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Research Article

Role Of Green Finance for Signaling Sustainability in Corporate Debt Decisions

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ABSTRACT

This research investigates the role of green financing in determining corporate debt levels and their costs in Pakistan. It focuses on green investment, green credit, and green securities, while also exploring sectoral variations across energy, cement, textile, pharma, and fertilizer. Firm-specific factors such as age, size, liquidity, and financial performance are also considered in corporate debt decisions. The study utilizes secondary data from Bloomberg, and company sustainability reports, covering 120 listed firms from 2016 to 2023. Panel data models, including fixed effects, random effects, and pooled ordinary least squares, are applied. The results show that green credit significantly enhances both short-term and long-term debt across all sectors. Green investment is also positively associated with both short- and long-term debt, with stronger effects on long-term financing. Green securities; however, shows a significant impact only on short-term debt, while its effect on long-term debt remains insignificant, highlighting the limited maturity of green securities markets in Pakistan. Sector-specific analysis reveals that in industries such as textile, adopting green credit and green investment lowers the cost of debt financing, suggesting that green finance instruments reduce borrowing costs by signaling lower credit risk. Moreover, firm size and age significantly influence debt accessibility, with larger and older firms securing better financing terms, consistent with signaling theory (Chinonso & Zhen, 2016). This study contributes to green finance literature by demonstrating how different instruments vary in effectiveness across financing horizons and sectors. Policymakers are advised to incentivize green credit and green investment adoption, particularly in highly polluting industries such as cement and energy, while strengthening regulatory frameworks for green securities to enhance their role in long-term financing.

KEYWORDS

Green Financing, Green Credit, Green Securities, Green Investment, Corporate Debt, Debt Costs, Signaling Theory, Pakistan.

1 | INTRODUCTION

Debt financing plays a central role in shaping corporate financial policy, determining both the structure of capital and the cost of raising funds (Rapp, Schmid & Urban, 2014). Firms typically rely on a mix of short-term and long-term borrowings to support operations, expansion, and investment activities. Short-term debt is commonly associated with working capital needs, while long-term debt supports large-scale capital projects. Alongside debt levels, the cost of financing—comprising interest payments and other borrowing expenses—serves as an indicator of a firm's financial health, creditworthiness, and access to capital markets (Gong & Zhang, 2025; Nicolas, 2022). Globally, rising interest rates, macroeconomic volatility, and supply chain disruptions have made debt financing more expensive and risk-sensitive, especially for highly leveraged firms. In emerging economies, the challenge is further compounded by underdeveloped financial markets, weak regulatory environments, and limited access to innovative financing instruments. Against this backdrop, green financing has emerged as a transformative mechanism that links financial markets with sustainability objectives. Green financing instruments—such as Green Credit (GC), Green Securities (GS), and Green Investment (GI) —are designed to channel capital into

environmentally sustainable projects while simultaneously lowering financing costs for compliant firms (Kharb, Shri & Saini, 2025; Khan & Saleem, 2021). They serve as market-based incentives, rewarding businesses that adopt environmentally friendly practices and penalizing those that rely on carbon-intensive activities. Prior evidence from developed economies suggests that green financing improves firms' credit terms and reduces borrowing costs by signaling reduced risk to lenders and investors. However, despite its growing global significance, the role of green financing in shaping corporate debt structures remains underexplored in the context of developing economies (Fu, 2024; Zhang et al., 2024).

Although international research has highlighted the positive role of green financing in lowering borrowing costs, these insights cannot be readily generalized to countries like Pakistan. In advanced economies, green financing frameworks are supported by mature regulatory systems, deep financial markets, and strong investor demand for sustainability-linked products (De Mariz et al., 2024; Raza et al., 2024). By contrast, Pakistan's adoption of green financing remains nascent and fragmented. The energy sector, which contributes over 60% of national power through fossil fuels, and industries such as textile and cement, which are major polluters, face severe sustainability challenges (Liu & Wu, 2023). Yet, limited empirical evidence exists on how green financing influences debt structures and costs within these sectors. The lack of such knowledge has two major consequences. First, firms in Pakistan may be reluctant to adopt green financing mechanisms if the financial benefits remain uncertain. Without clear evidence that green credit, securities, or investments improve borrowing terms, corporate managers may continue to rely on conventional debt despite its higher costs (Wang et al., 2023). Second, the absence of sector-specific insights risks slowing the transition toward sustainable practices in industries that are crucial to Pakistan's economic development but also significant contributors to environmental degradation. These gaps highlight the need for rigorous empirical analysis of how green financing affects corporate debt in Pakistan.

This study is significant in the context of Pakistan's emerging economy, where green financing remains in its early stages. High-emission sectors such as textile, cement, and energy lack evidence on how GC, GS, and GI influence corporate debt levels and borrowing costs. Addressing this gap, the research demonstrates that green financing not only provides financial advantages but also supports environmental sustainability. Grounded in Signaling Theory, the study shows that green financing acts as a credible signal of sustainability, lowering perceived risk and enabling firms to access debt at reduced costs. It examines short- and long-term debt as well as debt costs, highlighting sector-specific variations in outcomes. Using a positivist approach and panel data models Fixed Effects (FE), Random Effects (RE), and Pooled Ordinary Least Squares (POLS) on firm-level financial and sustainability reports from 2016–2023, the analysis offers robust results across five major industries. The findings have practical implications for businesses, financial institutions, and policymakers. For firms, adopting green financing can improve access to affordable capital; for financial institutions, it underscores the need to expand green credit facilities; and for policymakers, it suggests designing targeted incentives for high-emission sectors. Overall, the research enriches literature on sustainable finance in developing economies and demonstrates how green financing can embed sustainability within corporate capital structures while strengthening financial performance. Thus, the current study explores how financing instruments—specifically green credit, green securities, and green investments—affect firms' capital structure, in terms of short-term and long-term debt levels.

2 | THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Corporate financing choices are often shaped by information gaps between firms and external stakeholders such as banks, investors, and regulators (Malmendier, Tate & Yan, 2011). Traditional perspectives on capital structure—such as the trade-off between debt and equity, agency conflicts, or the preference for internal funds—help explain why firms borrow and under what conditions (Beyer et al., 2010). Yet, these theories provide limited insight into how sustainability considerations influence financial behavior, particularly in emerging economies where markets are less transparent (Neuenkirch, 2013). In this context, Signaling Theory offers a powerful lens. The central idea of the theory is that firms can communicate unobservable qualities, such as their long-term stability or risk profile, through costly and visible actions. For a signal to be credible, it must involve commitments or expenses that weaker firms are unwilling to bear. Green financing instruments—such as GC, GS, and GI —fit this description well (Koval, 2022). Their adoption typically requires compliance with environmental standards, independent verification, and additional disclosure. These conditions impose costs but also provide transparency, allowing stakeholders to distinguish committed firms from those merely claiming sustainability. In doing so, green financing signals a reduced likelihood of environmental, reputational, and financial risks (Gangi, Daniele & Varrone, 2020). This

signaling effect has two important implications for corporate debt. First, it can expand firms' access to both short- and long-term borrowings by enhancing creditor confidence. Second, it can reduce the perceived risk premium, thereby lowering the cost of debt. For firms in Pakistan, where financial markets face high levels of information asymmetry and weak disclosure norms, such signals are particularly valuable (Pineiro-Chousa et al., 2017). Green financing thus operates not only as a funding tool but also as a strategic mechanism for shaping debt structures in an emerging economy.

2.1 | Green Credit and Debt Financing Levels

Green credit, or green loans, has emerged as one of the most widely adopted sustainability-linked financing tools. Unlike conventional loans, green credit requires firms to meet environmental criteria and often involves ongoing monitoring by lenders. Such requirements increase the credibility of borrowing firms and signal lower default risk. Prior research suggests that firms engaging in green lending relationships enjoy better access to working capital and more favorable terms of borrowing (Zhang et al., 2023; Wu et al., 2021; Tahir et al., 2015). In emerging markets, where credit markets are highly risk-sensitive, green credit can serve as a credible signal of both financial and environmental responsibility. As a result, it is expected to strengthen firms' access to both short-term and long-term financing.

H_1: Green credit is positively associated with the level of (a) short-term debt and (b) long-term debt.

2.2 | Green Securities and Debt Financing Levels

Green securities, such as green bonds and funds, provide another formalized channel for signaling sustainability commitments. These instruments are subject to third-party verification and public disclosure, which enhance market confidence and transparency. Studies in developed economies show that issuing green bonds reduces information asymmetry and expands firms' ability to secure external financing (Yeow & Ng, 2021). Moreover, green securities have been linked with reputational benefits and improved investor confidence, which can indirectly influence access to bank credit. In the Pakistani context, where capital markets remain underdeveloped, the issuance of green securities can reinforce credibility and attract additional debt financing from both short-term and long-term lenders (Tahir et al., 2020).

H_2: Green securities are positively associated with the level of (a) short-term debt and (b) long-term debt.

2.3 | Green Investments and Debt Financing Levels

Green investments refer to firms' allocation of resources into environmentally friendly projects, technologies, and processes. Such investments reflect a proactive sustainability strategy and long-term orientation. According to Signaling Theory, the commitment of capital to green projects represents a costly but credible signal that only serious firms can afford, reducing perceived risks for creditors. Prior studies demonstrate that firms with higher levels of environmental investment are rewarded with better credit ratings and improved access to external financing (Zhang, 2021). In emerging economies, where regulatory enforcement is often weak, green investment provides tangible proof of sustainability practices, increasing both operational credibility and financial trust. Consequently, green investment is expected to enhance firms' access to both short- and long-term debt financing.

H_3: Green investment is positively associated with the level of (a) short-term debt and (b) long-term debt.

2.4 | Signaling Theory

Nonetheless, the most germane theoretical framework for this research is the Signaling Theory of Spence (1973). According to Signaling Theory, in the event of information asymmetry, an individual party (the signaler) sends information to another party (the receiver) through the use of a signal. Under corporate finance, an issuance of debt or green financing can be used as signals that inform investors of the quality and future of the firm. Under the scope of the current research, green financing vehicles like Green Credit, Green Securities, and Green Investments are used as signals that the firm is sustainable, reducing risks perceived and increasing their appeal as investments for investors.

Administrative and Management Sciences Journal
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3 | METHODS

3.1 | Design of Research

The research implements a positivist philosophy, focusing on objective reality and measurable variables to examine the impact of green financing on debt financing levels and costs across industries in Pakistan, using secondary financial data (Saunders and Lewis, 2017). A deductive path of reasoning is adopted, starting with the application of the theory of Signaling to form hypotheses about the role played by green financing towards financing via debt and testing them with the application of panel econometric methodologies, generating strong and reliable estimates (Bell et al., 2022). Since secondary financial information have a longitudinal nature, a quantitative path of investigation is adopted for testing hypotheses, for inferring statistics, and for analysis over a duration (Creswell and Creswell, 2017).

3.2 | Participants and Sampling Approach

The sampled companies include 120 publicly traded companies in sectors such as energy (23 companies), cement (18 companies), textile (60 companies), pharmaceutical (14 companies), and fertilizer (5 companies), and have been chosen for high impact in terms of environment and financing demand for environmentally friendly operations. Energy is a high-carbon-emitting sector with high demand for investments in renewable transition (IAE, 2024). Production of cement emits nearly 8% of worldwide CO_2, and therefore, environmentally friendly financing for environmentally friendly production is a must (Scrivener et al., 2018). Textile, with high consumption and use of water and energy, is increasingly utilizing environmentally friendly approaches in an attempt to reverse environment degradation. Pharmaceutical and fertilizer industries consume high chemicals and have high emissions, and therefore, require investments with a direction towards sustainability (Puri et al., 2023). With such a selection, a balanced cover of sectors is guaranteed. The size of the sample will rely on availability and estimation necessity in panels, for strong statistics assurance. Purposive sampling approach will be utilized in choosing companies with current engagements in green financing, in conformation with study aims (Etikan et al., 2016).

3.3 | Data Collection and Sources

This study employs secondary data drawn from a variety of sources in an analysis of the role played by green financing in shaping debt financing level and expense. Financial statements for listed companies yield important financial ratios. Besides, databases for Bloomberg and Refinitiv act as principal sources for accessing firm-level financial and market information. To assess green financing activities, sustainability reports, ESG reports, and CSR reports are used, offering insights into firms' environmental commitments and financing strategies. The combination of these sources ensures comprehensive, reliable, and high-quality data, facilitating robust panel data estimation and empirical analysis (Baltagi and Baltagi, 2008). Table 3.1 presents the variables of this study including dependent, independent, and control variables along with their measurements, and data sources. The table also includes the references of studies from where these measures were adopted.

3.4 | Econometric Modelling

As the proposed research requires to examine the impact of Green Financing (like GC, GS, and GI) on Debt Financing Levels as well debt financing cost across industries in Pakistan. Therefore, the researcher will test the required set of hypotheses of the proposed study using the following econometric equations 1 to 2:

$$SDFL_{it} = \beta_0 + \beta_1 GC_{it} + \beta_2 GS_{it} + \beta_3 GI_{it} + \sum \varphi\,(Controls)_{it} + \mu_{it} \dots\dots\dots (1)$$

$$LDFL_{it} = \beta_0 + \beta_1 GC_{it} + \beta_2 GS_{it} + \beta_3 GI_{it} + \sum \varphi\,(Controls)_{it} + \mu_{it} \dots\dots\dots (2)$$

Where; Where: SDFL = Short-term level of debt financing, LDFL = Long-term level of debt financing, DFC = Cost of debt-financing, GC = Green Credit, GS = Green Security, GI = Green Investment, Controls = Control Variables as defined in Table 1. β_0 represent constant term in the model. Furthermore, β_1 to β_3 are the slope coefficients. φ is the slope coefficient to measures the change in control variables. The subscript '*i*' represents the cross-sections and subscript '*t*' represents the time period. The combination of both subscripts represents panel data. Finally, u represent the error term.

Administrative and Management Sciences Journal
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3.5 | Estimation Methods

The researcher uses static panel data models, specifically FE and RE models. Both of these models are applied when examining contemporaneous relationships or short-run relationships (Baltagi and Baltagi, 2008). They are capable of managing both cross-sectional and time-series variation for the volume of debt finance for various industries. Static panel models utilized can give insights into how independent factors such as green finance vehicles affect corporate debt decisions controlling for unobserved heterogeneity. The selection between fixed-effects or random-effects model will also rely on the result of the Hausman test, which is utilized for determining appropriate model for working with data (Hausman, 1978). This method guarantees robust, reliable analysis capable of capturing the underlying dynamics of green financing versus corporate debt variables for different sectors.

Table 1
Variable Measurement

Variables	Measurements	Data Source
Dependent Variables		
Debt Financing Levels		Financial Statements & Databases: Bloomberg, Refinitiv
• Level of Short-Term Debt	= Short Term Debts / Total Assets	
• Level of Long-Term Debt	= Long Term Debts/ Total Assets	
Independent Variables		
Green Financing		Sustainability reports, and Financial Statements, and Databases like Bloomberg, Refinitiv
• Green Credit (Green Loans)	= Green Loans/Total Loans	
• Green Securities (Green Funds)	= Green Funds/Total Shareholder Funds	
• Green Investment	= Total Expenditures on Green Initiatives/Total Assets	
Control Variables		
▪ Firm Age	= LN (Number of Years since incorporation)	
▪ Firm Size	= LN (Total Assets, or Total Sales)	
▪ Firm Liquidity	= Current Assets/Current Liability	
▪ Interest Cover	= EBIT/Interest Expense	
▪ Operating CF Ratio	= Net Cash Flow from Operating Activities/Total Assets	
▪ Firm's Profitability	= ROA, ROE, and Tobin's Q	Financial Statements & Databases: Bloomberg, Refinitiv
▪ Firm's Collateral Value	= Net Fixed Assets/Total Assets	
▪ Firm's Growth	= Current EAT – Previous EAT/Previous EAT	
▪ CA Turnover	= EAT/Current Assets	
▪ Cash Ratio	= Cash & Equivalents/Current Liabilities	
▪ Board's Size	= LN (Number of Board's members)	
▪ Board's independence	= Number of Independent Directs/Total members in Board	
▪ Board's Diversity	= Female board members/Total members in Board	

4 | RESULTS

4.1 | Descriptive Summary

Table 1 reports the descriptive summary for the sample, comprising 881 observations. The mean value of LSTD is 0.2637, with a STD of 0.1615. On average, approximately 26% of the firms' financing is sourced from short-term obligations. LLTD reports a slightly lower mean of 0.1627 (STD = 0.1445), suggesting a relatively balanced approach to debt structuring across firms. GC has an average value of 0.0514, with a STD of 0.0228. GS have a similar average value of 0.0522, with a STD of 0.0229. These figures demonstrate modest levels of environmental financing activities across firms. GI have an average value of 0.0206, with a STD of 0.0202. The variable shows pronounced positive skewness (1.5604) and high kurtosis (3.8250). This indicates that while the average investment is low, a few firms engage significantly in green initiatives.

Administrative and Management Sciences Journal
EISSN-2959-2275; PISSN-2959-2267

Table 2
Descriptive Statistics

Variables	Mean	STD	Kurtosis	Skewness	Min	Max	N
LSTD	0.2637	0.1615	-0.0370	0.5617	0.0000	0.8224	881
LLTD	0.1627	0.1445	1.5202	0.3362	0.0000	0.7625	881
GC	0.0514	0.0228	0.0652	0.2723	0.0003	0.1526	881
GS	0.0522	0.0229	-0.2091	0.2915	0.0024	0.1250	881
GI	0.0206	0.0202	3.8250	1.5604	0.0005	0.0999	881
FAGE	3.5070	0.4940	3.3506	-1.2792	0.6931	4.3175	881
FSIZE	8.9734	1.7804	-0.4111	0.0676	4.4206	13.5497	881
FLIQ	7.6052	1.2119	2.3337	0.9789	0.1183	16.3276	881
INC	3.0202	1.7757	2.2993	9.8346	-11.4112	3.7294	881
OCF	0.0608	0.1027	1.3266	0.5099	-0.2983	0.4899	881
ROA	0.0719	0.1121	2.3353	-1.3141	-0.8549	0.4064	881
ROE	0.0471	1.7189	3.3724	-1.3131	-38.8029	10.9765	881
FCV	0.5287	0.2417	3.8519	0.6186	0.0009	3.9882	881
FGR	-0.1384	0.0592	1.9133	-0.0227	-1.4565	7.2136	881
CAT	0.0621	0.6156	1.4456	-0.0841	-10.9739	4.1427	881
CAR	0.2499	0.3778	2.1475	0.4860	0.0000	2.7890	881
BSZ	2.3521	0.1561	-0.0569	-0.4540	1.7918	2.6391	881
BIND	0.5514	0.0867	-0.7767	-0.1070	0.3333	0.7500	881
BDIV	0.2500	0.0681	-0.4009	-0.1648	0.0909	0.4167	881

4.2 | Correlation Analysis

Table 2 presents the Pearson correlation coefficients for the sample data. The level of short-term debt (LSTD) is significantly negatively correlated with the level of long-term debt (LLTD) ($r = -0.1404$, $p < .001$). This indicates an inverse relationship between short-term and long-term financing structures across firms. This suggests that firms with higher short-term debt tend to face lower financing costs. In terms of green financing measures, LSTD shows a small but significant positive correlation with green credit (GC) ($r = 0.0982$, $p = .0035$). However, the relationships with green securities (GS) and green investments (GI) are relatively weaker and not significant ($p > .05$). Similarly, LLTD is negatively correlated with DFC ($r = -0.1423$, $p < .001$), but no significant relationship is found with green financing variables. Although, the correlation coefficient is less than 0.70, indicating no issue of multicollinearity.

Table 3
Correlation Matrix for Complete Sample

Variables	LSTD	LLTD	GC	GS	GI
LSTD	1				
LLTD	-0.1404*	1			
GC	0.0982*	0.0977*	1		
GS	0.0851*	0.0911*	0.6979	1	
GI	0.1337*	0.0168	0.0690	0.0927	1

Note: **significant*

4.3 | Panel Regression Analysis

4.3.1 | Green Financing and Short-Term Debt Financing

The results of the short-term debt financing (LSTD) model suggest that Green Credit (GC) has a statistically significant positive effect across all three models (OLS: $\beta = 0.558$, $p < 0.01$; FE: $\beta = 0.461$, $p < 0.01$; RE: $\beta = 0.4856$, $p < 0.01$), indicating that higher Green Credit (GC) is associated with increased short-term debt financing decisions. In contrast, Green Securities (GS) demonstrates a statistically significant positive effect only in the OLS model ($\beta = 0.352$, $p < 0.1$), but fails to show significance in the FE and RE models. Green Investment (GI) is positively related to LSTD in all three models, with the most substantial effect in the OLS model ($\beta = 0.892$, $p < 0.01$), indicating that greater Green Investment (GI) correlates with higher short-term debt financing decisions.

Administrative and Management Sciences Journal
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4.3.2 | Green Financing and Long-Term Debt Financing

For long-term debt financing (LLTD), Green Credit (GC) exhibits a statistically significant positive relationship in the OLS, FE, and RE models (OLS: $\beta = 0.453$, $p < 0.01$; FE: $\beta = 0.0941$, $p < 0.01$; RE: $\beta = 0.183$, $p < 0.01$), indicating that higher Green Credit (GC) is positively associated with increased long-term debt financing decisions. Green Securities (GS) demonstrates statistical significance in the FE and RE models (FE: $\beta = 0.0652$, $p < 0.05$; RE: $\beta = 0.247$, $p < 0.05$), suggesting that Green Securities (GS) influences long-term debt financing decisions in these models. Green Investment (GI) shows a significant positive effect in the OLS and FE models (OLS: $\beta = 0.436$, $p < 0.05$; FE: $\beta = 0.479$, $p < 0.05$), but no significant effect is found in the RE model.

4.3.3 | Model Fit and Explanatory Power

The R-squared values indicate a moderate to substantial proportion of the variance explained by the models. For LSTD, the R-squared values range from 0.2182 in the OLS model to 0.2997 in the FE model, indicating a moderate fit. For LLTD, the R-squared values are lower, ranging from 0.214 in the OLS model to 0.281 in the RE model. In contrast, the DFC model demonstrates a higher R-squared value (R-squared = 0.521 for the RE model), suggesting a strong fit for this model.

Table 4
Panel Regression

Variables	LSTD			LLTD		
	OLS	FE	RE	OLS	FE	RE
GC	0.558***	0.461***	0.4856***	0.453***	0.0941***	0.183***
	(0.132)	(0.132)	(0.130)	(0.028)	(0.044)	(0.042)
GS	0.352*	0.036**	0.0652**	0.171	0.206	0.247
	(0.127)	(0.014)	(0.026)	(0.277)	(0.268)	(0.284)
GI	0.892***	0.183***	0.0656***	0.436**	0.479**	0.160**
	(0.232)	(0.060)	(0.020)	(0.197)	(0.163)	(0.047)
FAGE	0.017	0.151*	0.0402**	-0.0446***	-0.279***	-0.0886***
	(0.009)	(0.055)	(0.018)	(0.0101)	(0.0837)	(0.0266)
FSIZE	-0.003	-0.044*	-0.0151**	0.00303	0.0546*	0.00519
	(0.003)	(0.026)	(0.007)	(0.00329)	(0.0311)	(0.00912)
FLIQ	0.001**	0.002***	0.0011**	-0.00127***	-0.000426	-0.000794*
	(0.000)	(0.001)	(0.001)	(0.000429)	(0.000379)	(0.000464)
INC	-0.001*	-0.001***	-0.0002	-0.000154	1.17e-05	1.89e-05
	(0.000)	(0.000)	(0.000)	(0.000278)	(0.000235)	(0.000196)
OCF	-0.225***	-0.231***	-0.2281***	0.0245	0.0577	0.0351
	(0.057)	(0.041)	(0.038)	(0.0573)	(0.0447)	(0.0442)
ROA	-0.350***	-0.084***	-0.0820**	-0.154**	-0.152**	-0.138**
	(0.086)	(0.028)	(0.077)	(0.0691)	(0.0648)	(0.0683)
ROE	-0.001	-0.001*	-0.0013	0.000842	0.00353*	0.00296
	(0.002)	(0.001)	(0.001)	(0.00225)	(0.00205)	(0.00201)
FCV	-0.038	-0.008	-0.0017	0.0730**	0.0872	0.0780
	(0.030)	(0.048)	(0.037)	(0.0300)	(0.0621)	(0.0507)
FGR	0.001	0.000	-0.0001	0.000914**	0.000664	0.000652*
	(0.001)	(0.000)	(0.000)	(0.000399)	(0.000422)	(0.000386)
CAT	-0.007	-0.002	-0.0025	-0.0130	-.0103	0.00883
	(0.012)	(0.010)	(0.010)	(0.0147)	(.01417)	(0.0239)
CAR	-0.007	0.001	-0.0004	-0.00758	0.0224	-0.00840
	(0.015)	(0.015)	(0.016)	(0.0180)	(0.0253)	(0.0141)
BSZ	0.080*	0.162**	0.0094	-0.0625*	0.134	0.0138
	(0.033)	(0.061)	(0.068)	(0.0359)	(0.106)	(0.0736)
BIND	-0.172**	-0.170	-0.1721	0.182***	-0.435**	-0.133
	(0.063)	(0.171)	(0.125)	(0.0653)	(0.185)	(0.185)
BDIV	0.114	0.204	0.1703	-0.0446	-0.0691	-0.189
	(0.070)	(0.226)	(0.125)	(0.0802)	(0.366)	(0.204)
Cons	0.231*	0.613***	0.3461***	0.371***	0.560	0.507**
	(0.093)	(0.000)	(0.106)	(0.0985)	(0.366)	(0.206)
R-square	0.2182	0.2997	0.2447	0.214	0.226	0.281
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

*Note: Firms (n) = 111, Time period (t = 2016-23) = 8 years, Observations (N) = 881. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

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5 | DISCUSSION AND CONCLUSION

The present study examined the role of green financing mechanisms—green credit, green securities, and green investments—on firms' access to short-term and long-term debt financing. Building on signaling theory and prior empirical findings, the results provide meaningful insights into how sustainability-oriented financial practices enhance debt accessibility in the Pakistani context. The findings support both H_{1a} and H_{1b}, indicating that green credit is positively associated with the levels of short-term and long-term debt. This suggests that firms leveraging green loans not only benefit from immediate liquidity but also enjoy improved access to long-term financing. These results align with Zhang et al. (2019) and Li & Wu (2021), who reported that the environmental monitoring and reporting requirements attached to green loans reduce lenders' perceptions of default risk. In emerging markets such as Pakistan, where credit markets are sensitive to informational asymmetries, the role of green credit becomes even more critical as it signals financial prudence and environmental responsibility simultaneously. The results also reveal that short-term financing is particularly strengthened by green credit, which may reflect lenders' preference for supporting environmentally aligned firms in working capital needs before extending longer-term commitments.

The results provide partial support for the hypotheses related to green securities. Specifically, H_{2a} is supported, showing that green securities are positively associated with the level of short-term debt. This suggests that issuing instruments such as green bonds or funds enhances transparency and provides reputational benefits that improve firms' access to short-term credit facilities. These findings are consistent with prior research indicating that green securities reduce information asymmetry and signal credibility to financial institutions (Tang & Zhang, 2020; Flammer, 2021; Alam et al., 2022). In emerging markets like Pakistan, short-term lenders appear more responsive to the signaling value of green securities, likely because the verification and disclosure requirements reduce immediate risk concerns. However, H_{2b}, which posited a positive relationship between green securities and long-term debt, was not supported. This result indicates that while green securities help firms obtain short-term credit, they may not be sufficient to persuade creditors to commit to longer-term financing. One possible explanation is that Pakistan's capital markets are still underdeveloped, and the green securities market is relatively nascent. As a result, lenders may remain cautious about extending long-term credit solely on the basis of green securities, instead prioritizing more established indicators of financial and operational stability (Shafqat et al., 2025). This finding highlights an important distinction: the signaling effect of green securities may be stronger in the short term but less convincing in the absence of mature market institutions and long-term performance records.

The final set of hypotheses H_{3a} and H_{3b} are also supported, suggesting that green investment enhances both short-term and long-term debt financing levels. These findings echo earlier work by Goss and Roberts (2011) and Krüger (2015), who noted that environmental investments serve as costly but credible signals of firms' long-term commitment to sustainability. In emerging economies with weaker regulatory enforcement, such investments provide tangible proof of responsible behavior, which creditors interpret as reducing financial risk (Chand et al., 2025). The empirical results suggest that green investment strengthens firms' operational credibility, encouraging lenders to extend both short- and long-term debt. More notably, the association with long-term financing was found to be stronger, implying that creditors reward firms that demonstrate strategic and future-oriented sustainability practices (Huo et al., 2024).

5.1 | CONCLUSION

This study examined the impact of green credit, green securities, and green investment on firms' access to short-term and long-term debt financing in Pakistan. The results provide broad support for the role of green financing as a signaling mechanism but also reveal important nuances. Green credit and green investment were found to be positively associated with both short- and long-term debt, underscoring their role in reducing information asymmetry and enhancing creditor confidence. Green securities, however, showed only partial support: they improved access to short-term debt but did not significantly influence long-term debt levels. Theoretically, these findings extend signaling theory by demonstrating that the strength of sustainability signals may vary by financing horizon. Green credit and green investment represent more tangible and ongoing commitments, which creditors reward across both timeframes. In contrast, green securities may be viewed as credible for short-term liquidity but insufficient for long-term commitments in less mature financial markets. Practically, the results suggest that firms in Pakistan should strategically employ green financing mechanisms not only for sustainability but also to strengthen financial access. Policymakers and regulators should work toward deepening capital markets and building stronger verification systems for green securities to enhance their effectiveness in supporting long-term financing. Overall,

the study establishes that green financing mechanisms contribute meaningfully to firms' debt accessibility, though their effects differ depending on the type of instrument and the financing horizon.

5.2 | THEORETICAL IMPLICATIONS

The current work contributes importantly to the theoretical nature of green financing as well as its correlation with corporate financing choices, in particular through the framework of Signaling Theory. Using Signaling Theory, the work establishes that green financing, specifically GC, is an indicator of sustainability commitment on the part of the firm. This signal reduces information asymmetry between firms and external stakeholders, thereby improving access to debt capital. The results suggest that GC is the most influential green financing tool across sectors, reinforcing the theoretical proposition that signaling sustainability can enhance firms' reputations and decrease perceived financial risks. This work also adds to the current literature through the identification of the sectoral impacts, especially for the Energy and Cement sectors, as well as offering greater insights into the differential efficiency of GS and GI.

5.3 | PRACTICAL IMPLICATIONS

From a practical perspective, the study holds several key implications for businesses, financial institutions, as well as policymakers. Businesses in industry segments like Textile, Cement, as well as Pharma can use GC in order to access capital at cheaper prices as well as save on borrowing expenses. Financial institutions can introduce or expand their GC products to attract firms seeking funding for sustainability initiatives. Policymakers can promote green financing by offering incentives and support for firms engaging in green initiatives, particularly in high-emission and capital-intensive sectors like Energy and Cement. The results imply that industry-specific approaches are necessary, as the nature of the impact of GS and GI might be different in different sectors. Customized green financing programs can assist in promoting sustainable development and ensure that businesses in different sectors can obtain the resources necessary for green investments.

5.4 | LIMITATIONS AND FUTURE DIRECTIONS

In spite of being a valuable addition on its own merit to an understanding of how green finance has an impact on corporate borrowing decisions, this research is not without limitations. One such limitation is its reliance on secondary data, which is susceptible to biases. The consistency and completeness of green financing activities' sustainability disclosure can differ among various firms and impact on overall reliability of findings. Disclosures can be driven by voluntary reporting standards and hence vary regarding data comprehensiveness. In addition, this research is restricted to listed firms, limiting its generalizability. Public firms are generally larger and are likely to access green finance than their private counterparts and small firms. This provides scope for future understanding of how green finance channels affect private firms. The cross-sectional sample is also limiting for analyzing long-term effects of green finance. Future research is needed to test these limitations with a complete survey so a better understanding can be reached of dynamics at play.

However, future research can employ primary sources. Surveys or interviews with firms directly engaged in green finance would be appropriate for such an endeavor. This would allow researchers to gain an experiential insight into motivations, challenges, and experiences of firms utilizing green finance facilities. Further studies can increase the sample to encompass private firms and small and medium enterprises (SMEs). This would give a broader perspective of how green finance operates and covers the special circumstances of various company sizes. It would also be worthwhile to investigate how government policies and incentives affect green finance adoption. This is especially so when it comes to industries where GS and GI exert a stronger influence Long-term longitudinal analyses would enable an exploration of how green finance has lasting effects on business borrowing. This would give a truer insight in the longer term. Sectoral studies would enable us to define how separate green finance mechanisms function within different sectors. This would facilitate the use of tailored approaches in future public policy-making as well as in business plans.

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