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More Green, Better Funding? Exploring the Dynamics between Corporate Bank Loans and Trade Credit

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Abstract: As a critical aspect of corporate financing strategies, high-quality trade credit has been acknowledged as a favorable indicator for external stakeholders. Given the increasing prominence of sustainable development, it is worthwhile to explore whether an advanced environmental management system facilitates the attainment of financing for business operations. Therefore, to respond to this question, this study utilizes panel data spanning from 2012 to 2021, comprising Chinese listed firms in four energy and environment-related sectors, with the environmental dimension score of the CSI ESG scoring system employed for categorizing the sample into high and low environmental governance groups. The results reconcile the conflicting studies and find an inverted U-shaped effect between trade credit and corporate bank loans with lower levels of environmental governance. Within the domain characterized by higher environmental governance, the two are substituted for each other. In addition, this study introduces the Shapely decomposition method for the first time to quantify the contribution of trade credit to corporate bank loans. Drawing from these findings, we proposed practical advice to firms, financial institutions, and the government on how to choose between bank loans and trade credit against the background of sustainable development.

Keywords: corporate bank loan; trade credit; environmental governance; financing; ESG

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1. Introduction

The adoption of the Paris Agreement during the 21st United Nations Climate Change Conference on December 2015 established a unified framework for global action against climate change beyond 2020 [1]. Given the current post-epidemic era, countries worldwide are faced with the pressing need to steer economic recovery and expedite global sustainable development through effective efforts. For example, the European Union introduced the "European Green Deal" [2]; France proposed the "Energy Transition Plan" [3]; China articulated its ambitions of achieving carbon peaking by 2030 and carbon neutrality by 2060 [4]; and Korea introduced the "Resource Circulation Performance Management Program" [5], etc. These measures accelerated the reduction of carbon emissions, fostering green technological innovation, and enhancing the global competitiveness of industries and economies. With the promotion of high-quality development and an ecological protection mandate, ecological civilization and green development have morphed into a critical component of national development strategies [6].

Due to the implementation of diverse measures by various countries, China's sustainable development practices in different industries are increasingly attracting more and more attention, particularly in light of its status as the world's second-largest economy and leading industrial nation [7]. Against this background, Chinese green finance assumes a significant role in driving the transition towards a low-carbon economy through the deployment of economic and financial instruments. Green finance encompasses economic activities that aim to promote environmental improvement, climate change mitigation, and resource efficiency. China's financial sector has steadily developed its market infrastructure

for green finance, resulting in the formation of a multi-level market system that includes green credits [8]. Based on the background of a green credit policy and from the perspective of development, firms, as the main body of social production, are the main force promoting the improvement of the total-factor productivity of society. From the perspective of consumption, the production processes of firms inevitably cause damage to the environment and consume energy. Therefore, it is necessary to further study the environmental behavior of firms. Although the pursuit of profit is one of the main goals of a firm's development, firms need to assume the corresponding corporate social responsibilities, and environmental responsibility is precisely one of these important links. The level of environmental governance is an important means with which firms can communicate the effectiveness of their environmental protection responsibilities to external stakeholders. In the process of implementing green credit policies, the financial risks arising from environmental issues are increasingly becoming a key influence on corporate financing capability. Commercial banks, being the primary financial institutions, integrate corporate environmental risks into their credit decision-making processes [9]. The level of environmental governance of firms has become an important medium for financial institutions to play games with firms. Balancing the demand for sustainable development with the imperative need for financing has become a significant challenge for firms. Have environmental risk factors become an essential component of bank loans for listed firms operating in related industries? Facing the pressure from different types of external stakeholders, it is necessary for firms to further improve their environmental management capabilities in time, and under the diversified requirements of credit policies.

With the aim of alleviating financial pressure and promoting sustainability, firms tilt the focus of financing channels from external banks to stakeholders within the supply chain, and trade credit is born. Trade credit is a short-term funding facility that occurs between a firm and its upstream and downstream partners. The literature has extensively examined the connection between corporate bank loans and trade credit. Both are important channels for corporate financing [10]. Despite this, some issues remain unresolved: (1) Prior research has overlooked the contemporary pillar industries for sustainable development. For instance, Zhou et al. choose Chinese listed firms to study corporate bank loans without stratifying the sample into industries [11]. Yang focuses on the manufacturing industry where financing occurs more frequently, to explore the relationship between trade credit and corporate bank loans [12]. Lin et al. set heavy polluters as the control group in their study, and other firms were considered as the experimental group for comparative analysis [13]; (2) The relationship between trade credit and corporate bank loans may either be positively promoted or negatively inhibited. Daisuke studied Japanese micro and small firms and argued that there was a positive correlation between trade credit and corporate bank loans [14]. Conversely, Wang et al. found that state-owned firms in China prefer bank loans to trade credit, and that these two forms of financing are substitutes [8]; (3) There seems to be an argument that the relationship between trade credit and corporate bank loans will transform within different scenarios, but it is unclear whether this relationship exhibits a positive U-shape or an inverted U-shape. Yu analyzed the economic definition of firms' trade credit and bank loans and concluded that there is an inverted U relationship between the two [15]. However, Eddie et al. argue that the nonlinear effect is not necessarily present, and that credit rationing determines whether firms choose to finance with bank loans or trade credit [16]. In summary, this study aims to explore the relationship between trade credit and corporate bank loans in representative industries, quantify the contribution of trade credit, and investigate any non-linear effects on corporate bank loans. Ultimately, this research seeks to extend the existing literature on corporate financing capability.

To address the aforementioned research gaps, this study collected data on the corporate bank loans and trade credit of 102 listed firms in China between 2012 and 2021. These firms represent four sectors: green building, green credit, contract energy, and, building energy efficiency—which are significant for the sustainable development of the industry. The environmental dimension (E) scores of these firms were obtained through CSI ESG,

and the sample was divided into two categories based on their scores. A fixed-effects model was then established for data analysis. The group regression findings reconcile the conflicting conclusions in the existing literature. Specifically, we identified an inverted "U" shaped relationship between trade credit and corporate bank loans for the group with weak environmental governance, which can facilitate the development of a more tailored financing plan for these firms. To explore this relationship in greater depth, we introduced a Shapley decomposition analysis to determine the degree of contribution of primary and secondary trade credit terms to corporate bank loans. This methodology has not been used in prior studies. Based on the abovementioned analysis process, this study provides corresponding implications for firms' financing strategies.

The main logic of this study is as follows: Section 2 analyzes the theoretical basis of the study, a literature review, and a summary of corporate financing capability and trade credit; Section 3 presents the source and distribution of the study sample and the descriptive statistics results of the main variables; Section 4 depicts the analysis of baseline regression, nonlinear effects, and Shapely decomposition, and the endogeneity test and robustness test further verify the reasonableness of the findings; Section 5 is the discussion and implications based on the study results; Section 6 outlines the conclusions and presents an outlook into future research.

2. Literature Review and Hypothesis Development

Signaling theory is a fundamental theory widely used and frequently updated in corporate finance literature. It constitutes a valuable tool for comprehending the communication of information among firms operating in a background where information is frequently imperfect [17]. The basis of the theory can be boiled down to three primary elements: the signaler, the signal, and the receiver [18]. The signaler refers to the party that obtains information regarding a product or organization that is not universally available [19], typically a firm in the field of corporate finance research. The signal, on the other hand, is a prompt of either implicit or explicit information intentionally or unintentionally transmitted by the signaler, with only readily observable information being potentially effective. For example, a firm's financial standing and credit level are fundamental signals that both stakeholders and banks take into account in corporate finance studies. By leveraging these signals, managers can communicate their expectations to investors and influence credit decisions. Finally, the receiver is an individual or entity seeking to obtain more information about the product or organization, limited in terms of information, and whose interpretation of the signal's validity can have significant implications [17]. Therefore, signaling theory has emerged as a critical component of corporate management. It is usually utilized in analyzing how publicly available data—such as trade credit—could function as an observable marker for the worth or conduct of typically unobservable entities in circumstances of information asymmetry and uncertainty [20].

By consolidating the current literature, we ascertain that studies about corporate financing capability, in the light of signaling theory, can be categorized into two distinct groups. The first pertains to the perspective of the information receivers, such as banks and stakeholders, while the second relates to the perspective of the signaler, i.e., the firm. Bank loans remain the most commonly employed source of financing for firms, and most firms rely on bank loans extensively for their growth and development [21]. As the incidence of loan defaults and bad debts has increased, banks face heightened lending risks, which have necessitated the imposition of restrictions on corporate lending. Against this backdrop, Ren et al. observed that to minimize capital loss, banks prefer partnering with socially responsible firms in response to the pressure of economic growth [22]. Similarly, the study by Ho et al. examined banks in emerging economies and concluded that they employ non-price terms for credit-risk firms to safeguard their interests [23]. Further, in an in-depth analysis comprising listed banks from 17 Asian countries for the period spanning 1995–2014, Chaiporn found that loan growth is positively correlated with non-performing loans, but not profitability [24]. Apart from the above-reviewed literature, many scholars

also analyze from the perspective of firms. Trade credit is considered a crucial mode of debt financing. It is an indicator of the partner's comprehensive assessment of the firm's business circumstances and can transmit signals about product sales, quality, financial situation, and other relevant aspects. These signals can influence the bank's credit decision and directly or indirectly affect the firm's ability to procure financing [16]. Firms with better disclosure of social responsibility information send positive signals to the capital market, thereby expanding their reputation and boosting transparency, which reduces the risk of information asymmetry. For example, Franck et al. discovered that financing in collaboration with upstream and downstream stakeholders can benefit all members of the supply chain simultaneously. This collaboration provides an incentive for firms to disseminate social responsibility "signals" more widely and project a more favorable image to banks [25]. The study by Xing et al. analyzing Chinese manufacturing firms found that under green credit policies, "greenwashing behavior" (giving false signals of environmental friendliness to outsiders) by firms adversely impacts their ability to obtain loans from banks [26]. Ding et al. revealed the implementation of green credit policies and demonstrated that empirical evidence supports the role of bank loans in corporate governance and promotes firms to actively reduce carbon emissions [27]. Regardless of the perspective, the significance of trade credit as a signal facilitating firms' internal and external communication and affecting their capability to raise financing cannot be underestimated.

As previously mentioned, there have been differing opinions regarding the relationship between trade credit and corporate bank loans. However, some scholars have attempted to reconcile these conflicts by examining the relationship between the two factors across different stages. For instance, Yang discovered that in periods of monetary stringency, trade credit was primarily used as a substitute for corporate bank loans, but in looser monetary conditions, trade credit and corporate bank loans exhibited complementary effects [12]. Furthermore, Love et al. analyzed the loan behavior of four East Asian countries before and after the financial crisis and observed that during the crisis, bank-constrained firms were unable to acquire the necessary trade credit funds. As a result, firms relied less on trade credit in the aftermath of the crisis [28]. Moreover, Du et al. found that trade credit is not an effective substitute for corporate bank loans in most developing and transitioning economies with weak economic institutions. In these cases, trade credit and corporate bank loans may work together to enhance firm performance as financial institutions become more formalized [29]. The above studies confirmed that trade credit has a definite effect on corporate bank loans, either directly or indirectly. Nevertheless, it is still unclear how and to what extent. More empirical findings are therefore necessary to reveal the relationship between trade credit and corporate bank loans at the firm level. On this basis the following is preliminarily proposed:

Hypothesis 1: *The degree of trade credit of firms has a relationship with the corporate bank loans.*

After conducting a comprehensive systematic literature review, three main challenges are identified. The first challenge arises from the lack of specificity in the sample industries, which has resulted in a considerable divergence in the findings. Consequently, the relationship between trade credit and corporate bank loans remains inconclusive, restricting the potential to provide effective recommendations. The second challenge pertains to the limited quantitative evidence demonstrating the extent of trade credit's contribution to firms' bank loans, despite the large sample size used in the study. This limitation raises concerns regarding the practical applicability of the conclusions. Finally, the existing studies have overlooked the importance of considering the environmental sustainability aspect of firms' financing capabilities, as many international organizations and institutions have started evaluating firms' environmental development levels. To address these research gaps, this study conducted an analysis of ten years of data from listed firms in four key environmental and energy sectors, dividing the sample by the environmental dimension scores of the CSI ESG authoritative rating system. Furthermore, by employing the nonlinear effects test and

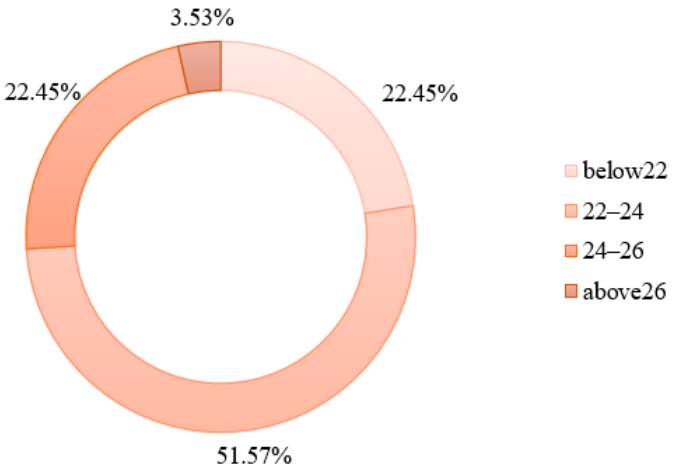
Shapely decomposition method, this study quantified the contribution of trade credit to corporate bank loans.

3. Data and Methodology

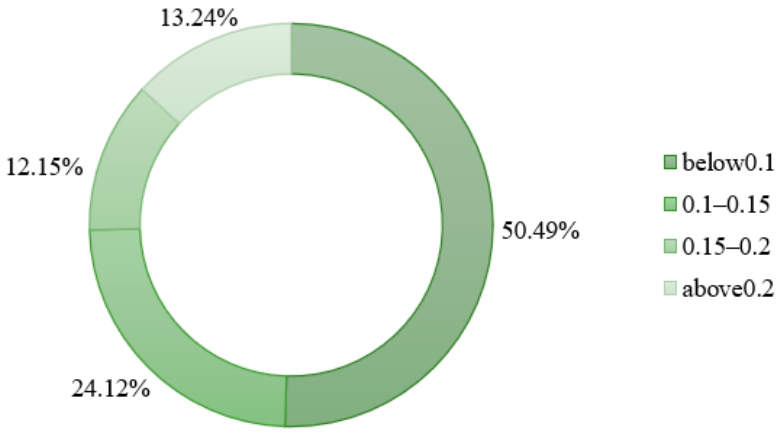
3.1. Sample and Data

We collected data from 2012–2021 for four major sectors of stocks (green building, green credit, contract energy, and building energy efficiency) among Chinese A-share listed firms as our sample. China is widely recognized as one of the largest emitters of greenhouse gases globally, accounting for approximately 25% of total emissions [30]. Given its status as the world's second-largest economy and a leading industrial nation, China's sustainable development practices across various industries have garnered increasing attention in recent years [7]. As such, China wields significant influence when it comes to promoting low-carbon initiatives, environmental protection, and sustainable development. Consequently, studying Chinese firms can provide valuable insights into best practices and lessons learned for the development of a low-carbon, environmentally friendly global economy. In 2012, China's financial sector was issued regulatory guidance with the publication of the "Green Credit Guidelines", which outlined specific measures for promoting green credit policies [8]. These measures included the integration of environmental risks into credit decision-making, the creation of green credit products, and the incentivizing of borrowers to adopt green technologies and practices. The introduction of the guidelines enabled financial institutions to incorporate environmental considerations into their financing activities, leading to the expansion of green finance in China's economy [13]. It is widely recognized that the "Green Credit Guidelines" have significantly contributed to promoting sustainable development and fostering cooperation among firms and commercial banks. For the four selected stock sectors, industries represented by green building, green credit, contract energy, and building energy efficiency play a key role in China's green economic transformation. Green building and building energy efficiency technologies can significantly reduce energy consumption and carbon emissions in the process of building low-carbon cities and ecological civilizations [31]; green credit is one of the links for capital to enter green projects [8]; and contract energy provides firms with the whole process of energy management services, including energy saving, emission reduction, and cost saving [32]. The sectors represented by these stocks also demonstrate China's strengths and experience in promoting green finance and green economic transformation. The samples labeled as ST and ST* were excluded due to their problematic operating conditions and screened-out data with missing values for each variable. The final sample consisted of 1020 panel data, which were obtained from the China Stock Market & Accounting Research Database (CSMAR), a comprehensive and reliable financial and economic database in China, comprising stocks, funds, bonds, financial derivatives, listed firms, economies, industries, high-frequency data, and personalized data services [33]. To perform an in-depth analysis of environmental governance and corporate sustainability, we acquired the "E" scores of the aforementioned 102 firms from the wind database over the past ten years, where the scores were based on the CSI ESG ratings. The CSI ESG Rating adopts a three-tier indicator system grounded on core ESG connotation and development experience and accounts for the market's actual situation. It is widely used in various scientific studies and in risk analysis [34]. To eliminate the undesired impact of extreme values on the analysis results, all continuous variables are under winsorization at 1%.

Figure 1a presents an overview of the collected sample from the standpoint of firm size (SIZE), where this study employs the natural logarithm of total assets to assess firm size, in line with the previous literature [30,35]. Figure 1b demonstrates the level of financial performance (ROE) of the sample firms, which serves as a useful indicator to gauge the earnings efficiency of firms utilizing their capital. The higher the profitability of firms, the greater their competitiveness in the market.



(**a**)



(**b**)

Figure 1. (**a**) Sample firms: total assets (natural logarithm); and (**b**) sample firms: return on equity.

3.2. Measures

3.2.1. Dependent Variable: Corporate Bank Loans

The corporate bank loans were calculated as the ratio of the firm's total bank loans as of year-end relative to the total assets at the onset of the same year, following prior studies [36,37]. A prevalent method to secure corporate financing involves a bank lending funds to a firm requiring capital at a defined interest rate in compliance with national policies and requiring repayment within a certain period. It has always been the most dominant way to support corporate operations, and most firms rely on financing capability for their growth. Proper utilization of financing can help firms expand their assets.

3.2.2. Independent Variable: Trade Credit

Trade credit, as the independent variable, was calculated as the ratio of the total of notes payable, accounts payable, and accounts receivable in advance to total assets, consistent with previous studies [38,39]. Trade credit denotes direct short-term financing that transpires between a firm and its upstream and downstream partners. Firms facing obstacles in acquiring bank loans often resort to their suppliers, who view their customers as stakeholders. As an upstream supplier, they are willing to supply short-term financial assistance to support the firm's smooth operations and attain their own operational goals.

3.2.3. Control Variables

Drawing from the extant literature on related topics [27,36,38,40], this study selected firm size (SIZE), gearing ratio (LEV), profitability (ROE), interest coverage multiple (INT), the annual growth rate of operating income (GROWTH), financing demand (CASH), asset maturity (AM) and firm risk (BETA) as control variables. These control variables were introduced to control for other factors that could have the potential to influence corporate bank loans. Each variable was exhaustively defined, as shown in Table 1.

Table 1. Definitions and calculation methods of control variables.

Variable	Meaning	Calculation Method
SIZE	Firm size	The natural logarithm of the total assets at the end of the year
LEV	Asset-liability ratio	Total liabilities/total assets
ROE	Return on equity	Net profit/capital of shareholders'equit
INT	Interest coverage multiple	Earnings Before Interest and Tax/Finance costs
GROWTH	The growth rate of total assets	(Total assets at the end of the period − Total assets initial value of the period)/(Total assets at the end of the period)
CASH	Financing demand	When the sum of net cash flow from operating activities and investing activities for the period is less than or equal to 0, the value is 1, otherwise, it is 0
AM	Asset maturity	Net fixed assets/total assets
BETA	Degree of total leverage	Change in net profit/Change in revenue from the main business

3.3. Model Specification

The fixed effects model is a widely employed approach for analyzing panel data. This approach is crucial in mitigating inter-individual heterogeneity and enhancing the accuracy of estimates concerning the linkage between dependent and independent variables [41]. Furthermore, it allows for an exploration of the impact of individual characteristics on the dependent variable. In this study, ten-year panel data (2012–2021) consisting of 102 listed firms were utilized to examine the relationship between trade credit and corporate bank loans under different levels of environmental management. The following fixed effects model was formulated:

$$MODEL1: \quad TL = \beta_0 + \alpha_1 \times TC + \beta_2 \times SIZE + \beta_3 \times LEV + \beta_4 \times ROE + \beta_5 \times INT + \beta_6 \times GROWTH + \beta_7 \times CASH + \beta_8 \times AM + \beta_9 \times BETA + \varepsilon_1 \quad (1)$$

$$MODEL2: \quad TL = \beta_0 + \alpha_1 \times TC + \alpha_2 \times TC^2 + \beta_2 \times SIZE + \beta_3 \times LEV + \beta_4 \times ROE + \beta_5 \times INT + \beta_6 \times GROWTH + \beta_7 \times CASH + \beta_8 \times AM + \beta_9 \times BETA + \varepsilon_1 \quad (2)$$

where β_0 is the constant term, $\alpha_1 - \alpha_2$ is the coefficient of the independent variable, $\beta_2 - \beta_9$ is the coefficient of the control variable, and ε_1 is the error term. $MODEL1$ and $MODEL2$ examine the relationship between trade credit and corporate financing capability, and the subsequent in-depth analysis was conducted based on these models.

3.4. Descriptive Statistics

Before the regression analysis, this study conducted a descriptive analysis of the ten-year data of 102 listed firms. This entailed computing the mean, extreme value, and standard deviation of each variable, as presented specifically in Table 2. In addition, a multicollinearity test was administered, and the variance inflation factor (VIF) values for each variable were observed to be below 5. This observation implies that the influence of

mutual cointegration among the variables was not significant, and thus, further regression analysis could ensue [42].

Table 2. Results of descriptive statistics.

Variable	Obs	Mean	Std. Dev	Min	Max	VIF
TL	1020	0.130	0.162	−0.418	1.841	-
TC	1020	0.201	0.135	0.007	0.737	1.58
SIZE	1020	23.087	1.499	18.385	28.480	1.25
LEV	1020	0.531	0.202	0.030	1.262	1.66
GROWTH	1020	0.247	1.483	−3.005	33.370	1.01
INT	1020	2.353	136.683	−18.278	27.701	1.00
CASH	1020	0.520	0.500	0	1	1.01
AM	1020	0.254	0.185	0.000	0.846	1.28
BETA	1020	2.802	5.725	0	123.395	1.03
ROE	1020	0.062	0.247	−1.731	5.301	1.09

Note: Obs, Observation; Std. Dev, standard deviation; Min, minimum; Max, maximum; VIF, variance inflation factor.

Figure 2 portrays the outcomes of the descriptive analysis post-sample grouping. The categorization proceeded on the basis of the "E" score from the ESG rating system, which prioritizes the business sustainability and social impact of the firm in the realm of the environmental dimension. Fifty percent of the sample with higher scores were placed in the "E_high" category, while the remaining were categorized as "E_low". Box plots were constructed to depict the distribution of the dependent and independent variables across different groups. Analysis of the results revealed a mean TL value of 0.119 and a mean TC value of 0.189 for the "E_high" group, which was lower in comparison with the mean TL value (0.141) and the mean TC value (0.212) for the "E_low" group.

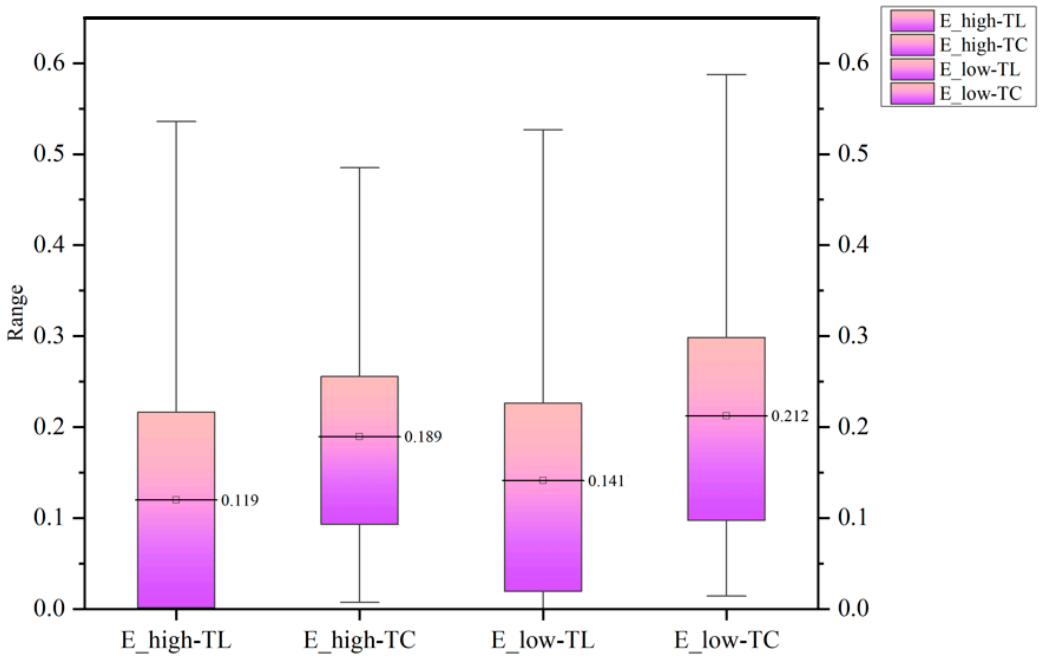


Figure 2. Distributions of TL and TC in different groups.

The Pearson correlation test can determine the existence of a correlation between variables. As shown in Table 3, there is a negative and statistically significant correlation between TC and TL ($\beta = -0.137$, $p < 0.01$). Conversely, SIZE ($\beta = 0.093$, $p < 0.01$), LEV ($\beta = 0.315$, $p < 0.01$), AM ($\beta = 0.153$, $p < 0.01$), BETA ($\beta = 0.121$, $p < 0.01$), and ROE ($\beta = 0.199$, $p < 0.01$) are positively and statistically significant with TL. Furthermore, all coefficients in Table 3 were found to be below 0.5, which provided further verification for

the multicollinearity test conducted earlier. Previous studies have established that correlation analysis featuring coefficients exceeding 0.8 may have problems of multicollinearity between variables [43].

Table 3. Correlation analysis of variables.

	TL	TC	SIZE	LEV	GROWTH	INT	CASH	AM	BETA	ROE
TL	1.000									
TC	−0.137 ***	1.000								
SIZE	0.093 ***	0.072 **	1.000							
LEV	0.315 ***	0.432 ***	0.407 ***	1.000						
GROWTH	0.047	−0.001	0.010	0.016	1.000					
INT	0.005	0.031	−0.001	0.038	−0.005	1.000				
CASH	−0.024	0.028	−0.056 *	−0.029	−0.012	0.034	1.000			
AM	0.153 ***	−0.428 ***	0.015	−0.060 *	0.062 **	0.006	−0.088 ***	1.000		
BETA	0.121 ***	−0.068 **	−0.003	0.066 **	−0.026	0.006	−0.040	0.142 ***	1.000	
ROE	0.199 ***	−0.009	0.032	−0.222 ***	0.036	0.005	0.046	−0.056 *	−0.021	1.000

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

4. Empirical Results and Analysis

4.1. Baseline Regression Results

The main results of the baseline regressions are presented in Table 4, categorized into three groups: the "E_high" group comprising firms with high environmental dimension scores on the ESG evaluation; the "E_low" group comprising those with low scores; and the full sample. To ensure the robustness of our findings, we performed cross-sectional tests as well, and found that the results were concordant with those of the fixed-effects model. Nevertheless, given that the fixed-effects model aligned better with the research question, we only present the fixed-effects regression results in this paper. Three control groups appear in the form of Models 1a, 2a, and 3a, solely featuring control variables. In contrast, Models 1b, 2b, and 3b depict the regression results following the addition of the independent variable. Findings suggest that, irrespective of the sustainability of management outcomes concerning the environmental dimension (whether the "E" score is high or low), trade credit adversely affects corporate bank loans. This outcome responds to the previous literature that there is a substitution effect between stakeholder loans via trade credit and firm loans sourced from banks [44,45]. Notably, the coefficient of trade credit in the "E_high" group is −0.583, which is smaller than the "E_low" group's corresponding figure of −0.481. The negative effect of trade credit is more significant for firms exhibiting high environmental governance effectiveness. As firms' environmental governance proficiency improves, they release more positive signals of sustainable development and social responsibility to the external environment. This, in turn, engenders greater willingness among firms upstream and downstream across the supply chain to allocate financial support. Consequently, firms could become increasingly reliant on stakeholders' loans sourced through trade credit at lower interest rates than bank loans. In other words, the ability of firms to finance appears to be "weakened".

Table 4. Baseline regression results of TL and TC.

	E_High		E_Low		Total	
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b
TC	-	−0.583 *** (0.061)	-	−0.481 *** (0.057)	-	−0.498 *** (0.043)
SIZE	−0.016 *** (0.005)	−0.029 *** (0.005)	0.001 (0.006)	−0.009 * (0.006)	−0.006 (0.004)	−0.015 *** (0.004)
LEV	0.338 *** (0.049)	0.614 *** (0.053)	0.362 *** (0.040)	0.583 *** (0.046)	0.268 *** (0.031)	0.486 *** (0.035)
GROWTH	0.003 (0.003)	0.002 (0.003)	0.004 (0.006)	0.005 (0.006)	0.003 (0.003)	0.003 (0.003)

Table 4. *Cont.*

	E_High		E_Low		Total	
	Model 1a	**Model 1b**	**Model 2a**	**Model 2b**	**Model 3a**	**Model 3b**
INT	−0.000	−0.000	−0.000	−0.000	−0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CASH	−0.007	−0.007	0.005	0.008	0.008	0.011
	(0.012)	(0.011)	(0.014)	(0.013)	(0.009)	(0.009)
AM	0.180 ***	0.009	0.063 *	−0.060	0.122 ***	−0.015
	(0.035)	(0.037)	(0.038)	(0.038)	(0.026)	(0.028)
BETA	0.003	0.002	0.003 ***	0.002 **	0.003 ***	0.003 ***
	(0.168)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
ROE	0.181 ***	0.272 ***	0.216 ***	0.233 ***	0.000 ***	0.000 ***
	(0.062)	(0.057)	(0.021)	(0.020)	(0.000)	(0.000)
_cons	0.236 **	0.551 ***	−0.107	0.138	0.042	0.280 ***
	(0.102)	(0.099)	(0.129)	(0.123)	(0.079)	(0.077)
Time effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	510	510	510	510	1020	1020
Adj-R^2	0.684	0.618	0.279	0.373	0.144	0.246

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. In this study, the Hausman test was performed before regression and the p-value was less than 0.05, which means the fixed effects model should be chosen [46].

4.2. Extended Analysis—Nonlinear Effects of TC

In spite of the statistically significant negative link between trade credit and corporate bank loans, is this negative effect necessarily invariant? Could the larger coefficients observed in the "E_low" group, compared to the other two groups, be attributable to a nonlinear effect? To address this issue, we conducted a U-test, and the original hypothesis for the "E_low" group was rejected at the 5% statistical level, suggesting the existence of a U-shaped effect. Table 5 shows the results obtained from squared term regressions of trade credit within the "E_high" group, "E_low" group, and full sample, respectively. While only a negative linear effect is observed for trade credit in both the "E_high" group and full sample, Model 4b shows the differential results where the primary term for trade credit is positively significant ($\beta = 0.384$, $p < 0.1$) and the squared term is negatively significant ($\beta = -0.887$, $p < 0.01$).

Table 5. Inverted U-shaped regression results for TC.

	Model 4a	**Model 4b**	**Model 4c**
TC	−0.541 *** (0.138)	0.384 * (0.197)	−0.394 *** (0.113)
TC^2	−0.074 (0.222)	−0.887 *** (0.340)	−0.178 (0.188)
SIZE	−0.029 *** (0.005)	0.018 *** (0.006)	−0.015 *** (0.003)
LEV	0.619 *** (0.053)	−0.006 (0.005)	0.480 *** (0.034)
GROWTH	0.002 (0.003)	0.006 (0.007)	0.003 (0.003)
INT	−0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)
CASH	−0.008 (0.011)	−0.002 (0.014)	0.010 (0.009)
AM	0.012 (0.037)	0.014 (0.043)	−0.008 (0.028)
BETA	0.002 (0.002)	0.003 *** (0.001)	0.003 *** (0.001)
ROE	0.274 *** (0.057)	0.188 *** (0.026)	0.000 *** (0.000)
_cons	0.557 *** (0.096)	−0.310 ** (0.149)	0.272 *** (0.076)
Time effect	Yes	Yes	Yes
Observations	510	510	1020
Adj-R^2	0.278	0.156	0.237

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

For a more intuitive depiction of the non-linear effects, Figure 3 presents a U-shaped graph of the "E_low" group. The maximum value of TL appears at TC = 0.216, with improvements in trade credit promoting improvements in corporate bank loans observed

to the left side of the symmetry axis. By contrast, a mutual substitution effect between trade credit and corporate bank loans sets in once TC exceeds 0.216. The main reason for the divergent findings is that the sample in this study focused on energy-efficient and environmentally sensitive firms, which incur greater costs in managing environmental concerns. When firms navigate their start-up phase, they typically require maximum financial support to enhance their potential for sustainability, and thus pursue loans from both banks and stakeholders upstream and downstream. Yet, as a firm's management level becomes mature and its industry reputation expands, the accumulation of credit enables the firm to obtain more loans from upstream and downstream stakeholders at lower interest rates, thus reducing the firm's financing needs with banks.

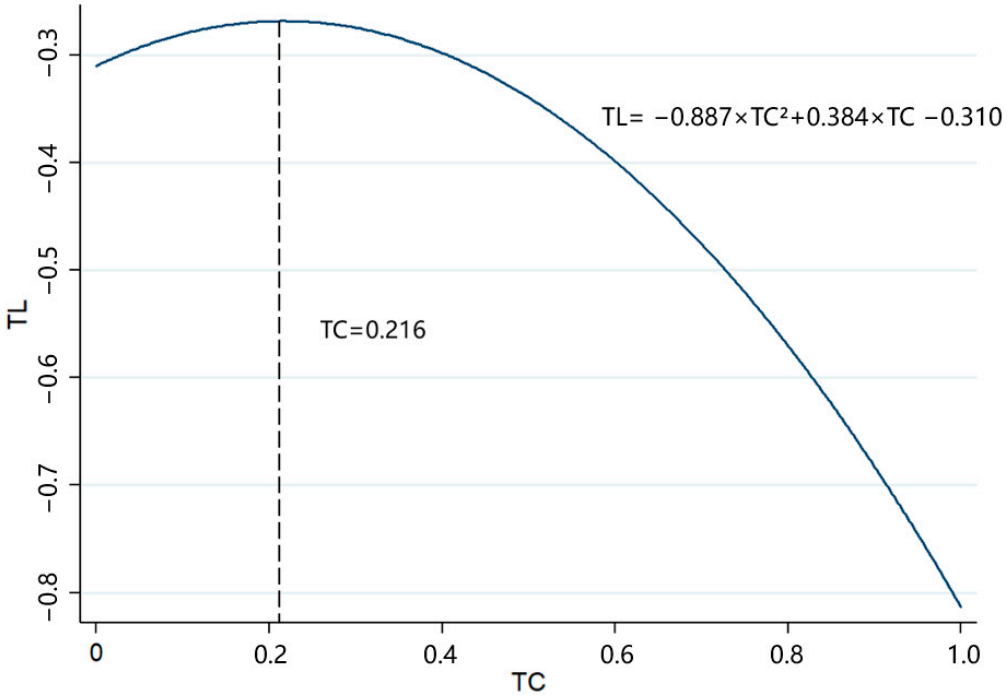


Figure 3. Inverted U-shaped effect graph.

4.3. Decomposing the Explained Variation in TL

The foregoing outcomes highlight that both TC and TC^2 are related to corporate bank loans. Nevertheless, conclusive evidence regarding which of these two variables is more substantial in accounting for the variation in the dependent variable is yet to be ascertained. The estimated correlation between TC and TC^2 might be substantial, but the actual magnitude of change is likely to be relatively negligible, thus failing to account for the significant variance in TL. Consequently, we proceeded to decompose the coefficient of determination to attain a better understanding of the relative importance of the regressors. In particular, following previous research [47], we utilize Stata14 to deconstruct the explained variance (R^2) of corporate bank loans into contributions from TC and TC^2.

Figure 4 portrays the outcomes of the decomposition analysis conducted on three groups- "E_high," "E_low," and the entire sample. The results of the decomposition analysis illuminate the diverse strategic priorities of firms in designing customized financing strategies. Notably, for firms committed to high environmental governance, TC accounts for 14.71% of corporate bank loans, demonstrating a relatively more efficient explanatory power compared to TC^2. Conversely, among the second cohort of firms, TC^2 explains 6.13% of the corporate bank loans, evidence of a greater extent of explanatory power compared to TC, with a 1.67% margin. Within the overall sample, the explanatory power of TC and TC^2 does not differ significantly, accounting for approximately 6.80%. This illustrates that trade

credit's detrimental influence on corporate bank loans is most pronounced among firms with stringent environmental governance. The overall contribution of the variable TC, encompassing both TC and TC^2, is also displayed, revealing that TC was the most sizable explanatory factor within the "E_high" group, contributing more than 25% of the total. In the "E_low" group and full sample, the overall contribution of TC is not substantially different, with TC accounting for more than 10%. For firms operating in the nascent stages of implementing environmental governance, an understanding of the non-linear effects of trade credit is critical in optimizing their funding potential and establishing a solid foundation for future growth.

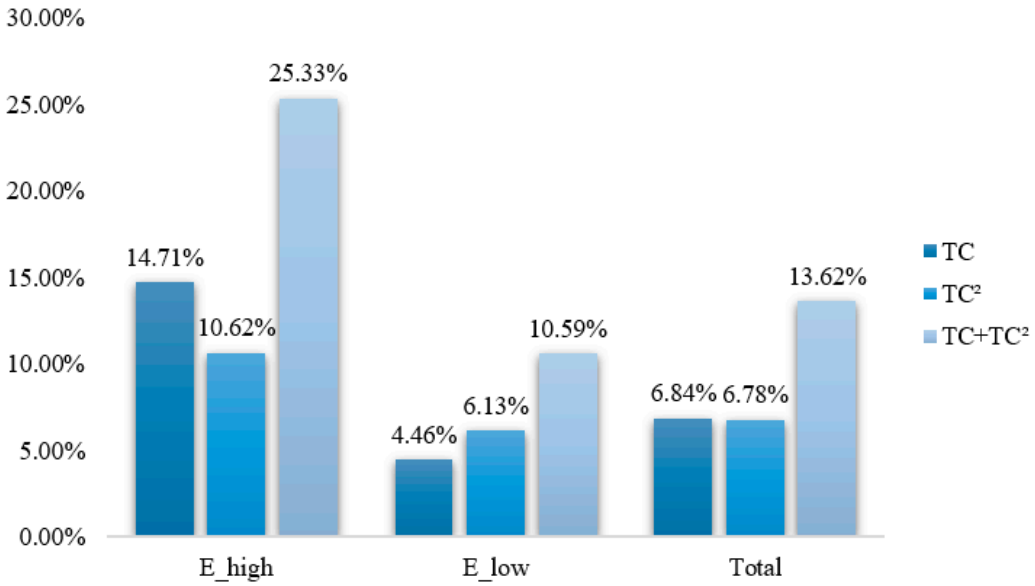


Figure 4. Results of decomposition analysis in three groups.

4.4. Endogeneity Test

To test for endogeneity, we choose TC values in year t−1 as the independent variables in the regressions, the results of which are presented in Table 6. Model 5a–c in Table 6 presents the findings for the "E_high" group, "E_low" group, and full sample, respectively. Each group showed a negatively significant result for TC $_{t-1}$, aligning with the results obtained for Model 1b, Model 2b, and Model 3b.

Table 6. Changing the inspection window of TC.

	Model 5a	Model 5b	Model 5c
TC $_{t-1}$	−0.528 *** (0.060)	−0.389 *** (0.058)	−0.353 *** (0.039)
SIZE	−0.027 *** (0.005)	−0.008 (0.006)	−0.013 *** (0.003)
LEV	0.594 *** (0.054)	0.542 *** (0.047)	0.452 *** (0.028)
GROWTH	0.003 (0.003)	−0.000 (0.006)	0.001 (0.003)
INT	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
CASH	−0.012 (0.011)	0.007 (0.013)	−0.006 (0.009)
AM	0.014 (0.038)	−0.024 (0.038)	0.063 ** (0.026)
BETA	0.002 (0.002)	0.002 ** (0.001)	0.002 ** (0.001)
ROE	0.272 *** (0.058)	0.242 *** (0.020)	0.228 *** (0.019)
_cons	0.502 *** (0.100)	0.099 (0.127)	0.232 *** (0.073)
Time effect	Yes	Yes	Yes
Observations	510	510	1020
Adj-R^2	0.580	0.361	0.283

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$.

4.5. Robustness Tests

4.5.1. Replacement of Dependent Variable

The dependent variable, TL, in this study comprises two components: long-term bank loans as a percentage of total assets (LL) and short-term bank loans (SL), also as a percentage of total assets. Tables 7 and 8, respectively, present the regression outcomes obtained after replacing TL with LL and SL. The coefficient for the TC term remains stable and negatively significant, again indicating the generalizability of the study's findings.

Table 7. Baseline regression results of LL and TC.

	E_High		E_Low		Total	
	Model 1a	**Model 1b**	**Model 2a**	**Model 2b**	**Model 3a**	**Model 3b**
TC	-	−0.093 *	-	−0.438 ***	-	−0.317 ***
		(0.219)		(0.044)		(0.029)
SIZE	−0.002	−0.000	0.001	−0.008 *	−0.002	−0.006 **
	(0.017)	(0.017)	(0.005)	(0.004)	(0.003)	(0.002)
LEV	−0.424 **	−0.468 **	0.211 ***	0.411 ***	0.176 ***	0.277 ***
	(0.162)	(0.193)	(0.032)	(0.036)	(0.019)	(0.020)
GROWTH	0.001	0.001	0.001	0.002	−0.001	−0.000
	(0.011)	(0.011)	(0.005)	(0.005)	(0.002)	(0.002)
INT	0.001 **	0.001 **	−0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CASH	−0.101 **	−0.101 **	0.004	0.007	0.005	0.004
	(0.041)	(0.041)	(0.010)	(0.010)	(0.007)	(0.006)
AM	−0.013	0.014	0.071 **	−0.041	0.105 ***	0.015
	(0.117)	(0.134)	(0.030)	(0.030)	(0.019)	(0.019)
BETA	0.001	0.002	0.002 **	0.001	0.001 **	0.001 *
	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)	(0.001)
ROE	0.143	0.129	0.233 ***	0.249 ***	0.209 ***	0.222 ***
	(0.204)	(0.207)	(0.017)	(0.015)	(0.014)	(0.013)
_cons	0.424	0.374	−0.111	0.112	−0.028	0.083
	(0.338)	(0.358)	(0.103)	(0.096)	(0.056)	(0.054)
Time effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	510	510	510	510	1020	1020
Adj-R^2	0.061	0.061	0.326	0.440	0.228	0.308

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8. Baseline regression results of SL and TC.

	E_High		E_Low		Total	
	Model 1a	**Model 1b**	**Model 2a**	**Model 2b**	**Model 3a**	**Model 3b**
TC	-	−0.266 ***	-	−0.061 *	-	−0.127 ***
		(0.043)		(0.057)		(0.027)
SIZE	−0.013 ***	−0.020 ***	−0.001	−0.003 *	−0.009 ***	−0.010 ***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)
LEV	0.202 ***	0.328 ***	0.161 ***	0.189 ***	0.173 ***	0.214 ***
	(0.033)	(0.037)	(0.025)	(0.030)	(0.017)	(0.019)
GROWTH	0.002	0.002	0.003	0.003	0.002	0.002
	(0.002)	(0.002)	(0.004)	(0.004)	(0.002)	(0.002)
INT	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CASH	−0.015 *	−0.015 *	0.004	0.004	−0.007	−0.007
	(0.008)	(0.008)	(0.009)	(0.009)	(0.006)	(0.006)
AM	0.116 ***	0.038	−0.008	−0.024	0.057 ***	0.021
	(0.024)	(0.026)	(0.024)	(0.026)	(0.016)	(0.018)
BETA	0.002 *	0.002 *	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ROE	0.110 **	0.152 ***	0.004	0.007	0.013	0.018
	(0.041)	(0.040)	(0.013)	(0.013)	(0.000)	(0.012)
_cons	0.236 ***	0.379 ***	0.018	0.050	0.163 ***	0.207 ***
	(0.068)	(0.070)	(0.081)	(0.084)	(0.048)	(0.049)
Time effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	510	510	510	510	1020	1020
Adj-R^2	0.147	0.687	0.216	0.185	0.123	0.141

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Tables 7 and 8, the coefficients of TC in the "E_high" and "E_low" groups are notably different, mainly related to the characteristics of LL and SL. In Table 7, the negative effect of TC on the "E_high" group is comparatively small. This is often attributable to firms with higher environmental governance levels presenting mature and reliable "signals" to the outside world. Therefore, the firms' upstream and downstream stakeholders and banks are more inclined towards long-term loans, and there is limited substitution between financing modes. Conversely, the coefficients of TC observed for the "E_low" group in Table 8 are significantly larger than those of the "E_high" group. Despite the less developed environmental management competence of firms in the "E_low" group, SL, as a short-term loan, is insignificant compared to LL in terms of the total loan amount. As a result, banks and stakeholders do not enforce stringent financing for smaller amounts, and there is limited substitution between the two in terms of short-term loans.

4.5.2. Replacement of Independent Variable

In this study, TTC was deployed as the independent variable for regression analysis instead of the regular variable, TC. TTC is an alternative academic definition of trade credit, representing the sum of notes payable and accounts payable divided by the total assets. The regression outcomes for TTC, presented in Table 9, are consistent with the findings of the previous section across the distinct groups represented by Models 5a−c. Even with the replacement of TC with TTC, the negative influence of trade credit on corporate bank loans persisted in all three groups, bolstering the robustness of our analysis.

Table 9. Baseline regression results for TTC.

	Model 6a	**Model 6b**	**Model 6c**
TTC	−0.548 *** (0.077)	−0.394 *** (0.057)	−0.400 *** (0.047)
SIZE	−0.021 *** (0.005)	−0.009 (0.006)	−0.012 *** (0.004)
LEV	0.495 *** (0.052)	0.507 *** (0.044)	0.402 *** (0.034)
GROWTH	0.003 (0.003)	0.003 (0.006)	0.002 (0.003)
INT	−0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)
CASH	−0.006 (0.012)	0.007 (0.013)	0.010 (0.009)
AM	0.079 ** (0.037)	0.012 (0.037)	0.056 ** (0.027)
BETA	0.003 * (0.002)	0.002 ** (0.001)	0.003 *** (0.001)
ROE	0.216 *** (0.059)	0.226 *** (0.001)	0.000 *** (0.000)
_cons	0.393 *** (0.100)	0.107 (0.126)	0.203 ** (0.079)
Time effect	Yes	Yes	Yes
Observations	510	510	1020
Adj-R^2	0.537	0.345	0.204

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.5.3. Increasing Control Variable

Robustness testing often leverages the inclusion of control variables. In light of the existing literature, we incorporated firm age (AGE) as a control variable for the regression [36,38]. AGE is defined as the natural logarithm of the number of years since the firm's inception up to the current period. The results in Table 10 illustrate that the negative effect of trade credit on corporate bank loans persists across all groups even after accounting for AGE as a control variable. These findings thus reinforce the reliability of our study results.

Table 10. Increasing control variable—AGE.

	Model 7a	Model 7b	Model 7c
TC	−0.587 *** (0.061)	−0.486 *** (0.057)	−0.432 *** (0.040)
SIZE	−0.029 *** (0.005)	−0.008 (0.006)	−0.015 *** (0.003)
LEV	0.618 *** (0.054)	0.591 *** (0.046)	0.478 *** (0.028)
GROWTH	0.002 (0.003)	0.005 (0.006)	0.002 (0.003)
INT	−0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)
CASH	−0.007 (0.011)	0.007 (0.013)	−0.004 (0.009)
AM	0.011 (0.037)	−0.062 (0.038)	0.037 (0.026)
BETA	0.002 (0.002)	0.002 ** (0.001)	0.002 ** (0.001)
ROE	0.269 *** (0.058)	0.235 *** (0.020)	0.221 *** (0.018)
AGE	−0.010 (0.019)	−0.031 (0.031)	0.013 (0.016)
_cons	0.588 *** (0.120)	0.207 (0.141)	0.235 *** (0.088)
Time effect	Yes	Yes	Yes
Observations	510	510	1020
Adj-R^2	0.572	0.375	0.308

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$.

Since this study focused on the financing capability of the firm, we tried to add another control variable: ND/EBITDA, which is effective for the debt repayment level of the firm [48]. The regression results are shown in Table 11 below, Model 8a–c for "E_high", "E_low" and the full sample, respectively, and trade credit is always negatively correlated with corporate bank loans. This result verifies the robustness of the previous study findings.

Table 11. Increasing control variable—ND/EBITDA.

	Model 8a	Model 8b	Model 8c
TC	−0.583 *** (0.061)	−0.492 *** (0.057)	−0.518 *** (0.041)
SIZE	−0.029 *** (0.005)	−0.011* (0.006)	−0.023 *** (0.003)
LEV	0.614 *** (0.053)	0.589 *** (0.046)	0.590 *** (0.034)
GROWTH	0.002 (0.003)	0.005 (0.006)	0.003 (0.003)
INT	−0.000 (0.000)	-0.000 (0.000)	−0.000 (0.000)
CASH	−0.007 (0.011)	0.009 (0.013)	−0.000 (0.008)
AM	0.008 (0.037)	−0.062 (0.038)	-0.016 (0.026)
BETA	0.002 (0.002)	0.002 ** (0.001)	0.002 ** (0.001)
ROE	0.271 *** (0.058)	0.233 *** (0.020)	0.238 *** (0.018)
ND/EBITDA	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
_cons	0.553 *** (0.100)	0.167 (0.124)	0.434 *** (0.074)
Time effect	Yes	Yes	Yes
Observations	510	510	1020
Adj-R^2	0.292	0.377	0.323

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.5.4. Grouped Regression

In this study, a total of four types of stock data were collected, including green building, green credit, contract energy, and building energy efficiency. Models 9a–d correspond to the regression results of these four types of stocks in turn. In this section, we conducted grouped regression analysis. Table 12 displays the regression results for the four types of stocks. As shown in the table, among the four types of stocks, trade credit has consistently negative and significant effects on corporate bank loans. The results of the grouped regression analysis further confirm the robustness of our research conclusions.

Table 12. Grouped regression results.

	Model 9a	Model 9b	Model 9c	Model 9d
TC	−0.477 ***	−0.625 ***	−0.324 ***	−0.242 ***
	(0.051)	(0.050)	(0.084)	(0.075)
SIZE	−0.014 ***	−0.003	−0.039 ***	−0.004
	(0.004)	(0.006)	(0.008)	(0.006)
LEV	0.603 ***	0.733 ***	0.372 ***	0.261 ***
	(0.041)	(0.049)	(0.063)	(0.059)
GROWTH	−0.007	0.001	0.008 ***	0.001
	(0.008)	(0.004)	(0.003)	(0.021)
INT	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
CASH	0.043 ***	0.052 ***	−0.039 ***	−0.049 ***
	(0.010)	(0.013)	(0.013)	(0.017)
AM	0.132 ***	0.168 ***	−0.105 *	−0.134 ***
	(0.033)	(0.037)	(0.054)	(0.045)
BETA	0.001	0.001	0.000	0.002 *
	(0.002)	(0.001)	(0.001)	(0.001)
ROE	0.000 *	−0.000	0.000 *	0.317 ***
	(0.000)	(0.000)	(0.000)	(0.021)
_cons	0.200 **	−0.072	0.849 ***	0.089
	(0.080)	(0.122)	(0.175)	(0.122)
Time effect	Yes	Yes	Yes	Yes
Observations	250	250	260	260
Adj-R^2	0.595	0.699	0.335	0.534

Note: Standard errors appear in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Discussions and Implications

This study makes a valuable contribution to the burgeoning literature on the nexus between trade credit and corporate bank loans, particularly given the inconsistent findings resulting from prior research. In addressing these disparities, we deployed an approach based on group analysis. Our results reveal that the provision of trade credit hampers the corporate bank loans of firms exhibiting substantial levels of environmental governance. That is, the more financing a firm obtains from upstream and downstream stakeholders, the less it will borrow from banks. This finding is contrary to the findings of Lin et al. [10] and echoes the findings of Carbó-Valverde et al. [49]. As firms become more mature, they communicate outward positive signals, such as behavior favoring sustainability and stable debt repayment. Due to the complementary demand orientation of firms and suppliers, trade credit remains an important substitute funding avenue for bank loans. Furthermore, we expanded on the study by delving into the nonlinear effects of trade credit and firm bank loans. There is an inverted U-shaped relationship between the two financing methods for firms with lower levels of environmental governance, which differs from the outcome of Eddie et al. [16] and Du et al. [29]. This conclusion demonstrates a transformation in the financing methods of firms under different scenarios. Engaging the right period can induce the simultaneous growth of trade credit and corporate finance for firms with poor environmental governance, establishing a connection that reconciles the previous conflicts in the literature. Finally, compared to the existing literature limited to causality arguments, we quantified the outcomes and applied Shapely decomposition to determine the contribution of primary and secondary terms of trade credit to corporate bank loans for the first time. These intriguing results broaden the boundaries of existing research [25,27] and provide implications for research and practice in the realm of corporate financing management and environmental sustainability.

Drawing on the aforementioned analysis, this study proposed several implications for the current state of sustainable corporate finance. First, this study introduced the environmental dimension "E" score in the CSI ESG rating system as a novel innovation. In our analysis, we leveraged the variable level of corporate environmental governance as

the basis for research grouping in the background of sustainable development claims, thus enabling us to analyze firms operating in different circumstances. Our results, derived from both grouped and overall regressions, demonstrated a substitute relationship between trade credit and corporate bank loans. Accordingly, we suggest that banks and related financial institutions develop varied loaning strategies for each firm's environmental governance status. For example, concessional loans can be provided to firms with superior sustainable development status, while more stringent lending requirements can be imposed on firms demonstrating inadequate environmental governance. The Jiangsu Provincial Department of Finance, in conjunction with the provincial Department of Ecology and Environment, has proposed the introduction of "environmental protection loans" as an inclusive financial product to encourage financial institutions (e.g., banks) to provide more credit support for environmentally conscious firms. This initiative aims to lower the barrier to entry for firm financing and reduce associated costs, all while promoting high-quality development of the ecological environment (Provincial finance innovation to improve the "environmental protection loan" policy to help promote the development of high-quality ecological environment. (http://czt.jiangsu.gov.cn/art/2022/5/17/art_7938_10452321.html accessed on 20 May 2023). Enhancing banks' risk identification capabilities and fostering communication channels between banks and firms can facilitate informed credit support for firms.

Second, this study identified an inverted U-shaped effect between trade credit and corporate bank loans for firms with low environmental governance, a finding that can inform financing strategies for firms in different development stages. We propose that firms in the initial phase, lacking comprehensive governance measures, can leverage the early stage for mutual reinforcement of trade credit and corporate bank loans, raising as much capital as possible for future development. Moving into the second stage, trade credit and corporate bank loans become negatively related. Leveraging the accumulated capital in the early stage, firms should duly consider the difference between trade credit provided by upstream and downstream stakeholders as well as bank loans and make a more appropriate preference according to the type of financing, such as long-term or short-term borrowing. Concurrently, firms must recognize their social responsibility and promptly take measures to improve their environmental management standards. Firms with higher environmental management scores can send positive signals to creditors regarding their sustainability efforts. These firms should convert external pressures into internal incentives to cultivate environmental awareness, learn green innovation techniques, and refine green innovation incentive mechanisms.

Third, the long-term growth and development of firms are closely intertwined with macro-control, thereby necessitating government intervention. The government can leverage its macro-control and regulatory functions to foster the development of the financial system. This entails expediting the establishment of green financial reform and innovation pilot zones, improving the government's systematization and functionalization, streamlining management processes, and providing supportive policy frameworks. By the end of March 2018, the balance of green loans in these five pilot zones, Zhejiang, Guangdong, Guizhou, Jiangxi, and Xinjiang, had reached more than 260 billion yuan, an increase of 13% over the beginning of the approval of the pilot zones, and 2% higher than the growth rate of the various loan balances in the pilot zones during the same period (Green Finance Reform and Innovation Pilot Zone 85% of the pilot tasks have been launched to promote. (http://www.gov.cn/guowuyuan/2018-06/13/content_5298248.htm accessed on 20 May 2023). Moreover, the government must strengthen its supervisory function by enhancing monitoring indicators and evaluation systems for firms in heavily polluted industries. This step facilitates better tracking and management of firms' environmental impacts, promoting accountability. Further, intensified government oversight of firms' operations and social responsibilities would ensure strict standards and regulations. By formulating and implementing relevant policies, thereby guiding firms towards sustainable investments and operations, and stimulating market vitality, the government can encourage an enabling market environment and reinforce the effectiveness of control strategies.

6. Conclusions and Future Research

This study provides an insightful discussion of trade credit and corporate bank loans, incorporating the environmental dimension scores of the CSI ESG scoring system in the analysis, in line with prevailing sustainable development demands. The findings, validated by the inverted "U" effect test and the Shapely decomposition method, offer actionable insights for businesses. The study widens the theoretical perspective by examining four segments of the energy sector and sustainability-related firms and provides advice for navigating the lending process. Rationalizing corporate resource allocation, consistently planning feasible and effective environmental protection measures, and sending positive signals to the outside world, including upstream and downstream stakeholders and banks, can all contribute to a firm's long-term sustainable development. Despite its contributions, this study also involved several research boundaries, which call for further research.

First, this study focused on firms in the energy and environmental protection sector in China, intending to emphasize the representativeness of the sample. Existing studies tend to be country-specific, such as China [22], the United States [37], Japan [14], and Indonesia [40]. Future studies could compare findings from different countries to obtain broader empirical results. Second, trade credit is only one of the main factors related to the capability of corporate bank loans. In the current era of information, media coverage significantly influences a firm's image. In addition to the financial and environmental information that firms themselves disclose, news reports are also "signals" released by the firm to external parties. Therefore, in the future, we can conduct an in-depth study on corporate bank loans from the perspective of media. Finally, this study focused on the level of environmental management of firms, while the remaining two dimensions of ESG scores—social and governance—will serve as opportunities for future research systems by including more facets of the theoretical framework for multi-dimensional comparisons.

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