

# The Impact of Supply Chain Finance on the Application of Digital Technologies

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**Abstract:** Amid the accelerating digital economy, SCF-as a financial service model embedded in industrial chains-has become a key driver of firms' digital technology adoption. Using data from Chinese listed companies, this study constructs SCF indicators and empirically examines its impact on digital adoption. Results show SCF significantly improves both the breadth and depth of digital technology application, with effects remaining robust under various endogeneity and sensitivity tests. Further analysis finds stronger effects in competitive and digitally oriented industries, primarily through enhanced innovation and reduced supply chain concentration.

**Keywords:** Supply Chain Finance; Digital Technology Application; Corporate Innovation; Supply Chain Diversification

## 1. Introduction

In the era of deepening digitalization, a firm's ability to adopt digital technologies has become a key indicator of its competitiveness and long-term viability. However, small and medium-sized enterprises (SMEs) often face high costs, information asymmetry, and uncertain returns during digital transformation, with financing constraints being a major barrier. The development of supply chain finance (SCF) offers a new solution by mitigating both financial and informational hurdles. SCF relies on the credit of core enterprises and cash flows from real trade transactions, with financial institutions or digital platforms optimizing capital and resource allocation. This fosters alignment between capital, product, and information flows, enhancing overall supply chain efficiency. Moreover, SCF improves credit transparency and industrial collaboration, lowering the threshold and risks of adopting technologies like big data and cloud computing. Nonetheless, existing research on SCF tends to focus on its individual attributes-defining it as

either a short-term financing tool or a working capital optimization system-and primarily explores its business models, value creation mechanisms, and risk management. While valuable, these studies often overlook a systematic examination of whether and how SCF can serve as a catalyst for digital technology application among enterprises. A comprehensive investigation into the driving effect and internal logic of SCF on corporate digital technology application not only enriches theoretical research in SCF but also provides a new analytical perspective for understanding the drivers of technological transformation in the digital economy era. This study contributes in the following ways: (1) From a research perspective, it redefines SCF as a key mechanism driving the adoption of digital technologies by enterprises, revealing its unique pathway for accelerating digital transformation. (2) From a mechanism perspective, it proposes and explains the dual-channel logic through which SCF promotes digital technology application-namely, through innovation-driven enhancement and diversification empowerment.

## 2. Literature Review and Hypotheses

### 2.1 Literature Review

In SCF research, most studies focus on its role in improving efficiency and shaping firms' micro-level behavior. Ali et al. (2019) highlight its importance in optimizing operations by enhancing working capital efficiency, lowering financing costs, and reducing default risks [1]. Subsequent studies adopt a behavioral perspective: Pan et al. (2020) find that SCF affects firms' cash holding strategies; Ling Runze et al. (2021) demonstrate its positive effects on R&D investment and capital structure adjustment [2,3]. Pei et al. (2022) further provide evidence that SCF enhances financial performance [4].

In digital technology research, the literature mainly explores how such technologies drive

innovation, enable knowledge collaboration, and improve firm performance. Williamson (2016), through case studies of internet and manufacturing firms, shows that digital user data processing helps identify innovation opportunities and enhance R&D efficiency [5]. Xue Cheng et al. (2020) find that digital technologies promote internal knowledge diffusion and external R&D collaboration [6]. Hong Junjie et al. (2022) reveal that this mechanism also supports export growth and trade upgrading [7]. Additionally, Ma Zhen (2025) suggests that under favorable digital economy policies, improved ESG performance can amplify the impact of digital technologies on innovation [8].

## **2.2 Hypotheses**

In the digital economy era, SMEs often face challenges in adopting digital technologies due to financial constraints and significant information asymmetries. SCF leveraging the credit of core enterprises and coordinated by financial institutions and technology platforms, alleviates financing difficulties while enhancing information transparency and resource allocation. These improvements provide institutional support for digital transformation. The credit structure and data interaction mechanisms of SCF, grounded in real transactions, help reduce uncertainty and the trial-and-error costs of technology adoption, encouraging firms to invest in innovations such as big data and cloud computing. Moreover, SCF facilitates credit penetration and industrial collaboration, contributing to the development of a stable digital ecosystem. In summary, SCF not only improves resource allocation but also provides institutional and technological support for digital technology adoption. Based on this theoretical reasoning, we propose the following hypothesis: H1: Supply chain finance significantly promotes the application of digital technologies by enterprises.

SCF supports digital technology adoption through two complementary mechanisms: resource reallocation and structural optimization. Through the innovation-driven pathway, SCF alleviates funding constraints, enhances R&D support, and increases firms' capacity to bear innovation risks, thereby encouraging investment in digital technologies. Through the diversification-empowerment pathway, SCF helps firms expand supply chain partnerships,

optimize structures, and strengthen the integration of data, information, and operations. The resulting complexity raises the demand for digital systems and improves adaptability, enhancing resilience and long-term digital commitment. The synergy of these pathways forms a systemic foundation for digital technology adoption. Hence, we propose the following hypothesis:

H2: Supply chain finance significantly promotes the application of digital technologies by enhancing corporate innovation and supply chain diversification.

## **3. Research Design**

### **3.1 Data Sources**

This study uses panel data of Chinese listed companies from 2011 to 2023. The sample is screened as follows to ensure data reliability: (1) Firms in the financial and insurance sectors are excluded; (2) ST and PT firms are removed; (3) Firms with asset-liability ratios above 1 are excluded; (4) Observations with missing key variables are dropped. The final sample comprises 35,666 firm-year observations. To reduce outlier effects, all continuous variables are winsorized at the 1st and 99th percentiles. Data are sourced from the CSMAR database.

### **3.2 Variable**

#### **3.2.1 Digital technology application**

Following Yang Peng et al. (2024), this study uses text analysis to assess firms' digital technology application based on annual report disclosures [9]. A two-dimensional indicator system is constructed to capture both the breadth and depth of digital use. Breadth measures the scope of adoption by identifying keywords related to core digital domains (e.g., big data, cloud computing, blockchain), while depth reflects the integration of digital technologies into operations via keywords on data collection, management, and integration. These indicators reflect the variety and sophistication of digital adoption.

#### **3.2.2 Supply chain finance**

Following Raghavan et al. (2011), this study measures SCF as the ratio of the sum of short-term borrowings, notes payable, and accounts payable to total assets [10]. SCF primarily provides short-term financing to SMEs based on supply chain transactions, easing their funding constraints. Unlike traditional financing

models, SCF is dynamic in nature, evolving with real-time trade flows, invoice approvals, and credit events along the supply chain. Short-term borrowings capture the financing support aspect, while notes payable and accounts payable reflect the structural characteristics of SCF operations—namely, its heavy reliance on genuine trade relationships between core enterprises and their upstream and downstream partners. These two components represent the role of core firms in financial intermediation and credit

transmission within the supply chain. This composite indicator thus offers a comprehensive measure of firm-level SCF participation.

### 3.2.3 Control variables

Based on prior literature, this study includes the following control variables: Tobin's Q, operating cash flow, return on equity (ROE), nature of the controlling shareholder, duality of chairman and CEO roles, proportion of independent directors, and administrative expense ratio. Definitions of these variables are provided in Table 1.

**Table 1. Variable Definitions**

Variables	Symbol	Definition
Digital Technology Usage Breadth	Tech_W	Key Technical Domain Terms
Digital Technology Application Depth	Tech_D	Data Governance Process Terms
Supply Chain Finance	SCF	(Short-term Borrowings + Notes Payable + Accounts Payable) / Total Assets
Tobin's Q Ratio	TobinQ	(Market Value of Tradable Shares + Number of Non-Tradable Shares × Net Asset Value per Share + Book Value of Liabilities) / Total Assets
Operating Cash Flow	Cashflow	Net Cash Flow from Operating Activities / Total Assets
Return on Equity	ROE	Net Profit / Average Shareholders' Equity
Nature of Controlling Shareholder	Con_N	1: State-Owned Enterprise; 0: Non-State-Owned Enterprise.
Duality of CEO and Chairperson	Dual	1: Chairman and General Manager are the same person; 0: Chairman and General Manager are not the same person.
Proportion of Independent Directors	Ind_DR	Number of Independent Directors / Total Number of Directors
Management Expense Ratio	Mfee	Management Expenses / Operating Revenue

### 3.3 Model Specification

To examine the impact of SCF on the use of digital technologies, this study constructs the following empirical model:

$$\text{Tech\_}W_{i,t} = a_0 + a_1 \text{SCF}_{i,t} + \text{Controls}_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$\text{Tech\_}D_{i,t} = \alpha_0 + \alpha_1 \text{SCF}_{i,t} + \text{Controls}_{i,t} + \varepsilon_{i,t} \quad (2)$$

where  $\text{Tech\_}W_{i,t}$  represents the breadth of digital technology use, and  $\text{Tech\_}D_{i,t}$  represents the depth of digital technology application.  $\text{SCF}_{i,t}$  is the core independent variable denoting the level of SCF. The coefficient of primary interest is  $\alpha_1$ . A significantly positive  $\alpha_1$  would support Hypothesis H1.

## 4. Baseline Results

### 4.1 Descriptive Statistics

Table 2 presents descriptive statistics of key variables. The mean (standard deviation) of digital technology application depth and breadth are 1.848 (1.208) and 1.389 (1.366), respectively, indicating substantial variation in firms' digital adoption, consistent with prior studies. The average SCF value is 0.213, with a median of 0.190, suggesting that over half of the listed firms have not yet adopted SCF, and that significant market potential remains in China.

**Table 2. Descriptive Statistics**

Variables	Obs	Mean	SD	Min	Median	Max
Tech_D	35666	1.848	1.208	0.000	1.792	6.778
Tech_W	35666	1.389	1.366	0.000	1.099	6.136
SCF	35666	0.213	0.144	0.000	0.190	0.916
Con_N	35666	0.096	0.295	0.000	0.000	1.000
Dual	35666	0.287	0.452	0.000	0.000	1.000
Ind_DR	35666	37.716	5.577	14.290	36.360	80.000

Mfee	35666	0.167	14.957	-0.757	0.067	2824.511
TobinQ	35666	2.061	2.314	0.611	1.598	259.146
Cashflow	35666	0.048	0.073	-0.744	0.047	0.876
ROE	35666	0.059	0.169	-8.393	0.069	2.379

## 4.2 Baseline Regression Results

Table 3 reports the regression results on the relationship between SCF and digital technology application. All models (1)–(4) control for industry and year effects, while models (3) and (4) further include a full set of control variables.

After adding controls, the SCF coefficients increase to 0.255 and 0.529, both significant at the 1% level. These results indicate that higher SCF levels are significantly associated with greater digital technology adoption, providing empirical support for Hypothesis H1.

**Table 3. Baseline Regression**

Variables	(1)	(2)	(3)	(4)
	Tech D	Tech W	Tech D	Tech W
SCF	0.219*** (0.082)	0.522*** (0.097)	0.255*** (0.084)	0.529*** (0.099)
Con N			0.023 (0.022)	0.009 (0.023)
Dual			0.022 (0.018)	-0.021 (0.021)
Ind_DR			-0.003** (0.001)	-0.006*** (0.002)
Mfee			-0.001*** (0.000)	-0.001*** (0.000)
TobinQ			-0.001 (0.003)	0.002 (0.003)
Cashflow			-0.087 (0.066)	-0.044 (0.079)
ROE			0.128*** (0.027)	0.042 (0.036)
cons	1.802***	1.278***	1.888***	1.516***
FFE	YES	YES	YES	YES
YFE	YES	YES	YES	YES
N	35666	35666	35666	35666
R <sup>2</sup>	0.796	0.787	0.797	0.787

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively (hereinafter the same).

## 4.3 Endogeneity and Robustness Tests

### 4.3.1 Endogeneity test

**Table 4. Endogeneity Test**

Variables	(1)	(2)
	Tech D	Tech W
L_SCF	0.165** (0.082)	0.396*** (0.099)
Controls	YES	YES
FFE	YES	YES
YFE	YES	YES
N	30126	30126
R <sup>2</sup>	0.8033	0.7987

To address potential endogeneity, this study conducts an endogeneity test using the one-period lag of the SCF variable as an instrumental proxy. Controlling for relevant variables and fixed effects, the lagged SCF shows positive and statistically significant coefficients at the 5% level in both depth and

breadth models. These results confirm the robustness of the main findings and reinforce the positive impact of SCF on firms' digital technology adoption, as shown in Table 4.

### 4.3.2. Robustness test

To ensure robustness, this study conducts several checks from multiple dimensions. Alternative Independent Variable: Following Zhou Lan et al. (2022), a new SCF index is constructed to replace the original measure [11]. Alternative Dependent Variable: Referring to Li Yuhua et al. (2024), a proxy variable (Ln\_Tech) is developed based on the frequency of AI-related terms in annual reports to capture firms' adoption of emerging digital technologies [12]. Expanded Fixed Effects Model: Industry fixed effects are added alongside firm and year effects to build an industry-adjusted model. Regression results in Table 5 (Columns 1–5) consistently show that SCF significantly promotes digital technology application, confirming the robustness of the baseline findings.

**Table 5. Robustness Test**

Variables	(1)	(2)	(3)	(4)	(5)
	Tech D	Tech W	Ln_Tech	Tech_D	Tech_W
SCF_Level	0.103*** (0.012)	0.108*** (0.014)			

SCF			0.305*** (0.077)	0.239*** (0.079)	0.543*** (0.095)
Controls	YES	YES	YES	YES	YES
FFE	YES	YES	YES	YES	YES
YFE	YES	YES	YES	YES	YES
N	31241	31241	35472	35665	35665
R <sup>2</sup>	0.784	0.745	0.772	0.802	0.792

### 5. Heterogeneity Analysis

To further examine whether the impact of SCF on digital technology adoption varies across different types of firms, this study conducts heterogeneity analysis using grouped regressions based on two dimensions: Industry Competition Intensity: The sample is divided into competitive industries and non-competitive industries. Columns (1) to (4) of Table 7 show that SCF has a significant positive impact on digital technology adoption in competitive industries, whereas the effect is not significant in non-competitive industries. This suggests that intensified market competition may amplify firms' incentives to leverage SCF in advancing their digital transformation. Digital Economy Relevance: Columns (5) to (8) of Table 8 indicate that the positive effect of SCF is more pronounced among firms in digital economy-related industries. This implies that

SCF provides stronger support to firms with better digital infrastructure and higher sensitivity to technological innovation.

To assess whether the impact of SCF on digital technology adoption varies across firm types, this study conducts heterogeneity analysis along two dimensions. Industry Competition Intensity: The sample is split into competitive and non-competitive industries. Table 6 (Columns 1–4) shows that SCF significantly promotes digital adoption in competitive industries, but not in non-competitive ones, suggesting that market competition strengthens firms' incentives to leverage SCF for digital transformation. Digital Economy Relevance: Table 7 (Columns 1–4) shows that the positive effect of SCF is more pronounced in digital economy-related industries, indicating that SCF offers stronger support to firms with advanced digital infrastructure and greater innovation sensitivity.

**Table 6. Heterogeneity Analysis (Industry Competition)**

Variables	(1)	(2)	(3)	(4)
	Tech D	Tech D	Tech W	Tech W
	Competitive	Non-competitive	Competitive	Non-competitive
SCF	0.294*** (0.094)	0.151 (0.161)	0.692*** (0.111)	0.265 (0.192)
Controls	YES	YES	YES	YES
FFE	YES	YES	YES	YES
YFE	YES	YES	YES	YES
N	26729	8790	26729	8790
R <sup>2</sup>	0.804	0.770	0.799	0.744

**Table 7. Heterogeneity Analysis (Digital Economy)**

Variables	(1)	(2)	(3)	(4)
	Tech D	Tech D	Tech W	Tech W
	Digital	Non-Digital	Digital	Non-Digital
SCF	0.285** (0.113)	-0.018 (0.113)	0.608*** (0.136)	0.173 (0.126)
Controls	YES	YES	YES	YES
FFE	YES	YES	YES	YES
YFE	YES	YES	YES	YES
N	20090	15478	20090	15478
R <sup>2</sup>	0.803	0.758	0.819	0.656

### 6. Mechanism Tests

To examine the underlying mechanisms of SCF's

impact on digital technology adoption, we construct the following econometric specifications to test Hypothesis H2.

$$IV_{i,t} = \alpha_0 + \alpha_1 SCF_{i,t} + \alpha_2 Controls_{i,t} + \sum Year_{i,t} + \sum Ind_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$Tech_{i,t} = \beta_0 + \beta_1 SCF_{i,t} + IV_{i,t} + \beta_2 Controls_{i,t} + \sum Year + \sum Ind + \tau_{i,t} \quad (4)$$



Where  $IV_{i,t}$  denotes the intermediary mechanisms, specifically corporate innovation (measured by Patent) and supply chain diversification (measured by SC\_Conc). The dependent variable Tech captures both the depth (Tech\_D) and breadth (Tech\_W) of digital technology application.  $\varepsilon_{i,t}$  and  $\tau_{i,t}$  are error terms. Other variable definitions are consistent with the baseline model.

### 6.1 Corporate Innovation

Columns (1) – (3) of Table 8 show that SCF indirectly promotes digital technology adoption by enhancing corporate innovation. Specifically, SCF improves cash flow efficiency and reduces financing costs, thereby easing financial constraints and supporting R&D activities. As innovation progresses, firms increasingly depend on data processing and intelligent tools in product design, production, and market response, heightening the demand for digital technologies such as big data and blockchain. Additionally,

SCF's reliance on digital platforms creates an external environment favorable to digital adoption.

### 6.2 Supply Chain Diversification

Columns (4)–(6) of Table 8 indicate that SCF also promotes digital technology adoption by encouraging supply chain diversification, i.e., reducing concentration. By easing financing constraints, SCF enables firms to expand supplier networks and reduce reliance on a single core enterprise. The resulting increase in collaborative nodes raises supply chain complexity, prompting firms to adopt digital technologies—such as artificial intelligence, blockchain, and IoT—to improve coordination and information integration. Furthermore, maintaining operational stability in a diversified supply chain network necessitates a stronger reliance on digital tools, which further incentivizes firms to adopt digital technologies within their external environment.

**Table 8. Mechanism Tests**

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Patent	Tech D	Tech W	SC_Conc	Tech D	Tech W
SCF	0.704*** (0.114)	0.230*** (0.083)	0.495*** (0.098)	-4.665*** (1.483)	0.243*** (0.084)	0.520*** (0.100)
Patent1		0.035*** (0.006)	0.048*** (0.007)			
SC_Conc					-0.003*** (0.001)	-0.003*** (0.001)
Controls	YES	YES	YES	YES	YES	YES
FFE	YES	YES	YES	YES	YES	YES
YFE	YES	YES	YES	YES	YES	YES
N	35666	35666	35666	34462	34462	34462
R2	0.776	0.797	0.788	0.764	0.800	0.791

### 7. Conclusions

Amid the rapid development of the digital economy, a firm's digital technology adoption capacity has become a key indicator of its competitiveness and growth potential. As a financing mechanism linking firms, financial institutions, and digital platforms, supply chain finance (SCF) is playing an increasingly vital role in advancing technology adoption. Using data from Chinese listed companies, this study explores the impact of SCF on firms' digital technology application and analyzes two mechanisms: innovation-driven enhancement and diversification empowerment. The main findings are: (1) SCF significantly improves both the breadth and depth of digital technology

use; (2) Mechanism tests show SCF boosts technology adoption by enhancing innovation and reducing supply chain concentration; (3) The effect is more pronounced in competitive and digitally intensive industries.

For policymakers, efforts should focus on building a digital platform-based SCF system, with unified, transparent infrastructure to enhance data sharing and credit flow. Targeted support for SME innovation and the development of decentralized supply networks can reduce reliance on single core customers and incentivize digital upgrades. For firms, active engagement with core enterprises and digital platforms is essential. Integration of big data, cloud computing, and other key technologies into operations should be accelerated. Firms

should align digital strategies with their industry context and development stage, improving technology integration and management to build sustainable competitive advantages.

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