THE IMPACT OF SUSTAINABLE SUPPLY CHAIN PRACTICES ON CORPORATE DEBT MATURITY: GLOBAL EVIDENCE

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ABSTRACT

This study analyzes the impact of sustainable supply chain practices on firms' debt maturity, based on 60,727 observations across 52 countries from 2013 to 2023. The research tests two opposing hypotheses and provides evidence that firms with stronger commitments to sustainable supply chain practices tend to hold a higher proportion of long-term debt in their debt structure. This finding is consistent with the view that sustainable supply chain practices enhance firms' access to long-term capital. The robustness of the results is maintained after controlling for macroeconomic factors, as well as time, industry, and market fixed effects. Based on the findings, firms' commitment to sustainable supply chain development can be regarded as a credible signal of their creditworthiness to creditors, thereby facilitating access to long-term debt financing for companies actively engaging in sustainable supply chain practices.

Keywords: sustainable supply chain practice, debt maturity, long-term debt, short-term debt.
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1. Introduction

In the context of growing global climate and social challenges, sustainability has become a strategic priority for businesses. The supply chain, in particular, is considered a critical area for sustainability improvement, since the majority of firms' environmental and social impacts originate within the supply chain. Analyses show that around 20% to 33% of global CO_2 emissions are embedded in goods and services traded through international supply chains (Li et al., 2020). Therefore, enhancing supply chain sustainability is regarded as an essential condition for achieving the net-zero emissions target. Under the pressure of consumers, investors, and government regulations, Sustainable Supply Chain Practices (SSCP) have emerged as a key element of modern corporate governance. SSCP are understood as a set of coordinated operational practices among supply chain actors, aiming to integrate environmental, social, and economic objectives simultaneously into supply chain management processes, including procurement, production, logistics, distribution, and reverse flows, ensuring transparency and optimizing material, information, and financial flows along the chain (Adams et al., 2021). In other words, firms commit to long-term sustainability by ensuring that activities from procurement and production to distribution harmoniously combine economic goals with environmental and social responsibilities. The adoption of this sustainable supply chain model not only reduces adverse impacts on the environment and community but also enhances firms' operational and financial performance.

Although all are directed toward sustainability, SSCP differs in scope and approach from broader frameworks such as ESG (Environmental, Social, and Governance) or CSR (Corporate Social Responsibility). Specifically, SSCP focuses on the supply chain, that is, how firms manage suppliers, logistics, and production in a sustainable manner, implementing those commitments into daily operations. Because of this specialized nature, SSCP has become a rapidly developing research field in the past decade (Modak et al., 2020), serving as a bridge between macro-level sustainability strategies and firms' operational performance. An analysis by Govindan et al. (2020) shows that SSCP significantly improves operational and financial performance. Furthermore, Zhao et al. (2025) demonstrate that firms with proactive sustainable supply chain policies outperform competitors in market competitiveness, investment attractiveness, and operational efficiency. Thus, sustainable supply chains are not only an ethical

imperative but also a strategic instrument in risk management and financial performance, influencing cost of capital, profitability, and shareholder value (Chava, 2014, El Ghoul et al., 2018).

Beyond internal operational benefits, an important question arises as to whether SSCP influences firms' access to capital, particularly debt structure. The choice of debt maturity, short-term or long-term, has long been studied in corporate finance and risk management. Classic theories argue that debt structure reflects trade-offs among agency costs, refinancing risk, and signaling motives. Diamond and He (2014) point out that short-term debt provides working capital but increases rollover risk, while long-term debt stabilizes liquidity but can exacerbate conflicts with shareholders. In practice, debt maturity is affected by firm characteristics, taxation, credit quality, and ownership structure. For example, Ben-Nasr et al. (2015) show that controlling shareholders prefer long-term debt to exploit tax shields and reduce refinancing pressure. Similarly, Kashefi-Pour and Lasfer (2019) find that favorable tax and governance environments encourage longer-term borrowing.

However, the relationship between SSCP and debt maturity remains unclear, revealing an important research gap. Most previous studies focus on firm-level ESG or CSR scores. For instance, Nguyen et al. (2020) show that firms with stronger CSR practices in Australia tend to hold a higher proportion of long-term debt in their debt structure, implying that social responsibility practices facilitate access to long-term funding. Likewise, high ESG performance reduces the gap between investment and financing, as firms increasingly use long-term debt to signal stability and resilience (Liu et al., 2025). While the impact of CSR and ESG on debt structure has been documented (Nguyen et al., 2020, Liu et al., 2025), no study has directly tested the role of SSCP, an operationally critical dimension of corporate governance, on debt maturity. Some other research highlights that specific environmental risks also play a role. For example, firms exposed to high biodiversity risks tend to extend debt maturities to reduce refinancing pressure (Duong et al., 2025). In the supply chain management field, many studies demonstrate the benefits of SSCP for operational performance and profitability, but their direct impact on debt structure has hardly been empirically examined. This raises an important research question, whether implementing sustainable supply chain practices truly brings financing benefits to firms in terms of access to capital.

Therefore, this study is conducted to answer the above research question. We employ 60,727 firm-year observations from 52 countries over 11 years, with firm-level variables sourced from Refinitiv and macroeconomic variables from the World Bank and OECD. The empirical results confirm that SSCP are positively and significantly associated with debt maturity. This positive effect remains robust after incorporating macroeconomic variables and controlling for year, industry, and country fixed effects.

Our study makes two main contributions. First, unlike previous studies focusing on CSR scores within a single country such as Australia (Nguyen et al., 2020), this research examines the impact of SSCP on debt maturity using a large-scale multinational dataset. Second, we provide new evidence that adopting sustainable supply chains improves access to long-term debt even after accounting for firm-specific characteristics and macroeconomic heterogeneity. This finding complements recent work by Bilyay-Erdogan et al. (2024), which shows that in the context of sustainability, creditors view sustainable supply chain governance as a transparent and risk-reducing signal.

The paper is structured into five sections. Following the introduction, Section 2 develops the research hypotheses, Section 3 presents the research design and data, Section 4 reports and discusses the empirical results, and Section 5 concludes the paper

2. Hypothesis development

Recent studies have shown that CSR and ESG activities are increasingly regarded as factors influencing firms' capital structures and lending terms. However, the impact of these activities on debt maturity remains inconsistent when examined under different financial theories.

From the perspective of **agency theory** (Jensen & Meckling, 1976), the costs of SSCP may be viewed as agency costs if they fail to generate immediate value (Cespa & Cestone, 2007, Barnea & Rubin, 2010). When managers intensify SSCP implementation for personal benefits such as image building or power consolidation without effective management, it can lead to overinvestment (Cespa & Cestone, 2007, Barnea & Rubin, 2010). This raises concerns for long-term creditors, making it difficult for sustainability-oriented firms to maintain long-term

debt. As a result, firms tend to prefer short-term debt to mitigate conflicts of interest with creditors (Goss & Roberts, 2011).

From the perspective of **signaling theory** (Spence, 1973), firms implementing SSCP often bear high upfront costs, such as investing in environmentally friendly materials and sustainability certifications. To signal liquidity and financial quality, firms tend to rely more on short-term debt, which serves as a positive indicator of creditworthiness (Diamond, 1991). Benlemlih (2017) also finds that CSR-oriented firms are more likely to use short-term debt and equity financing to signal quality, thereby alleviating concerns about overinvestment.

On the other hand, **stakeholder theory** (Freeman, 1984) suggests that SSCP can help firms build trust with creditors. Firms engaging in SSCP, essentially aligned with CSR principles, benefit from lower borrowing costs, better access to capital, and higher credit ratings (Goss & Roberts, 2011, Attig et al., 2013). More recently, Pohl (2023) reports that sustainability-linked loans also integrate incentives such as lower interest rates for firms with stronger environmental performance, although these advantages are often associated with short-term loans. Therefore, to signal financial quality, sustainability-oriented firms may be more likely to shorten their debt maturity structure. Based on this reasoning, we propose the first hypothesis:

H1: SSCP has a negative effect on debt maturity.

Reputation and firm performance

Alternatively, sustainable supply chain practices can prolong firms' debt maturity through the following channels. First, sustainable supply chain practices can enhance corporate reputation in the capital markets. Stakeholder theory (Freeman, 1984) emphasizes that firms must manage relationships with a broad range of stakeholders beyond shareholders. By applying sustainable supply chain practices, firms show responsibility, reliability, and commitment to cooperation with their stakeholders, which helps strengthen their corporate reputation (Jones, 1995; Hoepner et al. (2016)). Other research also finds that firms gain intangible capital - reputation by “greening” supplier relations. Quintana-García et al. (2021) show that green supplier selection, monitoring and termination based on environmental criteria significantly boost a firm’s reputation. Government-led green supply chain certifications also support this effect. Liu et al. (2025) notes that government certification improves firms’ reputations. A

favourable reputation is essential to improve financing conditions of the firm and contracting efficiency in debt markets. For example, Cao et al. (2015) find that firms with higher reputation scores enjoy a lower cost of equity capital and similarly and firms with high reputation scores face less stringent debt covenants, (Anginer et al. (2015)). They argue that corporate reputation captures 'soft information' that is not presented in financial reporting. Taken together, the reputational gains from green supply chains encourage creditors to extend longer-term financing for the firms.

Second, sustainable supply chain practices can influence debt maturity by improving firms' performance thus reducing financial distress of the company. The Resource-Based View (RBV) argues that firms can achieve sustained competitive advantage by developing valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). Sustainable supply chain practices including sustainable supplier management constitute path-dependent capabilities that build environmental, social and operational advantages that are difficult for competitors to imitate (Reuter et al., 2010). This competitive advantage is the mechanism through which resources can lead to superior firm performance (Peteraf, 1993). In line with this view, some research shows that sustainable supply chain management initiatives raise the performance of the firm. Hong et al. (2018) find that sustainable supply chain management practices have a significant positive effect on three dimensions of performances (economic, environmental, and social). Furthermore, Zhao et al. (2025) report that supply chain sustainability significantly enhances firm market competitiveness through promoting ESG practices and easing financing constraints. Likewise, Paulraj et al. (2017) note that sustainable supply chain management (sustainable product design, process design, supply-side sustainability collaboration, and demand-side sustainability collaboration) collectively play a central role in enhancing a firm's environmental and financial performance. Better performance in turn lowers financial constraints. For example, improved supply chain ESG performance significantly enhances internal management and production efficiency (Zhao et al. 2024), improves financial performance (Jia & Li. 2024), and increases attractiveness in capital markets, thereby alleviating financing constraints. Similarly, Ju et al. (2024) reveals that firms in a green supply chain demonstration project experience reduced financial distress risk. This effect is even amplified when they improve environmental information disclosure and maintain a flexible supply chain structure, which also suggests improved credit conditions for sustainable firms. Lower distress

means firms are less constrained by short-term liquidity needs so they can commit to longer debt maturities.

Overall, the improved firm performance and enhanced corporate reputation from sustainable supply chains supporting the alternative hypothesis:

H2: SSCP is positively related to debt maturity

3. Research design

3.1. Sample and data

Firm-level data are collected from the Refinitiv (LSEG) financial database. This is a widely used and reliable source, frequently employed in international academic research thanks to its broad coverage, real-time market information with minimal latency, and high accuracy (Nguyen et al., 2020). Macroeconomic data include: (i) GDP per capita from the World Development Indicators (World Bank), and (ii) the annual inflation rate (CPI) from OECD Data/Statistics. These are authoritative, verifiable, and widely used sources in academic studies, ensuring the reliability of the analysis. The research merges firm-level and macroeconomic data at the country–year level. Observations with missing information or unreasonable values are excluded, for example, long-term debt exceeding total debt, or negative market-to-book ratios. After data cleaning, the final sample consists of 60,727 firm-year observations across 52 countries during the period 2013–2023.

Table 1 presents the sample distribution by country. The sample is highly concentrated, with China (24.1%) and the United States (16.3%) together accounting for more than 40% of total observations. Including India (7.2%) and South Korea (7.0%), the four largest contributors represent over half of the sample. Other major contributors include the United Kingdom, Germany, Canada, and Japan, each providing more than 2.5%. Many other countries contribute less than 0.5%, reflecting a bias toward large economies, where data on SSCP, debt maturity, and related financial and ESG indicators are more fully disclosed.

Table 1: Sample distribution by country

Country	Frequency	Percent (%)	Cumulative (%)	Country	Frequency	Percent (%)	Cumulative (%)	Country	Frequency	Percent (%)	Cumulative (%)
Australia	1,448	2.38	3.08	Ireland	229	0.38	49.36	Qatar	92	0.15	75.4
Austria	257	0.42	0.69	Israel	222	0.37	49.72	Russia	200	0.33	75.73
Belgium	312	0.51	3.59	Italy	547	0.9	57.79	Saudi Arabia	471	0.78	76.51
Brazil	893	1.47	5.06	Japan	1,729	2.85	60.64	Singapore	646	1.06	79.85
Canada	1,840	3.03	8.09	Kuwait	61	0.1	67.71	South Africa	288	0.47	100
Chile	225	0.37	9.74	Luxembourg	179	0.29	68.35	South Korea	4,237	6.98	67.61
China	14,665	24.15	33.89	Malaysia	1,148	1.89	70.89	Spain	460	0.76	38.95
Colombia	68	0.11	34	Mexico	392	0.65	69	Sri Lanka	208	0.34	68.06
Denmark	311	0.51	37.82	Netherlands	307	0.51	71.66	Sweden	1,384	2.28	78.79
Egypt	227	0.37	38.2	New Zealand	237	0.39	72.85	Switzerland	775	1.28	9.37
Finland	393	0.65	39.6	Nigeria	162	0.27	71.15	Thailand	1,414	2.33	82.18
France	939	1.55	41.15	Norway	486	0.8	72.46	Turkey	218	0.36	82.54
Germany	2,009	3.31	37.31	Oman	90	0.15	73	United Arab Emirates	165	0.27	0.27
Greece	157	0.26	45.27	Pakistan	341	0.56	74.2	United Kingdom	2,349	3.87	45.01
Hong Kong	1,451	2.39	47.66	Peru	54	0.09	73.09	United States	9,922	16.34	98.88
Hungary	52	0.09	47.75	Philippines	335	0.55	73.64	Vietnam	393	0.65	99.53
India	4,352	7.17	56.89	Poland	548	0.9	75.1	Total	60,727	100	
Indonesia	748	1.23	48.98	Portugal	91	0.15	75.25				

Source: Authors' calculations

Table 2 describes the sample distribution by year during the period 2013–2023. The yearly distribution is uneven, with the share of observations peaking in 2022 (15.93%) and falling to the lowest level at the beginning of the period (2013). The three most recent years (2021–2023) together account for 43.51% of total observations, while the first two years (2013–2014)

represent only 7.28%. Therefore, the model incorporates year dummy variables (year fixed effects) to control for unobserved macroeconomic factors that vary over time and to enhance the reliability of the results.

Table 2. Sample distribution by year

Year	Frequency	Percent (%)	Cumulative (%)
2023	8,390	13.82	13.82
2022	9,676	15.93	29.75
2021	8,358	13.76	43.51
2020	7,391	12.17	55.68
2019	6,243	10.28	65.96
2018	4,963	8.17	74.14
2017	4,323	7.12	81.26
2016	3,374	5.56	86.81
2015	3,589	5.91	92.72
2014	2,839	4.68	97.4
2013	1,581	2.6	100
Total	60,727	100	

Source: Authors' calculations

3.2. Research variables and model

To analyze the impact of SSCP on firms' debt maturity, this paper follows prior studies (Liu et al., 2025; Duong et al., 2025; Wu et al., 2022) and employs the following variables:

Debt maturity (*debtmat1*)

According to prior studies on corporate debt maturity (Li, 2023; Chaderina et al., 2022), debt maturity is commonly measured as the proportion of long-term debt to total debt.

Table 3 shows that the variable *debtmat1* has a mean value of 0.592 (standard deviation of 0.329). This indicates that about 59% of the sample is characterized by a predominant use of long-term debt. This continuous ratio measure allows for a clear distinction between firms with primarily short-term versus long-term financing structures, while maintaining consistency with widely adopted approaches in the existing literature.

Sustainable Supply Chain Practice (*ssci*)

Similar to Karaman et al. (2024), the variable *ssci* reflects the extent to which a firm adopts sustainable supply chain practices. This variable is constructed as an index based on five criteria: environmental supply chain policy, sustainable packaging policy, environmental supply chain monitoring, environmental supply chain management, and supply chain partnership termination due to environmental reasons. The criterion environmental supply chain policy takes the value 1 if a firm has a policy integrating supply chains into overall efforts to mitigate environmental impacts, and 0 otherwise. The criterion sustainable packaging policy takes the value 1 if a firm has a policy aimed at improving the use of sustainable packaging, and 0 otherwise. The criterion environmental supply chain monitoring takes the value 1 if a firm surveys the environmental performance of its suppliers, and 0 otherwise. The criterion environmental supply chain management takes the value 1 if a firm applies environmental standards such as ISO 14000, energy consumption metrics, etc. in supplier or partner selection, and 0 otherwise. The criterion supply chain partnership termination due to environmental reasons takes the value 1 if a firm reports or demonstrates willingness to terminate cooperation when a supplier fails to meet environmental criteria, and 0 otherwise.

The variable ssci is measured as the total score of the five criteria divided by 5, resulting in a range from 0 to 1.

Control variables:

Following prior research (Wu et al., 2022; Deng et al., 2022; Wang et al., 2020; Fang et al., 2023), this paper employs the following control variables:

Firm leverage *(tdta)* is defined as total debt divided by total assets. Higher leverage increases liquidity risk; hence, firms are incentivized to extend debt maturity to reduce

refinancing pressure. Based on recent evidence regarding maturity choice under risk and creditor pricing, tdta is expected to be positively associated with debt maturity (Datta et al., 2024; Chen et al., 2021; Do, 2021).

Asset maturity *(lnamat)* is calculated as the natural logarithm of the weighted average maturity of current and fixed assets, where the weights are the share of each asset category in total assets. The maturity of current assets is measured as current assets divided by cost of goods sold, while the maturity of fixed assets is measured as gross tangible fixed assets divided by annual accumulated depreciation and amortization. Recent evidence shows that aligning debt maturity with asset life both preserves value and is observed in practice, with average debt maturity lengthening with asset life (Geelen et al., 2024). Debt maturity is therefore an important financing margin influencing investment dynamics (Poeschl et al., 2023) and is priced in capital markets (Chaderina et al., 2022). Accordingly, *lnamat* is expected to be positively associated with debt maturity.

Profitability *(PretaxROA)* is calculated as earnings before tax divided by total assets. This variable measures profitability and reflects a firm's ability to generate internal cash flows. Higher profitability reduces refinancing and default risks, thereby improving bargaining power and access to long-term financing. He et al. (2016) find that firms with stronger cash flows face lower liquidity risk and thus optimize by choosing longer-term debt. Similarly, Choi et al. (2018) emphasize that financially sound firms are better able to issue long-term debt, while Friewald et al. (2022) provide evidence that refinancing risk declines significantly for firms with stable earnings. Therefore, *PretaxROA* is expected to have a positive effect on debt maturity.

Profitability volatility *(sd_roa)* is measured as the standard deviation of return on assets over the past five years (Graham et al., 2015; Acharya et al., 2011). This variable reflects a firm's financial risk. Higher earnings volatility increases uncertainty regarding debt repayment and default risk, leading creditors to shorten debt maturity (Diamond, 1991). Conversely, firms with more stable earnings are more likely to issue long-term debt. Thus, we expect a negative relationship between *sd_roa* and debt maturity.

Sales growth *(sgrowth)* is measured as the annual change in revenue from year t–1 to year t. This variable represents growth opportunities, a central factor in debt maturity choice.

Fast-growing firms often require more external financing and face greater uncertainty about future cash flows. To mitigate agency conflicts and refinancing risks, creditors often restrict such firms to short-term debt. Johnson (2003) demonstrates theoretically and empirically that growth opportunities are associated with shorter debt maturity; Custódio et al. (2013) provide evidence that high-growth US firms rely more on short-term debt. Similarly, Barclay & Smith (1995) show that debt maturity is negatively related to firms' growth opportunities. Therefore, *sgrowth* is expected to negatively affect debt maturity.

Firm size *(lnta)* is measured as the natural logarithm of total assets, where total assets are taken from the balance sheet at the fiscal year-end (Fang et al., 2023). Larger firms generally have better credit quality and easier access to long-term debt, while smaller firms face information asymmetry and agency conflicts. Thus, *lnta* is expected to be positively associated with debt maturity (Wu et al., 2022; Deng et al., 2022).

Inflation *(Inflation)* is measured as the annual inflation rate, reflecting the overall increase in the price level of goods and services in the economy (Hatem & Ouni, 2021). Inflation directly affects the cost of capital and purchasing power; high inflation can hinder access to long-term credit, whereas low and stable inflation is often linked to a more sustainable financial environment. Thus, *Inflation* is expected to negatively affect debt maturity.

GDP per capita *(lngdppercap)* is measured as the natural logarithm of GDP per capita, with data obtained from the World Bank (Ben-Nasr et al., 2015). This indicator reflects the average living standard, consumption capacity, and economic strength of a country. Countries with higher GDP per capita often have more developed capital markets and a more stable financial environment, facilitating firms' access to long-term financing. Therefore, *lngdppercap* is expected to be positively associated with debt maturity.

The above variables are incorporated into the research model as follows:

$$debtmat1_{i,t} = \beta_0 + \beta_1 ssci_{i,t-1} + \beta_2 tdta_{i,t-1} + \beta_3 inamat_{i,t-1} + \beta_4 PretaxROA_{i,t-1} + \beta_5 sd\_roa_{i,t-1} + \beta_6 sg$$

In which, *i* and *t* denote firm *i* and year *t*, respectively. In addition to the main variables described above, year, industry, and country fixed effects are also included in the model to control for unobserved heterogeneity.

4. Empirical results

4.1. Descriptive statistics

Table 3 reports descriptive statistics for the variables used in the global sample. On average, the share of long-term debt in total debt (*debtmat1*) is 59.2%, indicating that firms worldwide rely more on long-term financing compared to short-term debt. The mean value of SSCP (*ssci*), the main explanatory variable, is 0.138, suggesting that although SSCP has been adopted by many firms, the overall level of implementation remains modest. Firm leverage (*tdta*), measured as total debt divided by total assets, has a mean value of 25.6% with a median of 23.3%, indicating that firms in the sample employ only moderate leverage, i.e., they are not overly dependent on debt to finance assets. Asset maturity (*lnamat*) has a mean of 2.386, while profitability (*PretaxROA*) is relatively low at 0.037, consistent with the fact that the dataset covers firms across multiple industries and countries at different stages of development. Profitability volatility (*sd_roa*) is 0.055, indicating that most firms experience only limited earnings fluctuations. Sales growth (*sgrowth*) averages around zero, with a slightly negative median value, showing that half of the firms in the sample face declining revenues. Meanwhile, firm size measured as the natural logarithm of total assets (*lnta*) has a mean of 20.886. At the macroeconomic level, GDP per capita (*lngdppercap*) of the host countries averages 9.975 (in logarithmic form), and the average inflation rate (*Inflation*) during 2013–2023 is 2.895%.

Table 3. Descriptive statistics

Variables	N	Mean	p50	SD	p25	p75
debtmat1	60,727	0.592	0.672	0.329	0.315	0.884
ssci	60,727	0.138	0.000	0.220	0.000	0.200
tdta	60,727	0.256	0.233	0.210	0.106	0.364
lnamat	60,727	2.386	2.268	1.138	1.659	2.938
PretaxROA	60,727	0.037	0.053	0.181	0.013	0.102
sd_roa	60,727	0.055	0.030	0.123	0.015	0.060
sgrowth	60,727	-0.001	-0.046	0.421	-0.153	0.064
lnta	60,727	20.886	20.800	1.899	19.607	22.162

lngdppercap	60,727	9.975	10.386	1.089	9.244	10.896
Inflation	60,727	2.895	2.075	2.628	1.234	4.085

Source: Authors' calculations

Table 4 presents the pairwise Pearson correlation coefficients among the research variables. The results show that debt maturity has a positive correlation with SSCP (0.254), which provides initial empirical evidence consistent with Hypothesis H2. In addition, debt maturity is also positively correlated with firm leverage (0.225), firm size (0.268), asset maturity (0.024), inflation (0.078), and GDP per capita (0.386). In contrast, profitability (-0.036) and sales growth (-0.029) exhibit negative correlations. Overall, the correlation coefficients are at moderate levels, indicating that multicollinearity is not a concern in the model.

Table 4. Pearson correlation coefficients between the variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) debtmat1	1.000									
(2) ssci	**1.254**	1.000								
(3) tdta	**0.225**	**0.053**	1.000							
(4) lnamat	**0.024**	**0.009**	**0.102**	1.000						
(5) PretaxROA	**-0.036**	**0.104**	**-0.241**	**-0.026**	1.000					
(6) sd_roa	-0.005	**-0.088**	**0.157**	0.006	**-0.460**	1.000				
(7) sgrowth	**-0.029**	**-0.011**	**0.015**	0.000	**-0.049**	**0.108**	1.000			
(8) lnta	**0.268**	**0.533**	**0.176**	**0.099**	**0.211**	**-0.225**	**-0.022**	1.000		
(9) lngdppercap	**0.386**	**0.205**	**0.070**	**-0.070**	**-0.171**	**0.082**	0.000	**0.134**	1.000	
(10) Inflation	**0.078**	**0.041**	**0.040**	0.000	-0.007	**0.037**	-0.001	**-0.106**	**-0.173**	1.000

Note: Correlation coefficients in boldface are significant at least at the 5 % level.

Source: Authors' calculation

4.2. Multivariate results

Table 5 reports the regression estimates with debt maturity (*debtmat1*) as the dependent variable**.** The models are estimated in three steps: Model (1) tests the effect of the sustainable supply chain index (*ssci*) along with firm-level control variables; Model (2) adds macroeconomic variables; and Model (3) further incorporates year, industry, and country fixed effects.

Table 5. Pooled OLS

	Model (1)	Model (2)	Model (3)
Variable	debtmat1	debtmat1	debtmat1
ssci	0.238***	0.110***	0.020***
	(0.007)	(0.007)	(0.006)
tdta	0.286***	0.267***	0.171***
	(0.012)	(0.010)	(0.009)
lnamat	-0.005***	0.005***	0.007***
	(0.001)	(0.001)	(0.001)
PretaxROA	-0.115***	0.026**	0.028***
	(0.014)	(0.012)	(0.010)
sd_roa	0.055	-0.008	-0.057***
	(0.049)	(0.029)	(0.020)
sgrowth	-0.021***	-0.016***	-0.012***
	(0.004)	(0.004)	(0.003)
lnta	0.027***	0.025***	0.029***
	(0.001)	(0.001)	(0.001)

	Model (1)	Model (2)	Model (3)
Variable	debtmat1	debtmat1	debtmat1
lngdppercap		0.114***	-0.007
		(0.001)	(0.016)
Inflation		0.020***	-0.002***
		(0.001)	(0.001)
Constant	-0.057***	-1.221***	0.111
	(0.022)	(0.022)	(0.176)
Observations	43.555	43.555	43.513
R-squared	0.128	0.268	0.449
Year FE	No	No	Yes
Industry FE	No	No	Yes
Country FE	No	No	Yes

*Note: Robust standard errors are reported in parentheses ***, **, and denote the statistical significance at 1%, 5%, and 10% levels, respectively.*

Source: Authors' calculations

The regression results show that in Model (1), *ssci* has a strong positive relationship with debt maturity (0.238, $p<0.01$), confirming Hypothesis H2 that firms focusing on SSCP use more long-term debt. In addition, the coefficient of firm leverage (*tdta*) is positive and highly significant (0.286, $p<0.01$), consistent with the argument that highly leveraged firms rely on long-term debt to manage liquidity risk.

In contrast, asset maturity (*lnamat*), profitability (*PretaxROA*), and sales growth (*sgrowth*) all have negative coefficients ($p<0.01$). The results suggest that firms with more tangible assets and higher profitability tend to rely more on short-term debt, while fast-growing firms use more short-term financing to meet working capital needs.

In Model (2), after including macroeconomic variables, the coefficient of *ssci* decreases to 0.110 but remains significant at the 1% level, reinforcing the positive relationship between sustainable supply chain practices and debt maturity. The coefficient of *lnamat* turns positive (0.005, $p<0.01$), indicating that firms with more tangible assets tend to align debt maturity with asset maturity when macroeconomic conditions are taken into account. Similarly, the coefficient of *PretaxROA* becomes positive and significant at the 5% level, implying that more profitable firms are better able to access long-term debt. Regarding macro variables, GDP per capita (*lngdppercap*) is positive (0.114, $p<0.01$) and inflation (*Inflation*) is also positive (0.020, $p<0.01$), suggesting that firms in developed economies and moderate inflation environments prefer long-term borrowing to lock in financing costs.

In Model (3), when year, industry, and country fixed effects are added, the results become more comprehensive. The coefficient of *ssci* remains positive (0.020, $p<0.01$), though smaller than in earlier models, suggesting that part of the effect is absorbed by unobserved heterogeneity across time, industry, and country. Nevertheless, the impact remains statistically significant, supporting H2 that SSCP enhances firms' access to long-term financing. The coefficient of firm leverage (*tdta*) is positive and significant (0.171, $p<0.01$), consistent with the view that highly leveraged firms prefer long-term debt to mitigate refinancing risk. In addition, asset maturity (*lnamat*) and firm size (*lnta*) both have positive and highly significant coefficients, reinforcing the principle of matching between asset structure and debt maturity.

Profitability (*PretaxROA*) is positive (0.028, $p<0.01$), while profitability volatility (*sd_roa*) is negative and significant ($p<0.01$), suggesting that higher earnings risk reduces the ability to obtain long-term debt. At the same time, sales growth (*sgrowth*) continues to have a negative and significant coefficient at the 1% level, showing that fast-growing firms typically rely more on short-term debt to meet working capital needs. For macro variables, inflation (*Inflation*) turns negative (-0.002, $p<0.01$), indicating that in high-inflation environments, rising financing costs reduce firms' ability to borrow long term. In contrast, GDP per capita (*lngdppercap*) loses significance when fixed effects are included, implying that firm- and institution-specific factors play a more decisive role in debt maturity than the overall level of economic development.

Finally, the R-squared increases significantly from 0.128 in Model (1) to 0.268 in Model (2) and reaches 0.449 in Model (3), indicating that the explanatory power of the models improves substantially with the inclusion of macro variables and fixed effects.

In conclusion, the results consistently show that the sustainable supply chain index (*ssci*) has a positive and significant relationship with debt maturity. This evidence rejects Hypothesis H1 and strongly supports Hypothesis H2, confirming that firms placing greater emphasis on sustainable supply chains are more capable of accessing and utilizing long-term debt.

5. Conclusion

This study examines the impact of SSCP on debt maturity, based on a global dataset of 60,727 firm-year observations across 52 countries. The paper tests two opposing hypotheses: (i) SSCP shortens debt maturity due to quality signaling and higher monitoring needs, or (ii) SSCP lengthens debt maturity by improving corporate reputation, reducing financial risk, and enhancing access to long-term financing. The empirical results are consistent with the second hypothesis. Firms with a higher level of commitment to sustainable supply chains tend to hold a larger proportion of long-term debt, even after controlling for firm-level, macroeconomic, and institutional factors. This positive relationship remains robust after controlling for year, industry, and country fixed effects.

These findings have important implications for managers, investors, and policymakers. For managers, adopting and effectively communicating SSCP can strengthen corporate reputation, reduce financial barriers, and expand access to long-term capital. For investors, understanding the financial benefits of sustainability commitments can improve capital allocation decisions. For policymakers, the evidence suggests that policies promoting green supply chains may indirectly enhance financial stability by improving access to long-term credit markets.

However, the study has several limitations. Although the sample is large and diverse, it only includes listed firms, and thus the findings may not be generalizable to unlisted firms. In addition, the data reflect only a fixed period and may not capture future dynamics of the global credit market or regulatory changes related to sustainability. Future research could be extended by examining the interaction between SSCP and other aspects of environmental, social, and

governance (ESG) performance, or by analyzing heterogeneous effects across industries and institutional environments.

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