary across institutional and market environments. Future research could further strengthen causal identification and examine how institutional and market heterogeneity shapes the relationship between ESG disclosure intensity and trade credit.

Acknowledgements: This work was supported by The University of Danang - University of Economics, code number of Project: B2023-DN04-13-TT.

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APPENDIX

Appendix 1. *Correlation matrix and Variance inflation factor (VIF)*

	VIF	AP/ COGS	AR/ SALES	ESG	ESG^2	firmsize	lev	liq	tangib	growth	Ln (tobinq)
AP/ COGS		1.000									
AR/ SALES		0.288***	1.000								
ESG	1.31	0.026***	-0.038***	1.000							
ESG^2	1.24	0.029***	0.018***	0.433***	1.000						
firmsize	1.13	0.035***	0.048***	0.221***	0.129***	1.000					
lev	1.27	0.043***	-0.025***	0.059***	0.002	0.099***	1.000				
liq	1.27	-0.119***	0.108***	-0.149***	-0.029***	-0.171***	-0.342***	1.000			
tangib	1.26	0.017***	-0.322***	0.053***	0.023***	0.041***	0.354***	-0.347***	1.000		
growth	1.02	0.015***	-0.034***	-0.054***	-0.001	-0.033***	-0.036***	0.039***	-0.021***	1.000	
Ln (tobinq)	1.25	-0.064***	-0.078***	-0.004	0.010**	-0.238***	-0.315***	0.262***	-0.271***	0.133***	1.000
Mean VIF	1.22										

*Notes: *** at the 1% level of statistical significance.*