

Original Paper

Supply Chain Finance and Total Factor Productivity: Evidence from China's Publicly Listed Companies

Yixin Dou^{1*} & Fan Zhang²

^{1,2} School of Finance, Harbin University of Commerce, Harbin 150028, China

* Correspondence, E-mail: 102745@hrbcu.edu.cn

Received: October 26, 2025 Accepted: November 27, 2025 Online Published: December 5, 2025

doi:10.22158/jepf.v11n4p107

URL: <http://dx.doi.org/10.22158/jepf.v11n4p107>

Abstract

Supply chain finance plays a supporting function in the development of the real economy, and it is becoming increasingly significant to China's economic growth. Our empirical analysis utilizes a dataset of Chinese A-share listed companies spanning 2008 to 2023. To identify the causal relationship, we estimate a two-way fixed effects model to assess how supply chain finance influences firm-level total factor productivity and explore the potential mechanisms involved. The results indicate that supply chain finance can improve the total factor productivity of enterprises through two mechanisms: improving the efficiency of resource integration and reducing agency costs, and this relationship is still valid after endogenous processing and a series of robustness tests. The heterogeneity analysis reveals that supply chain finance has a more apparent impact on raising total factor productivity in the case of small enterprise scale, low financing constraint, low industry competition and strong supply chain integration. The findings have dual implications: they extend the literature on the drivers of enterprise total factor productivity, while also providing theoretical and practical insights for enhancing supply chain modernization and advancing high-quality development in both firms and the broader economy.

Keywords

supply chain finance, total factor productivity of enterprises, efficiency of resource integration, agency cost

1. Introduction

Driving industrial system upgrading and empowering enterprise competitiveness through technological innovation has dual value and key support for China to achieve high-quality development (Xu, S., & Dong, H., 2023). Total Factor Productivity (TFP) has become a fundamental metric for measuring enterprise development. In terms of factors influencing corporate TFP, enterprises can enhance their risk-

taking ability through information empowerment, optimize resource allocation efficiency through operational empowerment, and gain greater competitive advantages through innovation empowerment. However, subject to the distortion of the system and the imperfect market system, the optimization and integration of capital, technology and other factor input combination along the industrial chain and supply chain is seriously insufficient, and the efficiency of resource allocation is generally not high (Pang, J., Jiao, F., & Zhang, Y., 2022). In the face of the adverse effects brought about by these issues, supply chain finance (SCF), as an essential conduit linking the real economy with financial services, has increasingly garnered extensive focus from both the academic and practitioner communities. In recent years, SCF has witnessed swift development globally. With the support of national policies and the progress of financial technology, SCF has come to be seen as an essential instrument for enhancing corporate competitiveness. It has propelled the improvement and efficiency enhancement of industrial chains and supply chains and has elevated their resilience and security levels. These factors have become key elements in driving the development of China's economy.

The rise of intricate and multifaceted global supply chains has resulted in a surge in the number of suppliers and the volume of transactions across the entire value chain (Qorri, A., Gashi, S., & Kraslawski, A., 2021). The flow of funds in supply chains, known as SCF, has increasingly garnered attention over the past decade (Abdel-Basset, M., Mohamed, R., Sallam, K., & Elhoseny, M., 2020). In SCF, customers, suppliers, and purchasers, financial institutions and providers of technology are all parties engaged (Chen, L., Moretto, A., Jia, F., Caniato, F., & Xiong, Y., 2021). Banks affect corporate development through the allocation of credit resources. Within a financial system dominated by banks, the key to meeting funding needs lies in actively guiding banking institutions to provide corresponding financing and investment support. Credit resource allocation is an important instrument for China to achieve sustainable development. Direct or indirect economic limitations imposed on enterprises inevitably influence their production activities, such as resource reallocation, capital investment, and technological innovation (Xie, Z., Qu, L., Lin, R., & Guo, Q., 2022), thereby affecting TFP. Enterprises primarily enhance productivity through industrial structure upgrading (Zhang, H., Huang, L., Zhu, Y., Si, H., & He, X., 2021), resource redistribution (Peng, J., Xie, R., Ma, C., & Fu, Y., 2021) and innovative behavior. SCF is a low-cost, high-efficiency financial model (Li, X., Yan, J., Cheng, J., & Li, J., 2023) that is founded on the actual transactions between core enterprises and their upstream and downstream partners. By integrating the cash flow, logistics, and information flow across the supply chain, it eliminates information asymmetry within the supply chain. This, in turn, reduces the credit risk for banks and alleviates the financial constraints of upstream and downstream firms. It effectively connects the funding gap on the industrial side with financing services on the financial side, reducing the financing costs of supply chain companies and optimizing the allocation of credit resources. Through offering more flexible and efficient financing solutions to enterprises, it effectively alleviates the financing constraints faced by SMEs and promotes the optimal allocation of funds within the supply chain. This, in turn, eases financial constraints and fosters the growth and development of enterprises, thereby boosting the overall efficiency and

competitive edge of the supply chain. TFP is output growth, which can be attributed to advancements in digital technology, enhanced efficiency in financing allocation, optimized factor inputs, the establishment of economies of scale, systemic and organizational structural innovations, and which comprehensively reflect the development level of enterprises across various dimensions (Xie, H., Wen, J., & Wang, X., 2022). Deeply exploring the mechanisms through which SCF enhances TFP holds substantial practical significance and policy value for promoting the better service of finance to the real economy and driving economic development in China.

The Shanghai and Shenzhen A-share listed enterprises in China from 2008 to 2023 are used as research samples in this study, identifies the involvement degree of enterprise supply chain finance through text analysis, and examines empirically the way SCF affects TFP as well as how it functions. The following three sections primarily characterize the research contribution: It broadens the scope of studies on the economic impacts of SCF. The influence of supply chain financing on the TFP is experimentally tested in this research using a large sample of Chinese listed companies from Shanghai and Shenzhen A-share. We substantially expand the theoretical analysis framework of the existing research on the economic impacts of SCF, and also offer a useful reference for comprehensively and objectively evaluating the impact of SCF adoption. It has enriched the theoretical research on the contributing elements of TFP at the micro level, namely the enterprise level. Most studies on contributing elements of TFP focus on macro and micro theories. We examine how supply chain financing affects TFP from the viewpoint of credit resource allocation and management supervision of SCF. It is believed that SCF is able to improve TFP and provide low-cost and efficient operation platform for enterprises on the chain. In theory, it can contribute to the modernization and transformation of businesses and achieve sustainable growth. The research conclusion is conducive to intensifying the reform of the financial supply side, inspiring more enterprises and financial organizations to conduct supply chain financing operations, and contributing a new angle to research in the superior development of businesses. General financing constraints and management opportunism are important reasons for restricting TFP, which has good practical value for the development of the contemporary industrial system. We analyze the SCF's intrinsic mechanism to raise total factor productivity of businesses, and offers a fresh approach to enhance the modernization level of enterprise supply chain and promote the superior growth of companies and economy.

2. Literature Review and Research Hypothesis

2.1 Literature Review

Researches in the field of SCF date back to the 1970s, when scholars concentrate on the impact of capital flow on operational management such as inventory management. Until Timme and Williams (2000) provide a clear definition of SCF, stating that it is a mutually cooperative relationship established between firms along the supply chain and corresponding financial institutions. Through specific mechanisms, it facilitates the combination of information, logistics, and cash flow, thereby enabling the involved parties to achieve mutual benefits. The academic and practical circles attach importance to supply chain finance

because of the challenge posed by the 2008 global financial crisis. Under the impact of the financial crisis, SMEs try to get trade credit from suppliers to complement other financing methods, which is the prototype of modern SCF. SCF refers to the process of optimizing financing among enterprises and integrating financing between core enterprises and upstream and downstream firms, so as to improve the market value of related companies in the supply chain.

SCF plays three core functions (Gelsomino, L.M., Mangiaracina, R., Perego, A., & Tumino, A., 2016):

1. Optimize capital allocation, decrease supply chain operating costs, and upgrade operational performance;
2. Alleviate the risk of supply chain disruption through risk diversification and prediction;
3. Create financial value, and realize a win-win situation between enterprises and supply chains.

The financial condition and credit risk of the core enterprise in the supply chain have an impact on the credit risk of both upstream and downstream companies. SCF can optimize enterprise capital allocation and reduce credit risk, thus significantly enhancing the overall efficiency and level of the supply chain (Ali, Z., Gongbing, B., & Mehreen, A., 2019). The majority of research in the field of supply chain primarily centers on solving various problems related to product and information optimization, and few focus on integrating financial aspects into supply chain processes (Jia, F., Blome, C., Sun, H., Yang, Y., & Zhi, B., 2020). Firms ought to take preventive measures against the credit risk associated with SCF, including the formulation of standards and the establishment of indicators (Ma, H.-L., Wang, Z., & Chan, F. T., 2020). As a novel financing instrument, SCF has arisen as a highly effective short-term financing tool to ease the financial constraints of corporations. It broadens the financing channels and addresses the financing dilemma faced by enterprises (Li, H., Mai, L., Zhang, W., & Tian, X., 2019). However, some scholars also put forward the opposite view. Enterprises may reduce R&D investment in the period of high cash flow to avoid potential losses in the future (Beladi, H., Deng, J., & Hu, M., 2021). Another study, using the Stackelberg game framework, provides two guidelines for how these small businesses can obtain supply chain financing, adopt clearance sales strategies, and when to repay loans (Priya, B., Biswas, I., Thürer, M., & Avittathur, B., 2023). The SCF information service platform needs the support of artificial intelligence and cloud computing to enhance its big data processing capabilities. A more comprehensive platform system can reduce the financing risk of enterprises and the lending risk of financial institutions (Beka Be Nguema, J.-N., Bi, G., Ali, Z., Mehreen, A., Rukundo, C., & Ke, Y., 2021). The core enterprises' engagement in SCF can conditionally upgrade the financial performance, risk level, and operational management of their companies (Pei, Q., Chan, H. K., Zhang, T., & Li, Y., 2023). Moreover, among the primary, secondary, and tertiary industries, the tertiary industry is the most suitable for the development of SCF. According to data from A-share listed firms, SCF can significantly enhance the level of green innovation, and proved that alleviating financial constraints and strengthening supply chain networks are key mechanisms for SCF to promote green innovation (Gu, H., Yang, S., Xu, Z., & Cheng, C., 2023).

Solow believes that the output growth rate in economic growth that could not be explained by capital and

labor input could be attributed to technological progress, and this residual was called Solow residual value, also known as total factor productivity, thus opening the prelude to the measurement of TFP. The measurement methods of TFP can be roughly divided into the following types:

The OP method takes the current investment of an enterprise as a proxy variable for TFP, that is, the investment is regarded as the adjustment variable when the enterprise is impacted by TFP. Then, the weights of capital and labor in the production function are calculated in two steps, and the TFP of the enterprise is obtained by Solow residual method (Olley, G. S., & Pakes, A., 1996). Since OP method demands investment and TFP to maintain a monotonous relationship, it indicates that samples with zero investment are inestimable, and many enterprises have zero or even negative investment, and this method leads to the loss of a large quantity of corporation samples. LP method employs intermediate input instead of investment as a proxy variable, which can minimize the loss of sample size (Levinsohn, J., & Petrin, A., 2003). The GMM method put forward by Blundell and Bond alleviates the endogenous issues within the model through instrumental variables (Blundell, R., & Bond, S., 1998). Specifically, the lagged values of the dependent variable are employed as instrumental variables. These instrumental variables are not related to the contemporaneous random shocks, thereby exhibiting strong exogeneity and relevance. However, this approach necessitates the use of numerous lagged values of variables, which in turn imposes high demands on the temporal span of the sample. Consequently, its practical application is often constrained by sample limitations.

At the level of financing constraints, by reducing operational risks, reducing financing costs, and improving the management ability and profitability of enterprises (Awinja, N. N., & Fatoki, O. I., 2021), the financing leverage ratio of enterprises can be reduced, financing constraints can be alleviated, and TFP can be increased. If a firm is confronted with severe financing constraints, the required technology, equipment, and materials for its development may be disrupted due to financial difficulties, posing a great challenge for the firm to survive and expand. In such cases, the firm must incur high debt or equity costs to support its development. Misallocation of the firm's capital structure will lead to low investment efficiency and a decline in TFP (Demarzo, P. M., 2019). In terms of innovation capacity, the inherent advantages of digital finance not only reduce the operational risks of enterprises and directly stimulate their willingness to innovate but also indirectly enhance their innovative capabilities by improving financial flexibility (Liu, J., Jiang, Y., Gan, S., He, L., & Zhang, Q., 2022) and alleviating the degree of financial misallocation, thereby contributing to the improvement of TFP. The refinement of corporate governance structures is conducive to promoting the enhancement of TFP (Wang, H., Yang, G., Ouyang, X., & Qin, J., 2021).

2.2 Research Hypothesis

2.2.1 Supply Chain Finance and Total Factor Productivity of Enterprises

SCF is a systematic liquidity solution that seeks to optimize cash flow, enhance the efficiency of working capital utilization in the supply chain, and assist businesses along the chain in achieving improved business performance at lower capital costs. The change of economic growth mode has put forward more

efficient, more sustainable and more innovative requirements for enhancing the TFP of enterprises. Total factor productivity reflects the comprehensive efficiency of transforming factor inputs into outputs and measures the level of output efficiency across different dimensions of economic units. It is a decisive factor in enhancing the level of intensive economic growth and the potential growth rate. In reality, the development of capital market is still in the preliminary stage, subject to institutional distortion and imperfect market system and other factors, enterprises' financing channels and tools are still relatively simple, and the operation process will become more uncertain due to increased financing charges, thus restricting the growth of TFP.

Given the presence of information asymmetry between financial institutions and enterprises, traditional financial institutions, represented by banks, are unable to provide financial support to potential SMEs and have a tendency to favor large state enterprises. Moreover, the lack of effective integration of factor input combinations within enterprises results in a generally low TFP. SCF, as an emerging short-term financing model designed to mitigate information asymmetry among enterprises and address their financing difficulties, can reduce corporate management, production, and transaction costs and lower default risk by integrating transaction information such as information flows and cash flows, thereby elevating the supply chain's efficiency. During the funding procedure, it can establish a favorable atmosphere for enterprise signal transmission, lessen the amount of information asymmetry gap that exists between borrowers and lenders, in order to efficiently balance the financial availability of upstream and downstream firms as well as core firms, reduce the financial limitations of businesses, and enhance their financing performance. By overcoming the inefficiencies in credit allocation inherent in traditional finance, SCF offers enterprises timely financial backing to seize investment opportunities, thereby driving an improvement in TFP. Relying on its internal close supply chain network, SCF can effectively support companies to fully utilize both upstream and downstream resources when engaging in investment operations and integrate various knowledge, technology and capital, thereby reducing transaction costs (Ali, Z., Gongbing, B., & Mehreen, A., 2019), improving resource integration efficiency and further improving TFP of companies. TFP is the output efficiency after considering all input factors, reflecting the contribution of technological progress, management efficiency, innovation ability and operational efficiency to economic growth. In addition, the strong connection formed by supply chain finance will exert strong supervision and restraint on managers, reduce opportunistic behavior of management, and enhance TFP. Therefore, the application of SCF is poised to serve as a key factor in enhancing corporate TFP. Based on this, the following hypothesis is proposed:

H1: Supply chain finance improves total factor productivity of enterprises.

2.2.2 Theoretical Mechanism of Resource Integration Efficiency

In essence, TFP is a form of resource integration efficiency, encompassing a wide range of production elements, including capital, technology and equipment, which can be specifically divided into two aspects: capital investment efficiency and technological innovation efficiency (Feng, J., Tang, J., Qi, Z., & Liu, J., 2024). In terms of capital investment efficiency, its essence is to exchange the current clear

capital input for the future uncertain output, which highlights the key role of information in making investment decisions. For the common goal of value creation, each enterprise node on the chain will exchange and share data information involving production, order processing, inventory management, sales dynamics, logistics and transportation more frequently through SCF, in order to mitigate the extent of the supply chain's asymmetry of information. This can assist businesses in comprehending the real-time dynamics of capital flow in each component of the supply chain, precisely capture the investment information and core nodes of the supply chain, through deepening cooperation with suppliers, distributors and other partners, enterprises can obtain more information about market dynamics, investment opportunities and risks, so as to react to the market promptly, improve the sensitivity and timeliness of investment decisions. The rapid flow of information promotes the efficient allocation of resources on the chain. This not only enhances the ability of enterprises to obtain credit resources, provides solid financial support for efficient investment, but also enables all parties on the SCF platform to share transaction, logistics, production and sales information, significantly reducing transaction costs between upstream and downstream and non-productive expenses of enterprises, while reducing supervision costs and improving supervision efficiency. On this basis, enterprises can more effectively integrate the resources of production, sales and research and development, and finally comprehensively upgrade the efficiency of businesses' capital investments through the dual dimensions of contract governance of formal system and relationship governance of informal system. From the perspective of technological innovation efficiency, the connection channels constructed by SCF significantly promote the information flow, cooperation, and exchange across supply chain upstream and downstream firms, aid in the establishment of trust relations, and thus realize more extensive information sharing. The richness of this information exchange promotes the in-depth cooperation of scientific research resources and technologies of companies in the supply chain, effectively lowers the risk and uncertainty of independent research and development operations of a single enterprise, and significantly improves the success rate of R&D projects as well as the caliber of the innovation's output. As the improvement of efficiency in capital investments and technological innovation means that companies have strong internal and external resource integration and optimization ability, resource integration, as an important means of enterprise strategic adjustment, a key component that propels TFP. Innovation is relied upon by enterprises to boost productivity, but technological innovation cannot be separated from financial support. Because of the riskiness, long-term nature, capital intensity, and information asymmetry of R&D activities, companies are more likely to encounter financing challenges when involved in technological innovation. Dong et al. verified the conclusion that technological innovation further elevates TFP by taking China as an example (Dong, X., Yang, Y., Zhao, X., Feng, Y., & Liu, C., 2021). Therefore, SCF raises the efficiency of resource integration, which improves TFP. In light of this, the following hypothesis is proposed:

H2: Supply chain finance improves the total factor productivity of enterprises by improving the efficiency of resource integration.

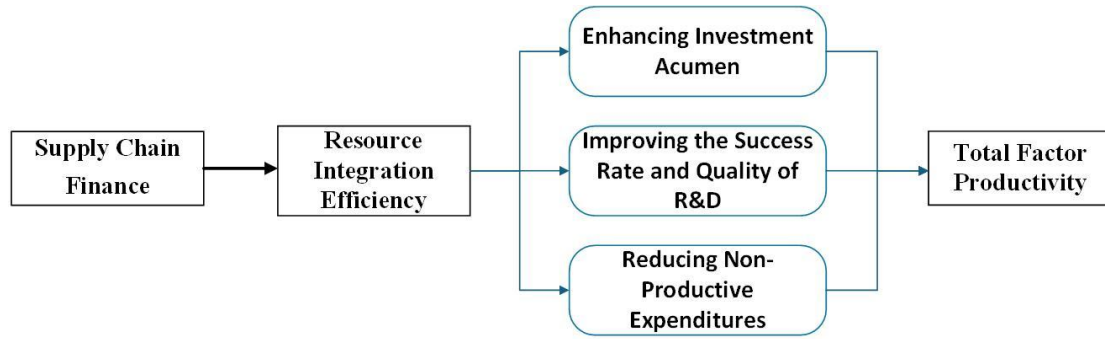


Figure 1. Indirect Mechanism of Resource Integration Efficiency

2.2.3 Theoretical Mechanism for Monitoring Opportunistic Behavior

The term “opportunism” was introduced into the realm of economics by Williamson, referring to behaviors that are deliberately misleading, distorting, concealing, disrupting, or confusing, often due to incomplete or distorted information. Such behaviors are characterized by a form of cunning self-interest. Ghouma et al., 2017) demonstrated that managerial opportunism negatively impacts corporate debt financing costs. Specifically, firms with lower managerial opportunism tend to have higher credit ratings and lower bond financing costs. Subsequent research by the authors revealed that when external shocks lead to enhanced regulatory scrutiny, managerial opportunism within firms continues to decline. SCF has a positive impact on curbing managerial opportunistic behavior, thereby promoting the improvement of TFP. The upstream and downstream firms in the supply chain will supervise the management of the core enterprises to enhance their operational efficiency. These suppliers closely linked to the interests of the enterprise actually constitute an effective corporate governance system that can monitor and restrain the management's conduct, thus reducing the agency cost. The supply chain network's transaction structure and trade linkages allow both upstream and downstream businesses to keep an eye on the enterprise's operations and cash flow. By the utilization of the supply chain network's transaction credit, they can determine whether the company has illegal operation, fraud or record of dishonesty, so as to realize the prior supervision of the management's behavior. Strong constraints are imposed by the close connections among supply chain participants, which encourages all members to consciously abide by the rules and regulations, effectively avoid moral hazard, and provides a strong guarantee for the subsequent supervision. When making credit decisions, bank creditors confront a very important issue: information asymmetry, which is the primary cause of the low efficiency of credit resource allocation. Therefore, third-party financial institutions such as banks also are instrumental in supervising core enterprises and restraining the opportunist motives of management. Banks can use their lending policies to monitor and influence the financial status and business activities of enterprises. With the aim of reducing credit risk and ensure timely recovery of loans, banks will conduct detailed analysis and evaluation of enterprises before lending, and continue to monitor the flow and use of funds after the loan is issued. This approach helps to successfully restrict management's opportunistic behavior, further reduce agency costs,

maximize the efficiency of businesses' resource allocation, thereby encouraging the enhancement of TFP. Based on this, the following hypothesis is proposed:

H3: Supply chain finance suppresses opportunistic behavior of management and improve total factor productivity.

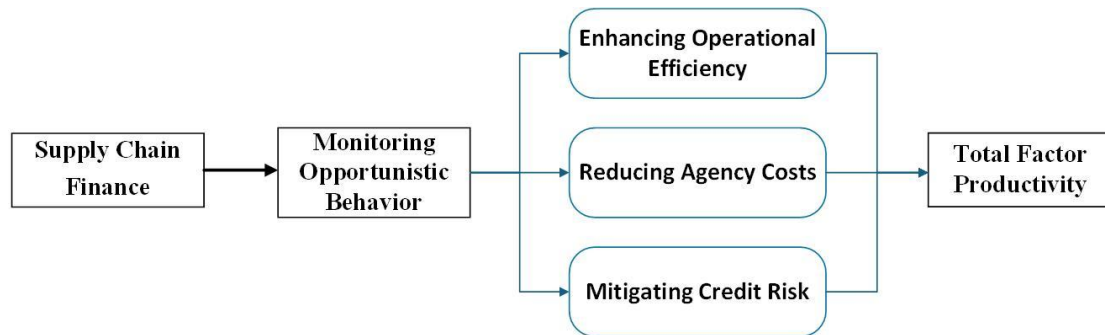


Figure 2. Indirect Mechanism of Monitoring Opportunistic Behavior

3. Empirical Design

3.1 Data

Our research sample consists of all Chinese A-share listed companies from 2008 to 2023. The CSMAR database provides the fundamental attributes and financial information of listed companies, meanwhile an analysis of the annual reports of A-share listed companies yields the word frequency data. Referring to existing literature, omit samples from *ST, ST, PT companies, financial industry, and samples lacking primary variables. In this study, the upper and lower 1% tail reduction is applied to all continuous variables in order to prevent the impact of outliers.

3.2 Variables

3.2.1 Explained Variable

The TFP of enterprises is the variable that this study explains. At present, OP (Olley, G. S., & Pakes, A., 1996) and LP (Levinsohn, J., & Petrin, A., 2003) methods are often used to measure the TFP of enterprises. These methods can effectively mitigate the endogenous problem between factor input and unobservable firm productivity. With reference to the practice of literature, we measures the TFP of enterprises using the total factor productivity level (TFP_LP/TFP_OP) as determined by the LP and OP methods (Yang, F., Chen, T., Zhang, Z., & Yao, K., 2024). Enterprises with better TFP have higher TFP values, and vice versa.

3.2.2 Explanatory Variable

SCF (lnSCF) serves as the study's explanatory variable. There is currently disagreement among academics over how to quantify the level of supply chain financial involvement. We employ the quantitative analysis method based on key word frequency (Chakuu, S., Masi, D., & Godsell, J., 2019; Parida, R., Dash, M. K., Kumar, A., Zavadskas, E. K., Luthra, S., & Mulat-weldemeskel, E., 2022; Huang, C., Chan, F. T., & Chung, S. H., 2022) to gauge the level of SCF engagement, and does logarithmic

processing.

1. According to the format and product characteristics of SCF, its application model is subdivided into four categories: receivables, prepayments, inventories, and comprehensive categories. For a more detailed list of keywords, please refer to the appendix.
2. The Python function is used to make detailed statistics on the frequency of keywords that appear in the firm's yearly financial statements. This is regarded as the initial measurement indicator of the degree of SCF that the business has implemented.
3. The level of SCF engagement is measured by adding one word frequency to the natural logarithm.

3.2.3 Control Variables

In this study, the following control variables are selected (Pan, A., Xu, L., Li, B., & Ling, R., 2020):

Table 1. Selection and Description of Control Variables

Variables	Descriptions
LEV	the ratio of total liabilities to total assets at the conclusion of the current year
Board	the natural logarithm of one plus the number of board members
Indboard	the proportion of independent directors to all directors at the conclusion of the year
Size	the natural logarithm of the enterprise's total assets for the current year
SOE	1 indicates state-owned enterprises, 0 indicates private enterprises
Growth	the operating revenue growth rate for the current year over the prior year
TOP1	the proportion of the largest shareholder
Age	the natural logarithm of the company's listing years plus 1
HHI	the Herfindahl index of the primary business income of same sector
Audit	1 indicates the enterprise has adopted the audit of the Big Four accounting firms
Fixed	dividing the enterprise's total assets for the current year by its net fixed assets
TobinQ	the current market value/book value of the enterprise
Dual	1 indicates that the chairman and general manager hold dual positions
ROA	the net profit of the company divided by the average balance of its assets for the current year
Cashflow	the net cash flow divided by the total assets generated by the company's operating activities for the year

3.3 Empirical Model

3.3.1 Baseline Regression Model

In an effort to investigate the relationship between supply chain finance and TFP of businesses, we construct a two-way fixed effects model for individual time as follows:

$$TFP_{it} = \beta_0 + \beta_1 \ln SCF_{it} + \lambda Controls_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (1)$$

In addition, i and t stand for the enterprise and the year respectively, TFP stands for the total factor productivity of the firm, lnSCF stands for the supply chain finance, Controls represents the control variable, γ_t represents the year-fixed effects, μ_i represents the enterprise-fixed effects, and $\varepsilon_{i,t}$ represents a random disturbance term. The coefficient of explanatory variable lnSCF is the main topic of this study. The TFP can be greatly increased by supply chain financing if β is significantly positive.

3.3.2 Mediating Effect Model

For the purpose of examining hypotheses H2, H3, and H4, we conduct mechanism tests for the four mediators, and builds models (Liu, H., Yuan, K.-H., & Liu, F., 2020) (2) and (3) based on model (1), with M as the mediating variable.

$$M_{i,t} = \beta_0 + \beta_1 \ln SCF_{i,t} + \lambda \text{Controls}_{i,t} + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (2)$$

$$TFP_{i,t} = \beta_0 + \beta_1 \ln SCF_{i,t} + \beta_2 M_{i,t} + \lambda \text{Controls}_{i,t} + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (3)$$

Among them, M represents the four mechanism variables of enterprise innovation performance (CT) and agency cost (Agc_Cost) respectively. Other variables are defined in an identical manner to those in model (1).

For the purpose of analyzing the mechanism of credit resource allocation, the mechanism variables selected for this study are as follows:

Innovation performance (CT) is measured as the natural logarithm of the cumulative count of patents acquired by a listed company in the reporting period plus 1 (Kamal, E. M., Lou, E. C., & Kamaruddeen, A. M., 2023).

Agc_Cost, we adopt (administrative expense + sales expense)/business income to measure agency cost, represented by Agc (Kim, D.-S., Yeo, E., & Zhang, L., 2021).

3.4 Summary Statistics

Table 2 displays the descriptive statistics for the primary variables. The average of TFP calculated by OP method is 6.774, which is very close to the existing research results. According to the LP technique, the average TFP is 8.457, the minimal value is 6.056, and the maximal value is 11.193, with no obvious bias in the data. The mean value of lnSCF is 0.364 and the standard deviation is 0.659, which indicates that there are significant differences in the implementation of SCF business.

Table 2. Descriptive Statistics of Main Variables

Variables	Number of Observations	Mean	Std. Dev	Min	Max
TFP_OP	24181	6.774	0.903	4.800	9.145
TFP_LP	24181	8.457	1.066	6.056	11.193
lnSCF	24181	0.364	0.659	0.000	2.890
LEV	24181	0.446	0.201	0.060	0.913
Board	24181	2.247	0.174	1.792	2.773
Indboard	24181	0.374	0.053	0.308	0.571

Size	24181	22.318	1.309	19.805	26.258
SOE	24181	0.364	0.481	0.000	1.000
Growth	24181	0.171	0.394	-0.589	2.443
TOP1	24181	34.635	14.906	2.197	89.991
Age	24181	2.205	0.759	0.693	3.367
HHI	24181	0.198	0.171	0.041	1.000
Audit	24181	0.069	0.254	0.000	1.000
Fixed	24181	0.213	0.147	0.002	0.675
TobinQ	24181	2.607	1.833	0.864	11.164
Dual	24181	0.274	0.446	0.000	1.000
ROA	24181	0.038	0.061	-0.250	0.197
Cashflow	24181	0.050	0.070	-0.161	0.248

4. Empirical Test and Result Analysis

4.1 Baseline Results

The benchmark regression results of the effect of SCF on TFP are displayed in Table 3. Thereamong, the explained variables are the TFP of enterprises calculated by LP method and OP method respectively. For the accuracy of analysis, the fixed effect of year and the fixed effect of industry are controlled for each column regression. The coefficients of supply chain finance (lnSCF) in column (1) and (3) are 0.0804 and 0.0965, respectively, and the significance level for both is 1%, indicating that under the condition of controlling individuals and years, SCF activities can significantly improve the TFP (TFP_OP and TFP_LP) of companies. The results after the introduction of control variables are listed in columns (2) and (4), and the regression coefficients of lnSCF are positive at 1% level of significance. The hypothesis H1 is preliminarily verified, that is, carrying out supply chain finance business can greatly increase TFP.

Table 3. Baseline Regression Results

Variables	(1) TFP_OP	(2) TFP_OP	(3) TFP_LP	(4) TFP_LP
lnSCF	0.0767*** (6.64)	0.0415*** (4.35)	0.0909*** (7.17)	0.0430*** (4.51)
Lev		0.312*** (5.69)		0.388*** (7.24)
Board		-0.0580 (-1.18)		-0.0281 (-0.54)
Indboard		-0.0603 (-0.47)		-0.00594 (-0.05)

Size		0.363*** (24.89)		0.507*** (33.63)
SOE		-0.0325 (-1.10)		-0.0226 (-0.81)
Growth		0.186*** (20.63)		0.186*** (21.59)
TOP1		-0.0103 (-0.20)		0.000184 (0.00)
Age		0.0764*** (4.00)		0.0771*** (4.05)
HHI		0.0860 (1.63)		0.119** (2.54)
Audit		0.0483 (1.37)		0.0532 (1.50)
Fixed		-0.880*** (-12.33)		-1.123*** (-14.50)
TobinQ		0.00445 (1.09)		0.00526 (1.34)
Dual		-0.0171 (-1.41)		-0.0131 (-1.10)
ROA		1.472*** (15.60)		1.508*** (16.08)
Cashflow		0.661*** (10.89)		0.691*** (11.51)
_cons	6.239*** (321.80)	-1.548*** (-4.52)	7.821*** (401.32)	-3.123*** (-9.27)
Enterprise and Year FE	YES	YES	YES	YES
N	24181	24181	24181	24181
R ²	0.290	0.626	0.300	0.738

*, ** and *** denote significance at the 10%, 5% and 1% levels, respectively, and the numbers in parentheses denote two-sided t values. The same applies to all subsequent tables.

4.2 Endogeneity Test

Some elements that were not observed may have an impact on the empirical conclusions of this article. Additionally, the issue of missing variables may cause the supply chain finance coefficient to deviate. To reduce endogeneity's influence on the model estimation outcomes, we adopt the method of instrumental variables to control the endogeneity problem of the measurement model, and selects "the average value

of SCF activities of businesses in the same province and year" and "the average value of SCF activities for firms in the same industry and year" as the instrumental variables (Rahman, H. U., Zahid, M., & Al-Faryan, M. A. S., 2023). They are represented by SCF_Pro and SCF_Ind respectively. The reason for selecting both as instrumental variables is that, for one thing, elements like regional homogeneity and industry development synergy influence other businesses in the same province and industry are eager to participate in SCF activities, which in turn influences whether companies engage in SCF activities. Thus, the correlation hypothesis is satisfied by the two instrumental variables. On the other hand, the TFP of individual businesses is not directly correlated with the broad variable of the degree of participation in SCF activities in the same province and industry, which meets the exogenous requirements. The first-stage instrumental variable test regression findings in column (1) of Table 4 demonstrate that the Kleibergen-Paap (KP) rk LM statistic is 653.77, and the significance threshold of the test is 1%, which excludes the problem of inadequate instrumental variable identification. There is no weak instrumental variable issue, as indicated by the Cragg-Donald Wald F statistic of 644.25, which is significantly higher than the 10% critical value of 19.93. The value of Hansen J test is 1.301, and there is no over identification problem of instrumental variables, as indicated by the p value of 0.254, which is higher than 0.1.

Table 4. Endogeneity Test

Variables	(1) lnSCF	(2) TFP_OP	(3) TFP_LP
lnSCF		0.1932*** (9.49)	0.2097*** (10.65)
SCF_Pro	0.756*** (17.79)		
SCF_Ind	0.690*** (30.59)		
LEV	0.018 (0.58)	0.3030*** (13.34)	0.3893*** (17.72)
Board	0.027 (0.74)	-0.0592** (-2.25)	-0.0323 (-1.27)
Indboard	-0.123 (-1.25)	-0.0905 (-1.26)	-0.0254 (-0.37)
Size	0.085*** (11.58)	0.3506*** (62.17)	0.4899*** (89.79)
SOE	0.055*** (3.00)	-0.0508*** (-3.76)	-0.0314** (-2.41)
Growth	0.008	0.1828***	0.1828***

	(0.95)	(30.91)	(31.94)
TOP1	0.002***	-0.0013***	-0.0011***
	(3.66)	(-3.93)	(-3.24)
Age	-0.007	0.0719***	0.0756***
	(-0.47)	(7.02)	(7.63)
HHI	-0.062**	0.0573***	0.0763***
	(-2.09)	(2.64)	(3.64)
Audit	-0.031	0.0611***	0.0591***
	(-1.22)	(3.33)	(3.33)
Fixed	-0.025	-0.8619***	-1.0956***
	(-0.59)	(-28.17)	(-37.01)
TobinQ	0.004	-0.0028	-0.0030
	(1.38)	(-1.37)	(-1.55)
Dual	-0.010	-0.0199***	-0.0143**
	(-1.05)	(-2.74)	(-2.03)
ROA	-0.162**	1.5694***	1.6130***
	(-2.29)	(30.25)	(32.13)
Cashflow	-0.017	0.6529***	0.6878***
	(-0.33)	(16.93)	(18.43)
_cons	-2.292***	-1.077***	-2.692***
	(-11.87)	(-7.60)	(-19.65)
Enterprise and Year FE	YES	YES	YES
Kleibergen-Paap rk LM statistic	653.77***		
Cragg-Donald Wald F statistic	644.25		
Hansen J statistic	1.301		
Observations	24181	24181	24181
R-squared	0.054	0.542	0.645

4.3 Robustness Test

4.3.1 Replace the Explained Variable

When measuring the TFP of companies, the inherent defects of LP algorithm and OP algorithm may lead to measurement errors. In view of this, OLS method, FE method and GMM method (Al-Mulali, U., Gholipour, H. F., & Solarin, S. A., 2022) were used in this paper to measure TFP and perform regression respectively. Table 5 displays the findings. The lnSCF coefficients are 0.049, 0.049 and 0.051 respectively, which are all statistically positive at the 1% level, proving that the TFP measurement method does not affect the relationship between the two and verifies hypothesis H1 once again.

Table 5. Replace the Explained Variable

Variables	(1) TFP_OLS	(2) TFP_FE	(3) TFP_GMM
lnSCF	0.049*** (5.13)	0.049*** (5.09)	0.051*** (4.89)
_cons	-5.492*** (-15.91)	-6.173*** (-17.72)	-0.505 (-1.31)
Controls	YES	YES	YES
Enterprise and Year FE	YES	YES	YES
Observations	24181	24181	24181
R-squared	0.804	0.816	0.563

4.3.2 Lagging Variable

In reality, enterprises with high production efficiency have a higher propensity to participate in SCF operations, that is, there may be a reverse causal relationship between SCF and TFP. To investigate whether SCF can sustain a consistent favorable effect on TFP in a long period, we conduct regression tests on SCF that lags in the first phase and the second phase respectively. As shown in Table 6, L.lnSCF, L2.lnSCF and control variables are supply chain finance with phase 1 lag and phase 2 lag respectively. The regression results show that the L.lnSCF and L2.lnSCF coefficients are considerably positive at the 1% level, suggesting that the previous research is still reliable.

Table 6. Lagging Variable

Variables	(1) TFP_OP	(2) TFP_OP	(3) TFP_LP	(4) TFP_LP
L.lnSCF	0.037*** (3.65)		0.039*** (3.84)	
L2.lnSCF		0.022*** (2.09)		0.020*** (1.98)
_cons	-1.495*** (-4.08)	-1.739*** (-4.48)	-2.914*** (-8.37)	-3.165*** (-8.20)
Controls	YES	YES	YES	YES
Enterprise and Year FE	YES	YES	YES	YES
Observations	21,731	19,073	21,731	19,073
R-squared	0.732	0.774	0.760	0.770

5. Mechanism Analysis

5.1 Resource Integration Efficiency

This paper examines the efficiency of technological innovation represented by the quantity of patents obtained. Column (1) of Table 7 displays the regression results of utilizing model (2) to investigate the mechanism of technological innovation efficiency. As can be observed, the lnSCF and CT coefficients are 0.113 and significantly positive at the 5% level. It indicates that SCF improves innovation performance, and that the key to boosting corporate TFP is increasing the efficiency of enterprise resource integration. The aforementioned findings demonstrate that SCF can encourage an increase in the TFP by enhancing the efficiency of resource integration, and hypothesis 2 is verified.

Table 7. Resource Integration Efficiency Effect

Variables	(1) CT	(2) TFP_OP	(3) TFP_LP
lnSCF	0.113** (2.02)	0.0118 (1.45)	0.0179** (2.16)
CT		0.00417** (2.38)	0.00455** (2.52)
_cons	-2.577 (-1.24)	-1.532*** (-3.91)	-3.051*** (-7.53)
Controls	YES	YES	YES
Enterprise and Year FE	YES	YES	YES
N	24181	24181	24181
R ²	0.106	0.648	0.726

5.2 Agency Cost

Some scholars have pointed out that agency cost is another key factor affecting the enhancement of TFP. The implementation of SCF can efficiently restrain the opportunistic behavior of management, significantly reduce agency costs, and encourage the enhancement of TFP. As for the intermediary mechanism examination of agency cost, the regression findings of the intermediate effect to reduce agency cost are shown in Table 8. In column (1), the regression coefficients of lnSCF is -0.005, which is substantial at the levels of 0.01, indicating that the supply chain decrease agency cost. In column (2) and column (3), the AGC regression coefficients were -2.326 and -2.342, both at the level of 0.01. The regression coefficients of lnSCF are -0.032 and -0.034 respectively, which both have significance at the 0.01 level, suggesting that SCF decrease agency costs and increase TFP.

Table 8. Agency Cost Effect

Variables	(1) AGC	(2) TFP_OP	(3) TFP_LP
lnSCF	-0.0049*** (-3.89)	0.0317*** (3.81)	0.0340*** (4.06)
AGC		-2.326*** (-20.75)	-2.342*** (-21.29)
_cons	0.500*** (8.85)	-0.268 (-0.83)	-1.755*** (-5.75)
Controls	YES	YES	YES
Enterprise and Year FE	YES	YES	YES
N	24181	24181	24181
R ²	0.198	0.664	0.752

6. Heterogeneity Analysis

6.1 Enterprise Scale

SMEs encounter a disadvantage in the financial market with asymmetric information when compared to giant corporations due to short business cycle, large performance fluctuations, insufficient collateral and other defects. Applying SCF can help businesses increase their production efficiency by more efficiently realizing the optimal allocation of funds. Moreover, SCF, as an innovative means to solve the financing difficulties of SMEs, combines the core enterprises, suppliers and sellers on the chain as a whole. By leveraging the cross-over characteristics of supply chain attributes and financial attributes, the collection of multidimensional comprehensive information can reduce information asymmetry, improve enterprise capital allocation, and expand the scale of credit fund allocation. Thus, it can alleviate businesses' financial limitations. Therefore, the effects of SCF will vary depending on the size of the company. The median size of enterprises is calculated, and the sample is divided into large businesses and SMEs as a basis for heterogeneity test. By observing the regression coefficient of SCF in columns (1) to (4) of Table 9, it is evident that SMEs have a higher coefficient than large businesses regardless of the OP algorithm or LP algorithm. And the results pass the test for differences in coefficients between groups, which implies that SCF is more profitable for SMEs and stimulate greater TFP.

Table 9. Enterprise Scale

Variables	(1)	(2)	(3)	(4)
	TFP_OP	TFP_OP	TFP_LP	TFP_LP
	Small and medium	Large	Small and medium	Large
lnSCF	0.0595*** (3.45)	0.0229** (2.54)	0.0599*** (3.42)	0.0245*** (2.83)
_cons	-1.301*** (-2.58)	-0.474 (-0.92)	-2.531*** (-5.01)	-2.289*** (-4.45)
Controls	YES	YES	YES	YES
Enterprise and Year FE	YES	YES	YES	YES
N	12835	11346	12835	11346
R ²	0.439	0.468	0.521	0.574
between-group coefficient difference(P-value)	0.020**		0.025**	

6.2 Financing Constraints

The existence of financing constraints will inhibit the enhancement of TFP by affecting the effective allocation of resources. The absolute value of WW index is taken as a measure of financing constraints. The greater the absolute value of financing constraints index, the greater the financing constraints of enterprises. And the industry annual median of the absolute value of the financing constraint index is used as the grouping criterion, and two groups are created from the samples in order to perform grouping regression. The outcomes are shown in columns (1) - (4) of Table 10, from which it is evident that the coefficient of lnSCF is significantly positive at the level of 1% or 5% for businesses with high or low financing constraints. It can be seen that both OP algorithm and LP algorithm pass the between-group coefficient difference test. In contrast to businesses with more severe financial constraints, businesses with lower degree of financing constraint have more obvious improvement effect on TFP by participating in SCF.

Table 10. Financing Constraints

Variables	(1)	(2)	(3)	(4)
	Degree of financing constraints			
	Higher	Lower	Higher	Lower
	TFP_OP	TFP_OP	TFP_LP	TFP_LP
lnSCF	0.0177** (2.00)	0.0603*** (4.08)	0.0180** (2.06)	0.0607*** (4.09)
_cons	-0.328	-1.470***	-2.280***	-2.694***

	(-0.67)	(-3.30)	(-4.74)	(-6.25)
Controls	YES	YES	YES	YES
Enterprise and Year FE	YES	YES	YES	YES
N	10689	13492	10689	13492
R ²	0.535	0.456	0.648	0.541
between-group coefficient difference(P-value)	0.004***		0.004***	

6.3 Degree of Industry Competition

The fierce market competition environment will encourage enterprises to lessen the amount of information asymmetry that exists between the demand and supply sides of the financial system to a greater extent, and enterprises will face more serious information asymmetry and distortion of credit resource allocation in the absence of competition environment. To further explore the influence of industry competition on the improvement of TFP in SCF, we use the Herfindahl-Hirschman Index (HHI) calculated based on main business income as a proxy variable for industry competition degree. There is less rivalry in the industry if this variable has a higher value. Specifically, we classify the industries whose Herfindahl-Hirschman Index is lower than the annual industry median as industries with relatively strong competition, and classifies the industries above the median as industries with relatively weak competition, and performs grouping regression. The findings are displayed in columns (1) - (4) of Table 11, and it is evident from these that both groups' coefficients of lnSCF are considerably positive at the 1% level. The results of the between-group coefficient difference test suggest that although SCF can greatly increase the TFP in both highly competitive and low-competitive industries, this enhancement effect is more prominent in low-competition industries. This also confirms from the industry level that supply chain finance can raise the TFP by reducing information asymmetry and resource allocation distortion in low-competition industries.

Table 11. Degree of Industry Competition

Variables	(1)	(2)	(3)	(4)
	Degree of industry competition			
	Higher TFP_OP	Lower TFP_OP	Higher TFP_LP	Lower TFP_LP
lnSCF	0.0300*** (5.32)	0.0657*** (8.01)	0.0361*** (6.66)	0.0615*** (7.74)
_cons	-1.421*** (-8.82)	-0.572** (-2.40)	-2.859*** (-18.46)	-2.031*** (-8.81)
Controls	YES	YES	YES	YES

Enterprise and Year FE	YES	YES	YES	YES
N	15444	8737	15444	8737
R ²	0.691	0.588	0.745	0.717

6.4 Supply Chain Integration Degree

Based on the studies of Modi and Mabert, we use supply chain efficiency to represent the level of supply chain integration and inventory turnover ratio (ITR) as the proxy variable of supply chain efficiency to test the impact of SCF on the long-term development of businesses under different supply chain efficiencies. The results of grouping regression are displayed in columns (1) - (4) of Table 12, and it is evident from these that the coefficient of lnSCF is considerably positive at the level of 1% in both groups with strong supply integration and weak supply chain integration, that is, SCF contributes positively TFP. However, the promotion effect of SCF on the long-term development of enterprises is more significant when the supply chain efficiency is strong, which suggests that the enhancement effect of SCF on the TFP can be better played in the setting of robust supply chain integration, which also confirms the SCF resource integration mechanism.

Table 12. Supply Chain Integration Degrees

Variables	(1)	(2)	(3)	(4)
	Supply chain integration degree			
	Weaker TFP_OP	Stronger TFP_OP	Weaker TFP_LP	Stronger TFP_LP
lnSCF	0.0216*** (3.69)	0.0381*** (5.71)	0.0216*** (3.81)	0.0429*** (6.83)
_cons	-2.413*** (-14.62)	0.666*** (3.29)	-3.675*** (-22.91)	-1.301*** (-6.83)
Controls	YES	YES	YES	YES
Enterprise and Year FE	YES	YES	YES	YES
N	12644	11537	12644	11537
R ²	0.592	0.564	0.780	0.714

7. Conclusion and Policy Implications

This study takes all A-share listed companies from 2008 to 2023 as samples to investigate the effect of SCF on the TFP of businesses, and the research findings show that growth of supply chain finance services can raise the TFP of businesses. Mechanism research shows that SCF can increase the TFP by enhancing the efficiency of resource integration and reducing agency costs. In the further analysis, we examine the influence of SCF on TFP in different situations. It is concluded that compared with

businesses with large scale, high degree of financing constraint, high competitive pressure within the industry and weak degree of supply chain integration, SCF has a more obvious contribution to TFP of companies under the condition of small scale, low degree of financing constraint, low competitive pressure within the industry and strong degree of supply chain integration.

Government departments should vigorously encourage the evolution of SCF, encourage and guide enterprises that have not yet set foot in this field to take the initiative to cooperate with other enterprises, jointly build supply chain finance systems and platforms, and further regulate and restrict the financing behaviors of enterprises, so as to reduce credit costs and raise the degree of marketization. SSCF significantly alleviates the problem of information asymmetry between firms and stakeholders, accelerates the efficient allocation of credit resources and improves the efficiency of integrating resources. Therefore, the relevant government departments should persist in advancing the structural reform of the financial supply side, and further activate the vitality of the SCF credit market and its institutions by increasing fiscal input, deepening interest rate liberalization reform, strengthening the construction of the credit system and providing more powerful financing policy support, so as to establish a superior outside environment for the dynamic advancement of SCF. At the same time, enterprises on the chain are encouraged to strengthen supply chain management, maintain stable cooperative relations with upstream and downstream companies, and encourage the sustainable and healthy growth of SCF.

The core operations of the supply chain, financial organizations and logistics firms and financial technology companies should strengthen the communication and cooperation between each other, deepen the level of collaboration with financial institutions, utilize all of the benefits of modern information technology including blockchain, the Internet of Things, artificial intelligence, and improve the construction of financial infrastructure, so that organizations might depend on each supply chain link's uniqueness and risk status. Continue to innovate and optimize the product service system, launch financial products that are in line with market demand and have high comprehensive performance. Thus, the credit resource allocation of businesses and it is feasible to optimize the entire supply chain, the resource allocation efficiency of enterprises can be boosted, and the supply chain's overall competitiveness can be enhanced, laying a firm foundation for the enhancement of TFP.

The legal department should continue to improve the legal and regulatory system in the field of SCF, build a SCF information service platform and a big data sharing platform, reduce compliance risks, and enhance monitoring of enterprise fund movements and operational performance. For violations and dishonesty of enterprises, it is necessary to strengthen supervision and put an end to opportunistic behaviors of managers to guarantee that the entire supply chain is stable. Additionally, businesses themselves should also deepen the understanding of SCF risks, establish and improve the supply chain risk prevention and security mechanism, in order to comprehensively deal with potential risks.

Funding

This study was funded by the 2025 Annual Planning Project of the "14th Five-Year Plan" for Educational Science in Heilongjiang Province (grant number GJB 1425233), Special Project of the Higher Education Society of Heilongjiang Province (grant number 24GJZXB042), Scientific Research Project of Heilongjiang Provincial Language Commission (2025).

References

- Abdel-Basset, M., Mohamed, R., Sallam, K., & Elhoseny, M. (2020). A novel decision-making model for sustainable supply chain finance under uncertainty environment. *Journal of Cleaner Production*, 269, 122324. <https://doi.org/10.1016/j.jclepro.2020.122324>
- Ali, Z., Gongbing, B., & Mehreen, A. (2019). Predicting supply chain effectiveness through supply chain finance: Evidence from small and medium enterprises. *The International Journal of Logistics Management*, 30, 488-505. <https://doi.org/10.1108/IJLM-05-2018-0118>
- Al-Mulali, U., Gholipour, H. F., & Solarin, S. A. (2022). Investigating the environmental Kuznets curve (EKC) hypothesis: does government effectiveness matter? Evidence from 170 countries. *Environment, Development and Sustainability*, 1-16. <https://doi.org/10.1007/s10668-021-01962-4>
- Awinja, N. N., & Fatoki, O. I. (2021). Effect of digital financial services on the growth of SMEs in Kenya. *African Journal of Empirical Research*, 2, 79-94.
- Beka Be Nguema, J.-N., Bi, G., Ali, Z., Mehreen, A., Rukundo, C., & Ke, Y. (2021). Exploring the factors influencing the adoption of supply chain finance in supply chain effectiveness: evidence from manufacturing firms. *Journal of Business & Industrial Marketing*, 36, 706-716. <https://doi.org/10.1108/JBIM-01-2020-0047>
- Beladi, H., Deng, J., & Hu, M. (2021). Cash flow uncertainty, financial constraints and R&D investment. *International Review of Financial Analysis*, 76, 101785. <https://doi.org/10.1016/j.irfa.2021.101785>
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, 87, 115-143. [https://doi.org/10.1016/S0304-4076\(98\)00009-8](https://doi.org/10.1016/S0304-4076(98)00009-8)
- Chakuu, S., Masi, D., & Godsell, J. (2019). Exploring the relationship between mechanisms, actors and instruments in supply chain finance: A systematic literature review. *International Journal of Production Economics*, 216, 35-53. <https://doi.org/10.1016/j.ijpe.2019.04.013>
- Chen, L., Moretto, A., Jia, F., Caniato, F., & Xiong, Y. (2021). The role of digital transformation to empower supply chain finance: current research status and future research directions (Guest editorial). *International Journal of Operations & Production Management*, 41, 277-288. <https://doi.org/10.1108/IJOPM-04-2021-838>
- Demarzo, P. M. (2019). Presidential address: Collateral and commitment. *The Journal of Finance*, 74, 1587-1619. <https://doi.org/10.1111/jofi.12782>

- Dong, X., Yang, Y., Zhao, X., Feng, Y., & Liu, C. (2021). Environmental regulation, resource misallocation and industrial total factor productivity: a spatial empirical study based on China's provincial panel data. *Sustainability*, 13, 2390. <https://doi.org/10.3390/su13042390>
- Feng, J., Tang, J., Qi, Z., & Liu, J. (2024). Supply Chain Finance and Innovation Investment: Based on financing constraints. *Finance Research Letters*, 63, 105349. <https://doi.org/10.1016/j.frl.2024.105349>
- Gelsomino, L.M., Mangiaracina, R., Perego, A., & Tumino, A. (2016). Supply chain finance: a literature review. *International Journal of Physical Distribution & Logistics Management*, 46. <https://doi.org/10.1108/IJPDLM-08-2014-0173>
- Ghouma, H. (2017). How does managerial opportunism affect the cost of debt financing? *Research in International Business and Finance*, 39, 13-29. <https://doi.org/10.1016/j.ribaf.2016.07.007>
- Gu, H., Yang, S., Xu, Z., & Cheng, C. (2023). Supply chain finance, green innovation, and productivity: Evidence from China. *Pacific-Basin Finance Journal*, 78, 101981. <https://doi.org/10.1016/j.pacfin.2023.101981>
- Huang, C., Chan, F. T., & Chung, S. H. (2022). Recent contributions to supply chain finance: towards a theoretical and practical research agenda. *International Journal of Production Research*, 60, 493-516. <https://doi.org/10.1080/00207543.2021.1964706>
- Jia, F., Blome, C., Sun, H., Yang, Y., & Zhi, B. (2020). Towards an integrated conceptual framework of supply chain finance: An information processing perspective. *International Journal of Production Economics*, 219, 18-30. <https://doi.org/10.1016/j.ijpe.2019.05.013>
- Kamal, E. M., Lou, E. C., & Kamaruddeen, A. M. (2023). Effects of innovation capability on radical and incremental innovations and business performance relationships. *Journal of Engineering and Technology Management*, 67, 101726. <https://doi.org/10.1016/j.jengtecman.2022.101726>
- Kim, D.-S., Yeo, E., & Zhang, L. (2021). Do cross-listed firms have a better governance structure and lower agency costs? evidence from Chinese firms. *Sustainability*, 13, 1734. <https://doi.org/10.3390/su13041734>
- Levinsohn, J., & Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *The review of economic studies*, 70, 317-341. <https://doi.org/10.1111/1467-937X.00246>
- Li, H., Mai, L., Zhang, W., & Tian, X. (2019). Optimizing the credit term decisions in supply chain finance. *Journal of Purchasing and supply management*, 25, 146-156. <https://doi.org/10.1016/j.pursup.2018.07.006>
- Li, X., Yan, J., Cheng, J., & Li, J. (2023). Supply-Chain Finance and Investment Efficiency: The Perspective of Sustainable Development. *Sustainability*, 15, 7857. <https://doi.org/10.3390/su15107857>

- Liu, H., Yuan, K.-H., & Liu, F. (2020). A two-level moderated latent variable model with single level data. *Multivariate Behavioral Research*, 55, 873-893. <https://doi.org/10.1080/00273171.2019.1689350>
- Liu, J., Jiang, Y., Gan, S., He, L., & Zhang, Q. (2022). Can digital finance promote corporate green innovation? *Environmental Science and Pollution Research*, 29, 35828-35840. <https://doi.org/10.1007/s11356-022-18667-4>
- Ma, H.-L., Wang, Z., & Chan, F. T. (2020). How important are supply chain collaborative factors in supply chain finance? A view of financial service providers in China. *International Journal of Production Economics*, 219, 341-346. <https://doi.org/10.1016/j.ijpe.2019.07.002>
- Olley, G. S., & Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64, 1263-1297. <https://doi.org/10.2307/2171831>
- Pan, A., Xu, L., Li, B., & Ling, R. (2020). The impact of supply chain finance on firm cash holdings: Evidence from China. *Pacific-Basin Finance Journal*, 63, 101402. <https://doi.org/10.1016/j.pacfin.2020.101402>
- Pang, J., Jiao, F., & Zhang, Y. (2022). An analysis of the impact of the digital economy on high-quality economic development in China—a study based on the effects of supply and demand. *Sustainability*, 14, 16991. <https://doi.org/10.3390/su142416991>
- Parida, R., Dash, M. K., Kumar, A., Zavadskas, E. K., Luthra, S., & Mulat-weldemeskel, E. (2022). Evolution of supply chain finance: A comprehensive review and proposed research directions with network clustering analysis. *Sustainable Development*, 30, 1343-1369. <https://doi.org/10.1002/sd.2272>
- Pei, Q., Chan, H. K., Zhang, T., & Li, Y. (2023). Benefits of the implementation of Supply Chain Finance, 1. *Annals of Operations Research*, 331, 251-283. <https://doi.org/10.1007/s10479-022-04566-x>
- Peng, J., Xie, R., Ma, C., & Fu, Y. (2021). Market-based environmental regulation and total factor productivity: Evidence from Chinese enterprises. *Economic Modelling*, 95, 394-407. <https://doi.org/10.1016/j.econmod.2020.03.006>
- Priya, B., Biswas, I., Thürer, M., & Avittathur, B. (2023). How to finance the supply chain when you are small? Clearance sale and loan payment timing in financially constrained supply chains. *International Journal of Production Economics*, 263, 108934. <https://doi.org/10.1016/j.ijpe.2023.108934>
- Qorri, A., Gashi, S., & Kraslawski, A. (2021). Performance outcomes of supply chain practices for sustainable development: A meta-analysis of moderators. *Sustainable Development*, 29, 194-216. <https://doi.org/10.1002/sd.2140>
- Rahman, H. U., Zahid, M., & Al-Faryan, M. A. S. (2023). ESG and firm performance: The rarely explored moderation of sustainability strategy and top management commitment. *Journal of Cleaner Production*, 404, 136859. <https://doi.org/10.1016/j.jclepro.2023.136859>

- Timme, S. G., & Williams-Timme, C. (2000). The financial-SCM connection. *SUPPLY CHAIN MANAGEMENT REVIEW*, *V. 4, NO. 2 (MAY/JUNE 2000)*, P. 33-40: ILL.
- Wang, H., Yang, G., Ouyang, X., & Qin, J. (2021). Does central environmental inspection improves enterprise total factor productivity? The mediating effect of management efficiency and technological innovation. *Environmental Science and Pollution Research*, *28*, 21950-21963. <https://doi.org/10.1007/s11356-020-12241-6>
- Xie, H., Wen, J., & Wang, X. (2022). Digital finance and high-quality development of state-owned enterprises—A financing constraints perspective. *Sustainability*, *14*, 15333. <https://doi.org/10.3390/su142215333>
- Xie, Z., Qu, L., Lin, R., & Guo, Q. (2022). Relationships between fluctuations of environmental regulation, technological innovation, and economic growth: A multinational perspective. *Journal of Enterprise Information Management*, *35*, 1267-1287. <https://doi.org/10.1108/JEIM-02-2021-0104>
- Xu, S., & Dong, H. (2023). Green finance, industrial structure upgrading, and high-quality economic development—intermediation model based on the regulatory role of environmental regulation. *International Journal of Environmental Research and Public Health*, *20*, 1420. <https://doi.org/10.3390/ijerph20021420>
- Yang, F., Chen, T., Zhang, Z., & Yao, K. (2024). Firm ESG Performance and Supply-Chain Total-Factor Productivity. *Sustainability*, *16*, 9016. <https://doi.org/10.3390/su16209016>
- Zhang, H., Huang, L., Zhu, Y., Si, H., & He, X. (2021). Does low-carbon city construction improve total factor productivity? Evidence from a quasi-natural experiment in China. *International Journal of Environmental Research and Public Health*, *18*, 11974. <https://doi.org/10.3390/ijerph182211974>