Article:
Wang, L., Xie, S., A, N. et al. (2026) The spillover effects of ESG performance on the trade credit : a supplier-customer dyad perspective. Journal of Business Research, 212. 116218. ISSN: 0148-2963

https://doi.org/10.1016/j.jbusres.2026.116218

The Spillover Effect of ESG Performance on the Trade Credit: A Supplier-Customer Dyad Perspective

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Abstract: While previous research has explored the effects of firm's ESG on its financial outcomes, the spillover effect of ESG performance on trade credit, particularly within supplier-customer dyads remains underexplored. This study examines how suppliers' ESG performance serves as a financial signal influencing customers' trade credit decision. We investigate the moderating roles of geographic distance and supplier power, two critical yet often overlooked factors that shape the effectiveness of ESG signaling in financial transactions. Using panel data from 1,234 supplier-customer dyads, we find that higher supplier ESG performance leads to more favorable terms from customers. However, this spillover effect weakens as geographic distance increases or when suppliers hold greater supply chain power. Furthermore, a post-hoc analysis suggests that these effects are stronger in high-tech industries but diminish in regions with less regulatory oversight.

This research highlights the financial signaling role of ESG in supplier-customer dyads, extending beyond firm-level ESG benefits to underscore its broader financial externalities. It also provides managerial and policy insights, emphasizing the need for firms to integrate ESG considerations into trade credit decisions to enhance resilience in supply chains. These findings reinforce ESG's growing relevance as a competitive differentiator, particularly in industries where sustainability is integral to business success.

Keywords: ESG, trade credit, dyad structure, geographic distance, supplier power

1. Introduction

More enterprises recognize the link between economic benefits and their Environmental, Social, and Governance (ESG) commitment. As projected by Bloomberg Professional Services, global ESG assets are expected to exceed $53 trillion by 2025, representing more than one-third of total managed assets (Diab & Adams, 2021). ESG reporting has become a vital mechanism enabling the evaluation of corporate sustainability efforts (Li et al., 2023), particularly as consumers demand greater transparency to validate ESG practices (Cao et al., 2023; Skarmeas & Leonidou, 2013). As shown by Deloitte's survey, 70% of enterprises are willing to pay up to 5% more to partner with ESG-compliant suppliers (Deloitte, 2023).

Existing studies show that firms' ESG performance can generate spillover effects in supplier-customer dyads, such as financial constraints and firm value (Xu et al., 2025), shareholder value creation (Iurkov et al., 2024), shaping collaboration with other customers (Cao et al., 2023), and access to bank loans (Houston & Shan, 2022). However, a critical gap remains concerning the financial channel through which ESG signals generate spillover effect across supply chains. Trade credit is one of the most prevalent forms of financing (Jing et al., 2012; Wang et al., 2023), embedded in the supplier-customer relationship and sustained by trust and repeated interactions (Cai et al., 2014; Wuttke et al., 2019). Although prior studies link firm ESG performance to its own trade credit financing (Luo et al., 2023; Yang & Tian, 2024), limited attention has been given to how ESG practices diffuse across the supply chain precisely through this financing channel.

In supplier-customer dyadic relationships, transactions often occur under information asymmetry, where customers cannot fully assess suppliers' reliability. Drawing on signaling theory (Connelly et al., 2011; Spence, 1973), suppliers' strong ESG performance could serve as a credible signal of long-term commitment and operational reliability. Because substantive ESG engagement is costly and difficult to imitate, it conveys information about otherwise unobservable attributes such as governance quality and reduced opportunistic behavior (Ming & Hillbun, 2019; Trinh & Zhao, 2024). As signal recipients, customers interpret superior ESG performance as indicative of a lower-risk supplier profile, which mitigates information asymmetry and increases their willingness to apply or extend trade credit. Thus, to deepen our

understanding of ESG spillover effect on trade credit across supply chain, we propose our first research question: *What is the influence of suppliers' ESG performance on customer firms' trade credit?*

However, signaling theory also suggests that the effectiveness of a signal is inherently context dependent. According to Connelly et al. (2011), a signal influences receivers' decision only when it can be clearly observed, credibly verified, and is not dominated by alternative signals. This implies that even credible ESG ratings may not uniformly translate into financial outcomes across supplier-customer relationships, particularly when conditions weaken signal transmission. One such important yet underexplored condition involves geographic distance between suppliers and customers. Geographical distance plays a crucial role in shaping signal strength (Cao et al., 2024), and can attenuate signal intensity (Katok & Tan, 2025). In the ESG context, greater distance may reduce signal observability and increase verification difficulties, thereby limiting customers' ability to assess whether ESG ratings accurately reflect suppliers' underlying practices. Based on these insights, we formulate the second research question: *How does supplier geographic distance influence the spillover effect between supplier ESG performance and customer trade credit?*

Beyond signal transmission conditions, signaling theory also emphasizes that receivers often rely on multiple, potentially competing signals when forming judgments (Connelly et al., 2011; Spence, 1973). In supplier-customer dyads, supplier power may function as an alternative signal. Specifically, suppliers with strong bargaining positions, arising from technological advantages, market dominance, or control over critical inputs (Dass et al., 2015; Fabbri & Klapper, 2016), are perceived as more stable and reliable, thereby reducing customers' reliance on ESG ratings when assessing trade credit risk. In this sense, supplier power may crowd out the informational role of ESG, rather than reinforcing it. Accordingly, we pose our third research question: *How does supplier power influence the spillover effect between supplier ESG performance and customer trade credit?*

To examine these research questions, we collect a panel dataset from several database sources, and our final sample contains 1,234 supplier-customer dyads observations from 2009-2023. Based on the dyads and year fixed-effects analysis, the findings show that suppliers with higher ESG performance positively affect customer trade credit, while geographic distance and

power negatively affect the relationship between supplier ESG performance and customer trade credit. Furthermore, to explore the marginal effects of spillover in the global value chain, we investigate enterprises across different value chains and regions with varying levels of regulatory intensity.

This study makes three key contributions. First, we articulate how ESG functions as a financial signal that translates into financial outcomes within supplier-customer dyadic relationships. While prior studies investigate the financial consequences of ESG, such as its effects on focal firm's financing conditions, cost of capital, and trade credit outcomes (Cheng et al., 2014; Dhaliwal et al., 2011; Luo et al., 2023; Yang & Tian, 2024), this literature predominantly focuses on intra-firm level effects and pays limited attention to the interfirm mechanisms through which ESG signals transmit across supply chains. We advance this stream by theorizing and empirically examining a dyadic ESG spillover mechanism operating through trade credit, highlighting ESG as an interfirm financial signal rather than merely a firm attribute.

Second, drawing on signaling theory and examining geographic distance and supplier power as key contextual factors, we show that the spillover effect of ESG performance on trade credit is contingent on signal observability, verification costs, and the availability of alternative signals. Geographic distance weakens ESG spillovers by reducing signal observability and increasing verification costs, whereas supplier power attenuates ESG effects by acting as an alternative signal that crowds out the marginal informational value of ESG. In doing so, this study advances understanding of when and how ESG information influences credit allocation within supply chains.

Third, our findings contribute to the literature on value chain creation by demonstrating how ESG principles foster long-term supplier–customer relationships through financial mechanisms. Collectively, these insights offer actionable implications for firms and policymakers seeking to leverage ESG performance for sustainable value creation.

2. Theoretical background and hypotheses development

2.1. ESG Performance as a Signal for Trade Credit

Consumers are increasingly aware of the importance of ESG reporting, actively seeking information to verify firms' claims (Skarmeas & Leonidou, 2013). This pushes firms not only

to maintain high sustainable standards themselves, but also to ensure their suppliers use environmentally friendly materials, uphold labor practices, and follow ethical business principles (Shen et al., 2025). Nevertheless, information asymmetries between suppliers and customers necessitate a signaling process to enable more accurate assessment of performance (Connelly et al., 2011; Kumar et al., 2023).

Drawing on signaling theory (Connelly et al., 2011; Spence, 1973), ESG ratings by external assessors could function as credible signals that help customers infer suppliers' unobservable quality. ESG ratings assess firms' environmental, social, and governance performance, and are typically produced by third-party agencies. As such, they reflect sustained investments in ESG practices and convey information about suppliers' commitment to ethical conduct, risk management, and long-term stability (Chatterji et al., 2016). In addition, suppliers' ESG commitments can signal alignment with customers' sustainability objectives in downstream markets. Environmentally responsible suppliers, for example, those investing in green technologies and energy efficiency, reduce resource dependency and are therefore more resilient to environmental risks (Busch & Lewandowski, 2017). Moreover, partnering with suppliers that exhibit strong ESG performance enhances customers' operational stability (Flammer, 2013), increases market value (Wang & Choi, 2013), and reduces compliance costs and operational risks (Cheng et al., 2014).

Within supplier-customer dyads, customer firms rely on ESG performance as a signal when making financially consequential decisions among suppliers. Trade credit, one of the most prevalent forms of interfirm financing (Jing et al., 2012; Wang et al., 2023), is particularly sensitive to customers' perceptions of supplier risk and trustworthiness (Cai et al., 2014; Wuttke et al., 2019). Suppliers' commitments to ethical leadership and strong internal controls foster long-term trust and mitigate information asymmetry (Dhaliwal et al., 2011; Kim et al., 2012). For example, ethical labor practices and community engagement strengthen supplier reputation and brand trust, increasing customers' willingness to extend trade credit (Liang & Renneboog, 2017). Suppliers with a stronger ESG signal are more likely to be perceived as stable, compliant, and strategically sustainable partners, which lowers customers' perceived risk of future disruptions or opportunistic behavior (Wu et al., 2024). Consequently, customers become more

willing to extend trade credit as a means of deepening long-term cooperation and safeguarding supply chain continuity. Thus, we propose:

H1: *A supplier's ESG performance provides a positive spillover effect on customer's trade credit decisions.*

2.2. Supplier geographic distance

According to Connelly et al. (2011)'s framework on signaling theory, the effectiveness of ESG performance depends not only on the signal itself, but also on the conditions under which the signal can be observed and verified by its receivers. Within supplier-customer dyadic relationships, geographic distance between suppliers and customers constitutes a critical factor shaping these conditions, as it directly affects signal observability and verification costs (Bode & Wagner, 2015).

When suppliers and customers are geographically proximate, customers can more easily access contextual information, engage in frequent communication, and undertake both formal and informal monitoring. Such proximity enhances the observability of ESG-related practices and reduces the costs of validating ESG claims (Bode & Wagner, 2015). By contrast, greater geographic distance limits face-to-face interactions, increases coordination and communication frictions, and raises monitoring costs, thereby making it more difficult for customers to verify whether ESG ratings reflect substantive practices rather than symbolic compliance (Gereffi & Lee, 2016; Steinle & Schiele, 2008). As a result, ESG signals become noisier and less credible in geographically distant supplier–customer relationships.

Moreover, greater geographic distance often implies operating across more geographically dispersed institutional contexts, which are typically characterized by institutional, regulatory, and cultural heterogeneity (Delios & Beamish, 1999). Such heterogeneity further complicates the interpretation and enforcement of ESG standards across locations (Dhanorkar & Muthulingam, 2020; Goerzen & Beamish, 2003). Taken together, these factors heighten uncertainty about suppliers' underlying sustainability practices and weaken customers' ability to rely on ESG performance when making financially consequential decisions. Consequently, the positive spillover effect of suppliers' ESG performance on customers' trade credit decisions is expected to diminish as geographic distance increases. Thus, we propose:

H2: *The positive spillover effect of supplier ESG performance on customer trade credit weakens as supplier-customer geographic distance increases.*

2.3. Supplier power

Supplier power refers to the extent to which suppliers can influence transaction terms and shape the allocation of risks in exchange relationships (Wang et al., 2023). Building on Connelly et al. (2011), supplier power can shape the informational environment of supplier–customer relationships by functioning as an alternative signal of supplier reliability and stability. When customers are highly dependent on suppliers due to resource criticality or market dominance, suppliers possess strong bargaining power (Trinh & Zhao, 2024). This positional advantage itself conveys credibility regarding continuity, performance, and enforcement capacity. In such settings, customers rely less on ESG ratings to infer supplier quality because supplier power already serves as a salient and credible signal (Cheng et al., 2014). As a result, the marginal informational value of suppliers' ESG performance declines, reducing its effectiveness in shaping customers' financial decisions (Connelly et al., 2011).

Specifically, this mechanism becomes more salient in contexts where suppliers face liquidity constraints and prioritize cash flow protection. Under these conditions, powerful suppliers are more likely to impose rigid trade terms based on bargaining power rather than engage in relational trust-building through sustainability signaling (Fabbri & Klapper, 2016; Xin et al., 2024). Consequently, ESG performance plays a diminished role in shaping customers' trade credit decisions when supplier power is high. By contrast, when supplier power is limited, ESG ratings become more informative and valuable as credibility signals (Bond & Levit, 2025; Hoejmose et al., 2013), reassuring customers and facilitating trade credit extension. Accordingly, we expect that stronger supplier power attenuates the positive spillover effect of supplier ESG performance on customer trade credit decisions.

H3: *The positive spillover effect of supplier ESG performance on customer trade credit weakens as supplier bargaining power increases.*

The research framework of this research is shown in Figure 1.

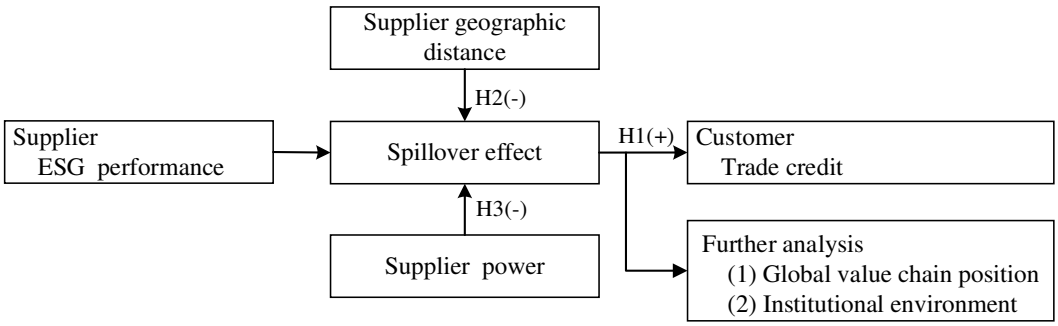

Fig. 1. Research framework

3. Data and methodology

3.1. Sample and data

We collect data from several databases. The main ESG data used in this study comes primarily from the *Sino-Securities Index* (*SSI*) ESG Ratings, which are compiled by the Wind database in collaboration with third-party rating agencies (Luo et al., 2023). These ratings are not self-reported by firms but externally assessed based on publicly available ESG disclosures. The *SSI* ESG system is grounded in international frameworks such as *GRI*, *SASB*, and *TCFD*, and adjusted for Chinese market characteristics. It evaluates firms across three main dimensions: Environmental, Social, and Governance, which are broken down into 16 categories and 38 key performance indicators. Scores range from 1 (lowest) to 9 (highest), providing a comprehensive benchmark for sustainability performance.

To identify supplier-customer dyads, we use *CSMAR*, a robust and comprehensive financial and economic database recognized internationally. *CSMAR* provides a detailed assortment of data mirroring the structure of well-established databases, covering various aspects of the Chinese economy, including supply chain relationships and corporate financials. Thus, it has been used to construct the dyadic relationships in studies of corporate social responsibility (He et al., 2023), trade credit (Zhang et al., 2024), supply chain transparency (Shi et al., 2024). In addition, *CSMAR* also provides data of national standard industrial classification (SIC) and geographical positions of firms, and financial statements, which are used to construct our moderators and control variables in our study. Finally, to further analyze the data from the perspective of the global value chain and institutional environment, we collect value chain characteristics data and provincial regulatory data from the China *NBS*.

To test the spillover effect of suppliers' ESG on customers' trade credit, we focus on the tier-one suppliers of customers (i.e., manufacturing firms), because a tier-one supplier has a more direct association with the customer than a tier-two supplier or others. We first identify all manufacturers as customers and their disclosed tier-one suppliers listed between 2009 and 2023. We then exclude suppliers from industries in the Trade, Finance, Service, and Public administration sectors (Song et al., 2024). We then determine the tier-one suppliers for the list of manufacturers. Then, we match this data list with ESG of SSI and financial data, and also drop observations of suppliers and customers with missing ESG information and other missing data on trade credit and control variables. Finally, our sample contains 1,234 observations with a supplier-customer dyad structure. This data cleaning process is summarized in Table 1. Furthermore, based on the final sample constructed through the process reported in Table 1, we present the industry distribution of customers by two-digit SIC codes.

Table 1

Data cleaning process

Steps（Referring to Song et al. (2024)）	No. of suppliers	No. of customers	No. of dyads
Step 1: excluding suppliers from industry in the *Trade, Finance, Service, and Public-administration* sectors, Compile a list of customers and all listed tier one suppliers between 2009 to 2023.	820	786	2195
Step 2: Match SSI ESG from wind and financial data from *CSMAR* to suppliers and customers.	479	511	1339
Step 3: Drop observation with missing on the independent, dependent, control variables.	451	488	1234
Step 4: Final supplier-customer dyads observations		1234	

3.2. Variable definition and measurement

3.2.1. Dependent variable

Customers' trade credit. TC^C, denotes the scale of trade credit received from suppliers obtained by customers within the supplier-customer dyad. Using financial statement data from *CSMAR*, the customers' trade credit is measured by the ratio of accounts payable to purchases (i.e., cost of goods sold) (Chod et al., 2019; Dass et al., 2015; Fabbri & Klapper, 2016). As a robustness test using an alternative measurement, we also compute the ratio of total accounts payable to total assets (Cai et al., 2014; Jhang et al., 2021; Zhang et al., 2024). Unless otherwise noted, all empirical analyses use the ratio of accounts payable to purchases as the main

dependent variable, while the ratio of total accounts payable to total assets is employed in robustness tests.

3.2.2. Independent variable

Suppliers' ESG performance. ESG^S, is measured by ESG rating scores of the *SSI* from the *Wind* database, covering A-share companies more comprehensively in China (Luo et al., 2023). ESG ratings of the *Wind* are based on international mainstream frameworks (e.g. *GRI, SASB, TCFD*, etc.), combined with Chinese localized market characteristics, and are constructed as a multi-tier evaluation system. The ESG rating system is characterized by scores ranging from 1 to 9, with 1 indicating the lowest level of ESG performance.

However, the emerging literature raises concern about the reliability of ESG ratings as ESG ratings may vary across providers due to differences in underlying methodologies (Berg et al., 2022; Chatterji et al., 2016). Chatterji et al. (2016) emphasized that such divergence arises largely due to differences in theorization and commensurability, as rating agencies often disagree on what aspects of ESG should be measured and how to measure them. For example, one agency may evaluate labor practices based on employee turnover rates, while another may emphasize third-party certifications or workplace diversity, leading to inconsistent evaluations even within the same ESG pillar. Berg et al. (2022) quantitatively decomposed the divergence and found that measurement differences (i.e., the ways agencies assess the same ESG attribute) account for 56% of the overall disagreement, followed by scope differences (38%) (i.e., whether a specific ESG issue is considered), and weighting differences (6%), (i.e., how much importance is assigned to each issue in the final score). This could introduce measurement noise or endogeneity in study of the relationship between supplier ESG performance and customer trade credit.

Therefore, to ensure the robustness of the estimation results and mitigate concerns about inconsistency across ESG providers, we conducted the following approaches. First, we introduce ESG divergence as a control variable by calculating the difference between ESG ratings from different agencies. Second, we perform robustness checks using ESG rating scores from *Bloomberg*, which are globally recognized and constructed based on a consistent, disclosure-based framework (Li et al., 2023). The similarity in results across these approaches confirms that the findings are not driven by a specific ESG provider.

3.2.3. Moderating variables

Supplier geographic distance, GD^S, represents the total geographic distance between customers and tier-one suppliers (Bode & Wagner, 2015). We measure geographic distance in terms of the actual geographic distance between customers and suppliers, capturing the degree of geographic variation among supplier chain members. Geographic distance among supply chain members increases the search costs for customers and thus reduces knowledge and information availability. This is calculated as follows in formula (1):

$$\begin{aligned} Geographic\ \ distance_{i,t}^{S} &= \sum_{j=1}^{n} \frac{2\pi r}{360} \Big[\text{across}\big[\cos(\text{lat}_j)\cos(\text{lon}_j)\cos(\text{lat}_i) \\ &+ \cos(\text{lat}_j)\, sin(\text{lon}_j)\cos(\text{lat}_i) \\ &+ sin(\text{lat}_j)\, sin(\text{lat}_i)\big]\Big] \end{aligned} \quad (1)$$

where j represents the tier-one supplier of each customer i at moment t. lat and lon denote the latitude and longitude of customers and tier-one suppliers, expressed in degrees. r is the radius of the Earth, specified as 6378 km.

Supplier power, SP^S, following Porter (1980)'s framework, is conceptualized as the extent to which suppliers can exert bargaining leverage and influence over customers in trade credit arrangements. In line with prior empirical research (Rahaman et al., 2022; Trinh & Zhao, 2024), we measure supplier power through supplier concentration, which captures the degree of dependency of a firm on a limited number of suppliers. Specifically, we construct a Herfindahl-Hirschman Index (HHI) based on the distribution of a firm's purchase shares across its major suppliers, consistent with approaches used by Patatoukas (2012). A higher index value indicates greater concentration of purchases among fewer suppliers, reflecting stronger supplier power and hence greater bargaining leverage in credit negotiations. It is calculated as shown in the formula (2).

$$Supplier\ \ power_{i,t}^{S} = \sum_{s=1}^{N} \left(\frac{V_{st}}{TV_{it}}\right)^2 \times (-1) \quad (2)$$

where V_{st} is the value of purchases by firm i from supplier s in year t, TV_{it} is the total value of purchases from all suppliers, which is used to compute a concentration index, ranging from 0 to 1.

3.2.4. Control variables

To control for other disturbing factors that may affect the empirical results, following previous literature (Barros et al., 2024; Trinh & Zhao, 2024), we introduce multiple control variables related to supplier and customer characteristics. First, we control for customer-based characteristics, including ESG practice level (ESG^C), size ($Size^C$), listing age ($ListAge^C$) , profitability (ROA^C), leverage (Lev^C), book market value (BM^C), liquidity ($Quick^C$), the ratio of independent directors ($Indep^C$), board size ($Board^C$). These factors may influence the relationship between customers' trade credit and supplier ESG performance.

Second, we control for supplier-based characteristics. On the one hand, while ESG ratings serve as a positive signal that reduces information asymmetry, ESG inconsistencies may lead to negative outcomes (Yang & Tian, 2024). Thus, we control the supplier ESG divergence ($DiverESG^S$) by calculating the overall standard deviation of a supplier's ESG ratings across the six agencies (Berg et al., 2022; Liu et al., 2024). This ESG divergence is measured across six third-party agencies, *FTSE Russell*, *MSCI*, *Hua Zheng, Menglang, Shangdao Ronglv, and Wind*. On the other hand, investing in ESG practices involves substantial costs, making adoption contingent on firms' capability (Cheng et al., 2014; Dhaliwal et al., 2011; Kim et al., 2012). Therefore, we control for the supplier characteristics including age, size, profitability, and market share, which may affect suppliers' ESG practice.

Moreover, to account for the macro characteristics that may affect signal intensity, we control for the level of digital infrastructure at the province level ($DigitPro^S$) obtained from official government statistical reports. Specifically, $DigitPro^S$ is constructed using text analysis of official government work reports by identifying keywords related to new digital infrastructure and computing their proportion relative to the total number of words in each report. Higher values indicate more advanced digital infrastructure. The definition and measurement of these variables are summarized in Table 2.

Table 2
Variable definition and measurement

Type	Name	Symbol	Definition and Measurement	References
Dependent	Customer trade credit	TC^C	Accounts payable to all purchases/ Accounts payable to total assets	e.g., Cai et al. (2014); Chod et al. (2019)
Independent	Suppliers ESG performance	ESG^S	ESG rating scores by SSI	e.g., Luo et al. (2023)

Moderators	Supplier geographic distance	GD^S	Total geographic distance from supplier to customer	Bode and Wagner (2015)
	Supplier power	SP^S	HHI	Rahaman et al. (2022); Trinh and Zhao (2024)
Customer-level Controls	ESG	ESG^C	Customer's ESG rating scores by SSI	e.g., Luo et al. (2023)
	Size	$Size^C$	The natural logarithm of customer's total assets	Rahaman et al. (2022)
	List age	$ListAge^C$	ln (the number of listed years +1)	
	Profitability	ROA^C	Customer's net profit to total assets	
	Leverage	Lev^C	Ratio of total debt to total asset	
	Book market value	BM^C	Book value to total market value	Trinh and Zhao (2024)
	Liquidity	$Quick^C$	Current assets less inventories, divided by current liabilities	Barros et al. (2024)
	Ratio of the independent directors	$Indep^C$	No. of independent directors to No. of all board members	
	Board size	$Board^C$	Capital expenditure to total assets	
Supplier-level Controls	ESG divergence	$DiverESG^S$	The overall standard deviation of ESG ratings across the six agencies	e.g., Berg et al. (2022)
	Age	Age^S	ln (the number of establishment years +1)	Trinh and Zhao (2024)
	Size	$Size^S$	The natural logarithm of supplier's total asset	
	Profitability	ROA^S	Supplier's net profit to total assets	
	Leverage	Lev^S	Ratio of total debt to total asset	
	Share percentage	$Weight^S$	Supplier's share of customer purchases	
Macro-level control	Digital infrastructure in province level	$DigitPro^S$	The proportion of digital infrastructure in province	

3.3. Model specification

To test our hypotheses, following Cameron and Miller (2015) and Song et al. (2024)'s research, we estimate a panel model with supplier-customer dyads fixed effects and year fixed effects, and cluster robust standard errors at the customer level. The inclusion of dyad fixed effects absorbs all time-invariant characteristics at the supplier-customer relationship level, including persistent customer financing policies, long-term contractual arrangements,

bargaining power, and unobserved relational heterogeneity between each supplier-customer pair. The dyad fixed effect is more stringent and subsumes any time-invariant supplier or customer-specific factors within a given relationship. As a result, the estimated coefficients are identified from within-dyad variation over time, rather than from cross-sectional differences across firms or relationships. Year fixed effects control for common macroeconomic shocks, regulatory changes, and time trends that affect all supplier-customer dyads in a given year.

Furthermore, we cluster standard errors at the customer level to account for potential serial correlation and heteroskedasticity arising from customer's repeated trade credit decisions across multiple suppliers over time. This clustering choice follows prior studies on supplier-customer relationship at the dyads level (Song et al., 2024), and provides conservative inference when residuals may be correlated within customers across dyads. The baseline specification is shown in Equation (1):

$$TC_{j,t}^{C} = \beta_0 + \beta_1 ESG_{i,t}^{S} + \delta X_{j,t} + \gamma X_{i,t} + \mu_{i,j} + \theta_t + \varepsilon_{i,j,t} \quad (1)$$

where i indicates the supplier, j indicates the customer, and t denotes the year. $X_{j,t}$ and $X_{i,t}$ represent the control variables discussed in Section 3.2.4, $X_{j,t}$ denotes customer-level control variables and $X_{i,t}$ denotes supplier-level control variables. The $\mu_{i,j}$ denotes supplier-customer dyad fixed effects, and θ_t denotes year-fixed effects, and $\varepsilon_{i,t}$ denotes the error term.

To examine the moderating effects proposed in Hypotheses 2 and 3, we extend Equation (1) by introducing interaction terms between supplier ESG performance and geographic distance ($GD_{i,j}^{S}$) or supplier power (SP_i^{S}), as shown in Equations (2) and (3):

$$TC_{j,t}^{C} = \beta_0 + \beta_1 ESG_{i,t}^{S} + \beta_2 GD_{i,j}^{S} + \beta_3 GD_{i,j}^{S} \times ESG_{i,t}^{S} + \delta X_{j,t} + \delta X_{i,t} + \mu_{i,j} + \theta_t + \varepsilon_{i,jt} \quad (2)$$

$$TC_{j,t}^{C} = \beta_0 + \beta_1 ESG_{i,t}^{S} + \beta_2 SP_i^{S} + \beta_3 SP_i^{S} \times ESG_{i,t}^{S} + \delta X_{j,t} + \delta X_{i,t} + \mu_{i,j} + \theta_t + \varepsilon_{i,jt} \quad (3)$$

where the interaction terms, $GD_{i,j}^{S} \times ESG_{i,t}^{S}$ and $SP_i^{S} \times ESG_{i,t}^{S}$ capture the moderating roles of geographic distance and supplier power in the relationship between supplier ESG performance and customer trade credit.

4. Empirical results

4.1. Descriptive statistics and correlation analysis

The descriptive statistics for this study are presented in Table 3. For the dependent variable,

the average value of trade credit is 0.096, with a standard deviation of 0.074, indicating notable variation in trade credit levels among listed customers in China. In contrast, for the independent variables, the mean ESG score is 4.485, with a standard deviation of 0.992, suggesting that listed suppliers show considerable differences in ESG ratings and varying levels of focus on ESG practices. Additionally, Table A.1 presents the correlation analysis of all variables, and the correlations among these variables are much smaller than 0.6, indicating that the regression model is not significantly affected by multicollinearity. Furthermore, to prevent a high degree of covariance, we performed the VIF test for all variables and found that the average of VIF value is 1.53 ($VIF < 3$), suggesting that multicollinearity is within an acceptable range.

Table 3

The results of descriptive statistics

Variable	Obs	Max	Min	Mean	p25	p50	p75	Std.
TC^C	1234	0.411	0	0.096	0.040	0.076	0.135	0.074
ESG^S	1234	7	1	4.485	4	4	5	0.992
$DiverESG^S$	1234	0.629	0	0.096	0	0.006	0.176	0.127
Age^S	1234	3.689	1.609	2.953	2.773	2.996	3.135	0.297
$Size^S$	1234	28.64	19.38	23.50	22.30	23.28	24.42	1.709
ROA^S	1234	0.602	-0.225	0.045	0.014	0.040	0.070	0.063
Lev^S	1234	1.050	0.044	0.496	0.358	0.506	0.645	0.191
$Weight^S$	1234	96.87	0.010	9.264	3.110	5.200	9.180	12.74
$DigitPro^S$	1234	0.006	0	0.002	0.001	0.002	0.003	0.001
ESG^C	1234	7	1	4.022	4	4	5	0.919
$ListAge^C$	1234	3.434	0	2.035	1.386	2.197	2.833	0.976
$Size^C$	1234	28.23	19.40	22.19	21.20	21.92	22.96	1.424
ROA^C	1234	0.344	-0.804	0.030	0.012	0.034	0.060	0.065
Lev^C	1234	1.303	0.021	0.445	0.280	0.430	0.606	0.210
BM^C	1234	1.335	0.053	0.678	0.493	0.692	0.874	0.254
$Quick^C$	1234	45.46	0.052	1.655	0.509	0.946	1.754	2.619
$Indep^C$	1234	0.667	0.214	0.367	0.333	0.333	0.400	0.061
$Board^C$	1234	3.219	1.609	2.333	2.197	2.303	2.485	0.220
GD^S	1234	1	0.037	0.184	0.095	0.156	0.224	0.130
SP^S	1234	7.663	0	4.976	4.617	5.217	5.867	1.580

4.2. Main empirical result

Table 4 reports the results of the baseline regressions examining the effect of supplier ESG performance on customer trade credit. Specifically, Column (1) shows the estimation result, controlling for supplier-customer dyads and year fixed effects, with standard errors clustered as the customer level, the coefficient of supplier ESG ($\beta_1 = 0.019$) is positive and statistically significant at the 5% level, indicating that suppliers with better ESG performance are more likely to provide their customers with greater trade credit. This finding supports our H1. In terms of economic significance, the estimates suggest that a one standard-deviation increase in

a supplier's ESG score is associated with an approximate 1.9% increase in the ratio of customer accounts payable to total purchases. This magnitude is economically meaningful, as it indicates that improvements in suppliers' sustainability practices translate into greater trade credit extended to customers.

Control variables also behave largely as expected. Larger firms, firms with higher profitability, and those with lower leverage tend to enjoy greater trade credit, consistent with prior evidence that stronger financial profiles reduce suppliers' concerns about repayment risk. In addition, the supplier and customer dyads fixed effects of Column (2) further confirm that the observed ESG effect is not driven by unobserved heterogeneity over time ($\beta_1 = 0.016$, significantly positive at the 5% level).

Overall, the baseline results provide robust evidence that supplier ESG performance generates positive spillover effects on customer trade credit, highlighting the financial relevance of sustainability practices in inter-firm credit relationships.

Table 4

Estimation results of baseline fixed-effect model

Variables	(1)	(2)
ESG^S	0.019**	0.016**
	(1.99)	(2.04)
$DiverESG^S$	0.012	0.010
	(0.21)	(0.27)
Age^S	-0.081	0.022
	(-0.34)	(0.94)
$Size^S$	-0.042	-0.005
	(-0.97)	(-0.52)
ROA^S	0.236	0.033
	(1.14)	(0.23)
Lev^S	0.232*	0.088*
	(1.90)	(1.86)
$Weight^S$	-0.000	-0.001
	(-0.30)	(-1.17)
$DigitPro^S$	-6.283	-3.963
	(-0.86)	(-0.90)
ESG^C	0.016*	0.003
	(1.87)	(0.39)
$ListAge^C$	0.069	0.058
	(1.57)	(1.18)
$Size^C$	-0.081**	-0.094**
	(-2.43)	(-2.45)
ROA^C	-0.032	0.082
	(-0.30)	(0.85)

Lev^C	0.184**	0.314***
	(2.20)	(4.14)
BM^C	0.189***	0.139**
	(2.74)	(2.11)
$Quick^C$	-0.021**	-0.008
	(-2.48)	(-1.51)
$Indep^C$	-0.077	-0.122
	(-0.83)	(-1.27)
$Board^C$	-0.057*	-0.019
	(-1.69)	(-0.57)
Constant	2.812*	1.983**
	(1.76)	(2.24)
Observations	1234	1234
R^2	0.843	0.811
Supplier-customer dyad FE	Yes	Yes
Year FE	Yes	No

t-statistics in parentheses*** p<0.01, ** p<0.05, * p<0.1

4.3. Moderating mechanism analysis

To further investigate the mechanisms through which supplier ESG performance influences customer trade credit, we examine two moderating factors: geographic distance between suppliers and customers, and supplier power. The estimation results are shown in Table 5.

4.3.1. Moderating effect of geographic distance

Column (1) of Table 5 includes supplier geographic distance (GD^S) and its interaction with supplier ESG performance (ESG^S). The coefficient of GD^S is negative ($\beta_2 = -0.011, p_{value} < 0.1$), indicating that greater geographic distance weakens customer trade credit. More importantly, the interaction term $GD^S \times ESG^S$ is also negatively significant ($\beta_3 = -0.003,\ p_{value} < 0.1$). This suggests that the positive effect of suppliers' ESG performance on customers' trade credit diminishes when suppliers are geographically distant from customers. This implies that the ESG signal is weaker in long-distance relationships**,** possibly due to higher information asymmetry or reduced supplier-customer trust over extended geographical distances.

In the view on the economically meaningful of geographic distance, a one-standard deviation increase in supplier-customer geographic distance reduces the marginal effect of supplier ESG performance on customer trade credit by approximately 0.04%, which corresponds to about 0.4% of the mean trade credit level. This result indicates that although

ESG performance continues to exert a positive influence, its economic value as a signal is attenuated in geographically distant supplier-customer relationships, consistent with higher verification costs and lower signal observability.

4.3.2. Moderating effect of supplier power

Column (2) of Table 6 presents the moderating effect of supplier power (SP^S) on the relationship between supplier ESG performance and customer trade credit. The coefficient of the interaction term ($SP^S \times ESG^S$) is negative and statistically significant between supplier ESG and supplier power ($\beta_3 = -0.015,\ p_{value} < 0.05$), indicating that the positive effect of supplier ESG on customer trade credit weakens as supplier power increases. This result is consistent with our theoretical argument that dominant suppliers rely less on ESG signaling to reduce information asymmetry, since their bargaining advantage already serves as an alternative signal of stability and reliability.

Furthermore, the moderating role of supplier power is not only statistically significant but also economically substantial. A one standard-deviation increase in supplier power reduces the marginal effect of ESG on trade credit by approximately 2.4%, corresponding to nearly 25% of the mean trade credit level. This sizeable attenuation suggests that when suppliers possess strong bargaining power, ESG performance yields markedly smaller trade credit benefits. The result supports the view that supplier power acts as a substitute signal that crowds out the informational role of ESG in shaping inter-firm credit decisions. When supplier power is strong, the marginal informational role of ESG diminishes, because credit terms are determined primarily by suppliers' market dominance rather than their sustainability performance.

Table 5

Estimation results on moderating role of geographic distance and supplier power

Variables	Moderating effects	
	(1)	(2)
ESG^S	-0.015*	0.005*
	(-1.89)	(1.88)
GD^S	-0.011*	
	(-1.66)	
$GD^S \times ESG^S$	-0.003*	
	(-2.08)	
SP^S		0.011
		(0.26)
$SP^S \times ESG^S$		-0.015**
		(-1.47)

$DiverESG^S$	0.001	0.004
	(0.08)	(0.29)
	(1.89)	(1.74)
Supplier-level control	Yes	Yes
Customer-level control	Yes	Yes
Observations	1234	1234
R^2	0.907	0.908
Supplier-customer dyad FE	Yes	Yes
Year FE	Yes	Yes

t-statistics in parentheses*** p<0.01, ** p<0.05, * p<0.1

4.4. Robustness check

To ensure the validity of our findings, we conduct a series of robustness checks and report the results in Table 6 and Table 7. Specifically, we re-estimate the baseline model by employing six approaches, including the instrument variable approach, propensity score matching, lagged one period on ESG, the Heckman two-stage regression, and alternative measurements on the independent variable and dependent variable to mitigate possible reverse-causality, endogenous issues, potential sample selection bias and measurement bias in the main variables.

4.4.1. Instrument variable approach

In order to mitigate potential endogeneity issues arising from reverse causality and omitted variables between supplier ESG performance and customer trade credit, we adopt an instrumental variable approach. Following Huang and Dou (2024)'s method, we use Environmental Regulation Intensity (ERI^{Pro}) in the province where the supplier is located as an instrument for supplier ESG performance. The descriptive statistics of ERI^{Pro} show that the mean value is 0.019953 (Min: 0.000476, Max: 0.151619) with a standard deviation of 0.017801. ERI^{Pro} captures the stringency of environmental regulations implemented by local governments, as reported in official government statistics. Environmental regulation primarily operates as a supplier-side institutional pressure, encouraging firms to increase investments in environmental compliance, sustainability practices, and ESG disclosures. Accordingly, suppliers located in provinces with more stringent environmental regulations face stronger incentives to improve their ESG performance, ensuring the relevance of the instrument.

Regarding the exclusion restriction, our identification strategy rests on the argument that ERI^{Pro} affects customer trade credit decisions toward a specific supplier mainly through its impact on supplier ESG performance, rather than through direct channels. Importantly,

environmental regulation in China targets firms' environmental compliance and disclosure obligations and does not directly regulate interfirm credit arrangements. Moreover, ERI^{Pro} is measured at the supplier's provincial level, whereas the dependent variable reflects time-varying trade credit decisions within supplier-customer dyads. Our baseline specifications include supplier-customer dyad fixed effects and year fixed effects, which absorb all time-invariant characteristics at the dyad level, including customers' persistent financing constraints, long-term credit policies, and relationship-specific factors, as well as common macroeconomic and regulatory shocks over time. As a result, any direct effect of environmental regulation on customer-side financing conditions that does not vary within a dyad over time is effectively controlled for.

Empirically, we adopt the Two-Stage Least Squares (2SLS) model for the regression of instrumental variable, and its results are presented in the Column (1) and (2) of Table 6. Column (1) demonstrates the results of the first-stage estimation that the correlation between ERI^{Pro} and supplier ESG is significantly positive at the 1% level (the coefficient of ERI^{Pro} is 0.011), indicating that the ERI^{Pro} has a significant explanatory power on supplier ESG. Column (2) shows the result of the second-stage estimation, in which the coefficient of supplier ESG is significantly positive at the 5% level. Therefore, we mitigate the potential endogeneity issues in the baseline regression using IV-2SLS, confirming the robustness of the baseline conclusion.

Table 6

The estimation results of robustness test by IV-2SLS, PSM and Lag-ESG

Variables	IV-2SLS		PSM	Lag-ESG
	(1)	(2)	(3)	(4)
ERI^{Pro}	4.324***			
	(3.27)			
ESG^{S}		0.051**	0.016***	
		(1.86)	(3.44)	
Lag_ESG^{S}				0.002**
				(1.67)
Supplier-level control	Yes	Yes	Yes	Yes
Customer-level control	Yes	Yes	Yes	Yes
Constant	-1.740	2.118***	2.025***	0.361
	(-0.55)	(7.35)	(5.72)	(1.59)
Observations	1234	1234	1,064	1234
R-squared	0.609	0.815	0.832	0.912
Supplier-customer dyad FE	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes

t-statistics in parentheses*** p<0.01, ** p<0.05, * p<0.1

4.4.2. Propensity score matching

To further address potential sample selection bias and endogeneity issues caused by differences in control variables, we employ the propensity score matching (PSM) method to validate the robustness of our findings. Specifically, we use the industry median in the same year as the classification criterion to divide the sample into a high-ESG group (equal to 1 if supplier ESG is greater than the industry median in the same year), otherwise a low-ESG group (equal to 0 otherwise). All control variables are included as covariates, and a 1:1 nearest-neighbor matching is performed between the two groups to ensure that each high-ESG sample has a closely matched counterpart in the low-ESG group based on the covariates. The regression outcomes following PSM matching are shown in Table 6, Column (3), where the regression coefficient of ESG^S is 0.016, which is significantly positive at the 1% level. This result indicates that after controlling for sample selection bias and differences in control variables, the research findings remain robust.

4.4.3. Lagged one period on supplier ESG

To further mitigate potential concerns about reverse causality and endogenous issues, we re-estimate the baseline model by lagging supplier ESG by one period. The logic is that current customer trade credit decisions are unlikely to influence the supplier's past ESG practices, which helps address simultaneity issues. The results reported in Column (4) of Table 6 show that the coefficient of lagged supplier ESG remains positive and significant at the 5% level (coefficient of ESG^S is 0.002). This finding suggests that supplier ESG performance has a persistent and lagged effect on customer trade credit, reinforcing the causal interpretation of our baseline findings.

4.4.4. Heckman two-stage regression

Next, although the China Securities Regulatory Commission encourages listed companies to reveal information about their top five suppliers, the decision to disclose ultimately lies with the companies. In this study, the disclosure of supplier information may introduce sample selection bias. To address this issue, we adopt the Heckman two-stage regression model for further testing (Heckman, 1979). First, using a probit model, we construct a dummy variable

(ESG^S_dummy) to determine whether a supplier's ESG rating score is below the median value of the industry and province in the same year. If the supplier's ESG rating is above the industry and provincial median for the same year, ESG^S_dummy is set to 1; otherwise, it is set to 0. At the same time, key control variables of Model (1) in Section 3.3 are included in the regression to obtain the inverse Mills ratio (IMR). Next, the IMR as a selection-correction term, is incorporated in Eq. (1). The results in Column (1) of Table 7 show that the IMR is not significant. Then, the estimation coefficient of ESG^S_dummy is 0.019, and is significantly positive at the 5% level by amending, thereby supporting H1.

Table 7

The estimation results of robustness test by Heckman two-stage, Alternative measurement of ESG and trade credit

Variables	Heckman two-stage	Alternative measurement of supplier ESG	Alternative measurement of customer trade credit
	(1)	(2)	(3)
ESG^S_dummy	0.019**		
	(2.03)		
$Bloomberg\ \_ESG^S$		0.019**	
		(2.51)	
ESG^S			0.003*
			(1.87)
IMR	-0.235		
	(-0.41)		
Supplier-level control	Yes	Yes	Yes
Customer-level control	Yes	Yes	Yes
Constant	3.700	0.704	0.202
	(1.25)	(0.94)	(0.72)
Observations	1234	844	1234
R-squared	0.843	0.912	0.929
Supplier-customer dyad FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

t-statistics in parentheses*** p<0.01, ** p<0.05, * p<0.1

4.4.5. Alternative measurement by supplier ESG

To address potential concerns regarding measurement bias associated with ESG ratings from a single agency (e.g., *Sino-Securities Bond* ESG), we employ *Bloomberg* ESG scores as an alternative measure (Li et al., 2009). The regression results, reported in Column (2) of Table 7, show that the coefficient of supplier ESG is 0.019, remains positive and statistically significant at the 5% level. This finding confirms that our baseline results are not driven by a

particular data provider and further strengthens the evidence for the spillover effect of supplier ESG performance on customer trade credit, thereby supporting H1.

4.4.6. Alternative measurement of trade credit

To ensure the robustness of our results to alternative definitions of the dependent variable, we measure customer trade credit using the ratio of total accounts payable to total assets, which has been widely adopted in prior studies (Cai et al., 2014; Jhang et al., 2021; Zhang et al., 2024). The results are shown in Column (3) of Table 7, where the estimated coefficient of supplier ESG remains positive and statistically significant at the 10% level. This consistency with the baseline findings based on accounts payable to total purchases confirms that our results are not sensitive to the particular choice of trade credit measurement.

4.5. Post-hoc analysis

To further examine the boundary conditions of the ESG spillover effect, we conduct heterogeneity analyses along two dimensions: firms' status in the global value chain and the institutional environment in which they operate. Following signaling theory (Connelly et al., 2011; Spence, 1973), signals are particularly valuable when information asymmetry is high, as they enable external stakeholders to infer unobservable firm qualities.

First, we split the sample into high-tech and low-tech industries. Prior research suggests that high-tech firms are subject to greater information asymmetry due to the complexity and intangibility of their products and processes in the supply chain (Aboody & Lev, 2000; Teece, 1986). In such contexts, ESG performance serves as a salient relational signal, conveying suppliers' long-term commitment, reliability, and sustainability orientation. By mitigating uncertainty, these signals become more credible and relevant. Accordingly, the spillover effect of supplier ESG performance on customer trade credit is expected to be stronger in high-tech industries.

Second, we consider heterogeneity across firms operating in more strictly versus less strictly regulated financial environments. From a signaling perspective, formal monitoring and compliance requirements in highly regulated contexts reduce information asymmetry by providing reliable information through institutional channels (Allen et al., 2005). As a result, the marginal value of ESG signals diminishes. By contrast, in less regulated environments with

weaker institutional oversight, information asymmetry is more severe, making ESG performance a critical substitute signal that helps firms establish credibility and build trust in inter-firm transactions. Thus, the spillover effect of supplier ESG performance on customer trade credit is expected to be stronger in less regulated settings. These results are presented in Table 8.

4.5.1. Global value chain position

Firms in different positions within the global value chain exhibit varying supply chain structures, degrees of globalization, and value capture capacities. These differences may influence the spillover effects of supplier ESG performance on customer trade credit. Column (1) and (2) show that the coefficient of ESG^S ($\beta_1 = 0.038$) is significantly positive at the 1% level in high-tech industries, while in low-tech industries, the effect is insignificant. These findings suggest that the spillover effect of ESG is contingent on industry type, with stronger effects observed in high-tech industries where ESG plays a critical role in market positioning and supply chain transparency. High-tech industries (e.g., Semiconductor, Biopharmaceutical) rely on global supply chains for sourcing, R&D, and production. Firms in these industries are typically midstream or downstream players, heavily dependent on reputation and investor trust. Customers in these industries may prefer to reward suppliers with high ESG ratings by extending trade credit, as strong ESG ratings signal sustainability, innovation, and regulatory compliance.

However, low-tech industries (e.g., Textiles, Chemicals, Mining) are more localized, with a stronger emphasis on cost control and large-scale production. In these industries, ESG primarily affects compliance rather than trade credit relationships, as customers may focus more on factors such as production efficiency rather than sustainability commitments. As a result, supplier ESG has little to no impact on trade credit availability in low-tech sectors. These findings suggest that the spillover effect of ESG is contingent on industry type.

4.5.2. Region financial regulation level

Additionally, the level of financial regulation in a region shapes market transparency and the availability of corporate information. Financial regulation is often measured by the ratio of financial regulatory expenditures to financial industry value-added, which reflects the strength

of financial oversight in a given region. Column (3) and (4) show that, in regions with high financial regulation, the coefficient of ESG^S is insignificant, whereas in regions with low financial regulation, the coefficient ($\beta_1 = 0.026$) is significantly positive at the 10% level. This suggests that supplier ESG has a greater spillover effect on customer trade credit in regions with weaker financial oversight.

High financial regulation regions are characterized by high market transparency, where firms' financial and ESG information is readily available. Customers in these regions already have access to comprehensive credit information, reducing their reliance on supplier ESG signals when making trade credit decisions. As a result, the impact of supplier ESG on trade credit is limited. In contrast, regions with lower financial regulation tend to have reduced market transparency, making it harder for customers to evaluate the creditworthiness of suppliers. In such environments, supplier ESG performance acts as a crucial signal for business stability and long-term viability for customers, leading to a stronger spillover effect on trade credit. Customers may prefer to use ESG as a proxy for trustworthiness, especially in the absence of reliable financial disclosures.

Table 8

Further analysis on global value chain position and region regulation level

Variables	Global value chain position		Region regulation level	
	High-tech	Low-tech	High	Low
	(1)	(2)	(3)	(4)
ESG^S	0.038***	0.006	0.009	0.026*
	(2.82)	(0.82)	(1.36)	(1.70)
Supplier-level control	Yes	Yes	Yes	Yes
Customer-level control	Yes	Yes	Yes	Yes
Constant	5.869**	0.836	-0.385	6.752*
	(2.54)	(0.78)	(-0.57)	(1.96)
Observations	567	667	565	669
R^2	0.900	0.883	0.897	0.850
Supplier-customer dyads FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

t-statistics in parentheses*** p<0.01, ** p<0.05, * p<0.1

5. Discussion and conclusion

Given the growing importance of ESG in sustainable business practices (Barros et al., 2024; Cao et al., 2023; Li et al., 2023; Sariyer et al., 2024), this study examines how

suppliers' ESG performance generates spillover effects on customers' trade credit decisions within supplier-customer dyads. Drawing on signaling theory, we argue that a supplier's ESG rating functions as a credible external signal that reduces information asymmetry and enhances customer trust in the supplier's long-term stability and sustainability commitments. Our empirical evidence shows that higher supplier ESG ratings are associated with greater trade credit provision by customers. Moreover, the strength of this relationship is contingent on contextual factors. Geographic proximity enhances the credibility of ESG signals, whereas greater geographic distance diminishes their impact. Similarly, strong supplier bargaining power weakens the role of ESG, as dominant suppliers rely less on sustainability signals when negotiating credit terms. These findings underscore that suppliers' ESG performance has broader financial and relational implications, shaping trade credit decisions.

5.1. Research implications

This study contributes to the supply chain finance literature by investigating how ESG signals translate into interfirm financial outcomes within dyadic supplier-customer relationships. Existing research at the intersection of ESG and finance predominantly focuses on intra-firm level effects, such as how a firm's own ESG performance influences its financing conditions (Cheng et al., 2014), cost of capital (Dhaliwal et al., 2011), or trade credit outcomes (Luo et al., 2023; Yang & Tian, 2024). While these studies show the financial consequences of ESG, they provide limited insight into the interfirm mechanisms through which ESG signals transmit across supply chains. We extend this literature by theorizing and empirically documenting a dyadic ESG spillover mechanism through trade credit within dyadic supplier-customer relationships. Moving beyond prior studies that examine trade credit at an intra-firm level (Luo et al., 2023; Yang & Tian, 2024; Zhang et al., 2024), we adopt a supplier–customer dyadic perspective to analyze how suppliers' ESG performance shapes customers' trade credit decisions toward specific suppliers. This approach allows us to conceptualize ESG not merely as a firm-level attribute, but as an interfirm financial signal that influences the allocation of credit within supply chains.

Second, our study advances the literature on ESG and trade credit by theorizing and empirically validating two critical moderators, geographic distance and supplier power that shape the effectiveness of ESG signals in trade credit. Prior research on the relationship between

ESG and trade credit has largely relied on aggregate intra-firm indicators, such as financial constraints (Zhou & Lei, 2025) and credit risk (Chen et al., 2025), and has paid limited attention to relational factors that influence how ESG information is interpreted and acted upon. By adopting a supplier-customer dyadic perspective, we show that ESG spillover effects are not uniform but instead depend on the informational environment of the relationship. Specifically, greater geographic distance undermines ESG signaling by reducing customers' ability to observe and verify suppliers' sustainability practices, thereby increasing signal noise and verification costs. Also, strong supplier power functions as a substitute signal of reliability and enforcement capacity, crowding out the marginal informational role of ESG in shaping trade credit allocation. Collectively, these findings extend signaling theory in the context of supply chain finance by demonstrating that ESG performance generates economically meaningful trade credit benefits only when signals are both observable and not dominated by alternative signals.

Third, our findings advance the understanding of how ESG signals contribute to value creation by signaling sustainability commitments and fostering long-term supplier–customer relationships (Houston & Shan, 2022; Iurkov et al., 2024). This enriches the broader literature on value chain creation by highlighting that ESG ratings function not only as a dimension of ethical alignment but also as a strategic tool for strengthening financial and operational ties between suppliers and customers (Barros et al., 2024; Bond & Levit, 2025). Suppliers' ESG efforts enhance customers' market positioning and end-market appeal, which in turn lead customers to extend more favorable trade credit terms to these suppliers.

5.2. Practical implications

From a practical standpoint, the research suggests that firms should integrate ESG factors into trade credit strategies to foster stronger, more sustainable relationships with their suppliers and customers. Firms that prioritize sustainability within their operations tend to secure more advantageous financial conditions, thereby enhancing both liquidity and market positioning. In addition to adopting ESG practices, firms should emphasize transparent ESG reporting to effectively communicate their sustainability efforts to potential customers. Incorporating ESG considerations into trade credit policies allows firms to align financial strategies with

sustainability goals, fostering a more resilient and responsible supply chain. Specifically, firms can explore strategic relocations or partnerships to strengthen customer relationships and reinforce the credibility of their ESG signals.

Moreover, to mitigate risks associated with dominant suppliers, client companies can enforce industry-wide ESG compliance standards and utilize third-party audits. These external validation mechanisms enhance transparency and accountability, preventing dominant suppliers from overstating or misrepresenting their ESG commitments. Furthermore, implementing a multi-supplier sourcing strategy enables firms to diversify their supplier base, promote competition, encourage fair ESG practices, and reduce the risks linked to excessive dependence on a single supplier. Additionally, this study provides a clear positive signal for suppliers to emphasize ESG governance, which can lead to improved customer business credit (e.g., purchase share) for suppliers and increased competitiveness among suppliers' peers.

Additionally, the study calls for greater regulatory support to help standardize ESG reporting and encourage more firms to disclose their sustainability performance. Stronger regulations around ESG disclosure can help alleviate information asymmetry, making it easier for customers to assess the ESG performance of suppliers and incorporate this information into trade credit decisions. Policies that incentivize sustainability disclosures could further amplify the positive spillover effect of ESG practices, benefiting both suppliers and customers. To address information asymmetry, regulators should implement standardized ESG disclosure requirements, ensuring that suppliers report transparent and verifiable data on sustainability practices. This could help customers better assess the credibility of ESG signals, facilitating stronger trade credit relationships.

5.3. Limitations and future research suggestion

While this study provides valuable insights, several limitations pave the way for future research. First, reliance on ESG ratings from Wind and Bloomberg may not fully capture qualitative aspects of ESG efforts, and future studies could explore textual analysis or machine learning-based sentiment analysis for a more nuanced evaluation (Barros et al., 2024). In future research, more studies could explore cross-country variations in the ESG-trade credit relationship, considering institutional and regulatory differences beyond the context of

Chinese-listed firms. Additionally, with the evolution of ESG regulations, longitudinal analyses could track how ESG adoption influences trade credit dynamics over time. Addressing these gaps will enhance our understanding of ESG's role in global supply chain dynamics and value chain creation.

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Appendix

Table A.1 Correlation analysis

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
(1) TC^C	1								
(2) ESG^S	-0.024	1							
(3) $DiverESG^S$	0.000	0.206***	1						
(4) Age^S	0.029	0.074***	0.155***	1					
(5) $Size^S$	-0.053*	0.323***	0.437***	0.065**	1				
(6) ROA^S	0.017	0.133***	0.053*	0.044	-0.*029*	1			
(7) Lev^S	0.030	-0.043	0.017	-0.006	0.337***	-0.468***	1		
(8) $Weight^S$	-0.170***	0.098***	0.087***	0.031	0.314***	-0.051*	0.070**	1	
(9) $DigitPro^S$	-0.021	0.003	0.234***	0.338***	-0.*042*	0.071**	-0.104***	-0.065**	1
	(10)	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*
(10) ESG^C	1								
(11) $ListAge^C$	-0.115***	1							
(12) $Size^C$	0.236***	0.454***	1						
(13) ROA^C	0.176***	-0.201***	-0.012	1					
(14) Lev^C	-0.073**	0.453***	0.528***	-0.298***	1				
(15) BM^C	0.134***	0.161***	0.636***	-0.043	0.342***	1			
(16) $Quick^C$	0.117***	-0.380***	-0.310***	0.122***	-0.570***	-0.181***	1		
(17) $Indep^C$	0.062**	0.015	-0.055*	0.010	-0.096***	-0.101***	0.014	1	
(18) $Board^C$	0.026	0.172***	0.229***	0.009	0.205***	0.128***	-0.158***	-0.283***	1
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
(19) SP^S	-0.027	0.049*	0.099***	-0.089***	0.373***	-0.071**	0.084***	0.208***	-0.101***

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