Research on the Empowerment of Heilongjiang Private Enterprises by Sci-Tech Innovation in Supply Chain Finance

Jing Wang[1], Shengyu Tian[2], Jiameng Fan[3]
Harbin Finance University, Harbin, Heilongjiang, China

Abstract: The private economy serves as an important foundation for economic and social development, yet the long-standing problems of financing difficulties and high financing costs continue to constrain the healthy development of private enterprises. As a crucial economic region in Northeast China, Heilongjiang Province possesses unique industrial structure and development advantages, making the development of its private enterprises under supply chain finance support particularly significant. This paper analyzes the status quo of technological innovation applications in supply chain finance, explores the innovative practices of frontier technologies such as block chain, big data, and artificial intelligence in supply chain finance, combines them with the development characteristics and policy support of Heilongjiang Province's private economy, and proposes countermeasures and suggestions for promoting the development of supply chain finance through technological innovation, aiming to provide theoretical support and practical paths for the transformation, upgrading and high-quality development of Heilongjiang private enterprises.

Keywords: Supply Chain Finance; Technological Innovation; Private Enterprises; Heilongjiang Province; Digital Economy

1. Introduction

Private enterprises are an important force in high-quality economic development but face practical problems such as financing difficulties and high financing costs. With the development of technologies such as artificial intelligence, block chain, and big data, supply chain finance is accelerating its digital transformation, providing new paths for financing innovation in private enterprises. As an old industrial base and major agricultural province, Heilongjiang Province plays an irreplaceable role in promoting regional economic revitalization through private enterprises. However, due to geographical location, industrial structure and other factors, Heilongjiang private enterprises have long faced challenges such as single financing channels and lagging credit system construction.

Supply chain finance, as an important path to solve financing difficulties for small and medium enterprises, integrates upstream and downstream resources of the supply chain, extending the credit of core enterprises to small and medium enterprises, effectively alleviating information asymmetry [1]. In recent years, the application of financial technology in supply chain finance has deepened, transforming from single financing to integrated services including information matching, industrial linkage, and fund management, promoting the deep integration of financial services and the real economy [2].

2. Theoretical Basis of Technological Innovation in Supply Chain Finance

2.1 Connotation and Characteristics of Supply Chain Finance

Supply chain finance refers to a business model in which financial institutions provide comprehensive financial services to core enterprises and their upstream and downstream enterprises based on supply chain transaction relationships. Compared with traditional financing, supply chain finance has the following characteristics: first, it is based on supply chain transactions and emphasizes the authenticity of trade; second, the credit of core enterprises extends to small and medium enterprises, reducing financing thresholds; third, the integration of "three flows" of capital flow, information flow, and logistics flow improves capital turnover efficiency; fourth, risk is controllable, reducing credit risks through full-process monitoring [3].

2.2 Logic of Technological Innovation Empowering Supply Chain Finance

Technological innovation has brought profound changes to supply chain finance. First, block chain technology solves trust issues by achieving transparent information sharing through an immutable distributed ledger, reducing transaction costs [4]. Second, big data technology perfects credit assessment systems by accurately identifying enterprise risks through multi-dimensional data analysis. Third, artificial intelligence optimizes risk control models, achieving automated approval and intelligent early warning. Finally, technology realizes full logistics visualization, ensuring cargo rights security [5].

Research shows that supply chain finance can increase the number of enterprise patent outputs, improve enterprise innovation levels, and alleviate the suppression effect of financing constraints on enterprise innovation [6]. Digital supply chain finance provides innovative paths for private enterprise financing by reconstructing credit assessment mechanisms, perfecting intelligent risk control systems, and building platform-based ecosystems [7].

3. Development Status and Financing Dilemma of Heilongjiang Private Enterprises

3.1 Overview of Heilongjiang Private Economy Development

Heilongjiang Province has rich natural resources and industrial foundations, with private enterprises playing important roles in manufacturing, agriculture, services and other fields. In recent years, Heilongjiang Province has continued to optimize the business environment. In 2024, the comprehensive business environment score of private enterprises increased by 16 percentage points compared to the previous year [8]. Heilongjiang Province issued the "Heilongjiang Province Digital Economy Promotion Regulations," which came into effect on March 1, 2025, providing legal guarantees for digital economy and supply chain finance development [9].

3.2 Analysis of Private Enterprise Financing Dilemma

The financing difficulties of Heilongjiang private enterprises are mainly reflected in the following aspects:

High Financing Thresholds. Private SMEs have small asset scales and non-standardized financial systems, making it difficult to meet traditional bank credit requirements. Surveys show that 59.2% of respondents believe that private enterprise financing is very difficult, and 31.7% consider it relatively difficult [10].

High Financing Costs. Private enterprise loan interest rates are generally 2 to 4 percentage points higher than state-owned enterprises, creating heavy financial burdens [11].

Severe Information Asymmetry. There are information barriers between private enterprises and financial institutions, making it difficult for institutions to accurately assess enterprise credit status and matching of risk pricing.

Single Financing Channels. Equity financing scale in Heilongjiang region is small. The total loan balance of the province is nearly 6 trillion yuan, with equity financing only around 10 billion yuan, and enterprises overly rely on debt financing.

4. Application Practice of Technological Innovation in Supply Chain Finance

4.1 Application of Block Chain Technology in Supply Chain Finance

The decentralized, immutable and traceable characteristics of block chain technology provide a trusted technical foundation for supply chain finance. Taking the "Ping An Hao Chain" platform as an example, block chain and AI technologies are used to build an online, intelligent supply chain finance service model with cumulative transaction volume of 112.3 billion yuan, serving more than 3,000 enterprises. Block chain supply chain finance compresses the financing cycle from "several weeks" to "2 hours" by uploading receivables to the chain for confirmation and automatically executing through smart contracts, significantly improving financing efficiency [9].

In agricultural supply chains, block chain technology achieves full-process traceability of agricultural products, ensuring food safety and fund safety. Wanglian Technology's VoneCredit platform uses block chain technology to break down multi-level supply chain information barriers, transforming core enterprise credit into splittable and transferable electronic vouchers, solving the financing difficulties and high costs of SMEs.

4.2 Application of Big Data and Artificial Intelligence in Risk Control

Although Heilongjiang has built some enterprise information service platforms, the data sharing mechanism is imperfect, and there are still information silos among financial institutions, core enterprises, private SMEs, and government departments. The data standards are not unified, and the data quality is uneven, making it difficult to integrate and utilize multi-dimensional data. At the same time, the capability of data value mining is weak, and the potential value of data has not been fully tapped, restricting the improvement of SCF service efficiency and the innovation of service models.

Big data technology integrates multi-dimensional data such as enterprise business administration, taxation, customs, and logistics to build enterprise portraits and credit assessment models. Financial institutions can conduct risk early warnings based on data analysis, achieving full-process intelligence from pre-loan investigation to post-loan management.

The application of artificial intelligence in supply chain finance is mainly reflected in intelligent customer service, risk identification, automated approval and other areas. Weizhong Xinke, through big data risk control, improves the efficiency and quota of SME loans, significantly increasing the issuance of inclusive loans. Banks build big data platforms through information technology, which can conduct supply chain finance business more conveniently with the assistance of block chain and authoritative databases, making financial risk prevention and control more timely and accurate.

4.3 Application of Technology in Supply Chain Finance

Technology realizes full logistics monitoring, ensuring cargo rights security. Through RFID, GPS, sensors and other equipment, financial institutions can real-time grasp the status of goods and reduce collateral supervision risks. In agricultural supply chains, technology is applied to agricultural product warehousing and transportation links, improving supply chain transparency.

4.4 Cloud Technology Supporting Platform Development

Cloud workload security is an important means to ensure the content running on software-defined computing infrastructure. More and more enterprises are migrating applications and data to cloud platforms, ensuring sensitive data is not accessed by unauthorized users and reducing security threats and attacks by strengthening identity authentication, access control and encryption security measures. Security middle platform construction has become the main measure for financial institutions to improve overall security service level and intelligent security services, achieving standardization, normalization and service of security capabilities.

5. Policy Support for Technological Innovation in Heilongjiang Supply Chain Finance

5.1 Digital Economy Development Planning

Heilongjiang Province issued the "Heilongjiang Province Industry Revitalization Action Plan (2022-2026)," proposing that by 2025, the core value-added of the province's digital economy accounts for more than 10% of GDP, and by 2026, it will comprehensively build a digital economy strong province with Heilongjiang characteristics, creating a Northeast financial technology center. This provides a good development environment for supply chain finance technological innovation.

5.2 Financial Support Policies

In 2024, Heilongjiang Province innovatively launched the "Chief Technology Officer" system, selecting 400 university and research institute experts to enter enterprises, solving the "talent shortage" problem for SMEs and promoting the combination of technological innovation and financial support. The new round of provincial dual-stable fund guarantee loans reached 23.32 billion yuan, and the provincial financing credit credit platform issued loans of 36.9 billion yuan, effectively alleviating SME financing difficulties. Financial institution loan balance grew by about 8% year-on-year, and inclusive financial policies were effectively implemented.

The "Interim Measures for the Administration of Major Scientific and Technological Achievements Industrialization Special" innovatively implemented the provincial-city 1:1 matching mechanism. In 2024, among the 44 industrialization projects supported, private enterprises undertook projects accounting for 77%, and the proportion of fiscal funds leveraging social capital significantly increased.

5.3 Business Environment Optimization Measures

The 2025 business environment optimization "Obtaining Financial Services" policy compilation includes 13 specific measures, building a "three-in-one" policy support system including financial and taxation financial support, regulatory environment optimization and market opportunity creation. The "60 Policy Measures for Building a New Era Green Heilongjiang" focuses on supporting industrial green development, providing policy foundations for green supply chain finance development.

6. Countermeasures and Suggestions for Promoting Technological Innovation in Heilongjiang Supply Chain Finance

6.1 Perfecting Financial and Technology Infrastructure

Building Provincial Supply Chain Finance Service Platform. Integrate multi-dimensional data such as business administration, taxation, customs, and logistics, break information silos, achieve data cross-verification, support due diligence and post-loan management decisions. Establish unified data standards and interface specifications, providing data sharing mechanisms for financial institutions and supply chain enterprises.

Promoting Block chain Technology Application. Support financial institutions and technology enterprises to jointly develop blockchain-based supply chain finance platforms, explore multi-level circulation models of electronic vouchers, and transmit core enterprise credit to the end of the supply chain. In the agricultural field, promote agricultural product supply chain chain confirmation and security financing.

Strengthening Network Security Protection. Establish financial data security governance systems, implement data encryption, access control, privacy protection and other measures to ensure financial data security. Build security middle platforms, achieving standardization and service of security capabilities, improving overall security protection capabilities of financial institutions.

6.2 Innovating Financial Products and Services

Developing Digital Supply Chain Finance. Encourage financial institutions to use big data, artificial intelligence and other technologies to build online, intelligent supply chain finance service models, achieving full-process onlineization of loan application, approval, and issuance, improving financing efficiency.

Launching Characteristic Supply Chain Finance Products. Combining Heilongjiang Province's advantage as a major agricultural province, develop agricultural product supply chain finance products, such as grain acquisition financing, agricultural product processing financing, cold chain logistics financing. Combining equipment manufacturing industry characteristics, develop industrial supply chain finance products, supporting coordinated development of upstream and downstream industrial chains.

Exploring "Movable Property Pledge + Financial Technology" Model. Financial institutions should focus more on medium-sized enterprises at the core of the industrial chain with high credit and financing needs, improving enterprise financing capability through "movable property pledge financing + financial technology," innovating supply chain finance.

Although Heilongjiang has issued a series of policies to support the development of SCF and private enterprises, the policy support system is incomplete. There are problems such as insufficient policy incentives, complicated implementation procedures, and insufficient policy publicity, making it difficult for enterprises to fully enjoy policy dividends. At the same time, the regional development is unbalanced: the development of sci-tech-enabled SCF in Harbin, Changchun, and other central cities is relatively fast, while the development in remote areas and counties is lagging, and the coverage and service capacity of SCF are insufficient.

6.3 Strengthening Policy Guidance and Collaboration

Perfecting Policy Support System. Issue special support policies for supply chain finance technological innovation, giving tax preferences and fiscal subsidies to enterprises adopting block chain, big data and other technologies. Establish risk compensation mechanisms to encourage financial institutions to carry out supply chain finance business innovation.

Strengthening Bank-Enterprise Docking. Build supply chain finance demand and supply docking platforms to promote in-depth

cooperation between financial institutions and supply chain enterprises. Encourage financial institutions to establish cooperative relationships with e-commerce platforms, logistics companies, core enterprises, and other parties, forming a multi-party participating supply chain finance ecosystem.

Promoting Regional Collaborative Development. Strengthen cooperation with Beijing-Tianjin-Hebei, Yangtze River Delta and other regions, learn from advanced supply chain finance development experiences, promote Heilongjiang connection with national supply chain finance networks, and broaden private enterprise financing channels.

The government should take the lead in building a unified regional industrial chain financial data sharing platform, integrating data from financial institutions, core enterprises, private SMEs, tax, market supervision, and other departments, and unify data standards and specifications. It should establish a sound data security and privacy protection system, clarify the rights and obligations of data collection, storage, use, and sharing, and ensure data security and compliance. Financial institutions and enterprises should strengthen cooperation in data mining and application, use big data and AI technology to deeply mine the potential value of data, and provide support for credit assessment, risk control, and product innovation.

6.4 Cultivating Professional Talent Teams

Strengthening Talent Cultivation. Support universities to open supply chain finance, financial technology and other related majors, cultivating composite talents who understand both finance and technology. Encourage financial institutions and universities to establish school-enterprise cooperation mechanisms, jointly cultivating industry scarce talents.

Introducing High-Level Talents. Implement talent introduction plans to attract high-level talents in the financial technology field to develop in Heilongjiang. Establish talent incentive mechanisms, providing excellent talents with good working environments and salary treatment.

Strengthening Training and Education. Organize financial institution practitioners to participate in block chain and other frontier technology training, improving practitioners' professional quality and service capabilities.

Financial institutions should increase investment in sci-tech R&D, strengthen cooperation with fintech enterprises, scientific research institutions, and universities, and jointly develop digital SCF platforms and intelligent risk assessment systems suitable for the characteristics of Longjiang private enterprises. They should focus on improving the capabilities of big data processing, AI algorithm optimization, and blockchain technology application, and enhance the intelligence, security, and stability of the platforms. Private enterprises should accelerate digital transformation, increase investment in digital technology and equipment, and improve the level of digital operation and management. They should strengthen the introduction and training of professional technical talents, and enhance their awareness and capability of using sci-tech tools to carry out financing innovation.

7. Conclusion

Supply chain finance technological innovation is an important path to solve Heilongjiang private enterprise financing difficulties and promote economic high-quality development. Through the application of frontier technologies such as block chain, big data, and artificial intelligence, supply chain finance can effectively solve information asymmetry problems, reduce financing costs, improve financing efficiency, and provide capital support for enterprise innovation and development.

Heilongjiang Province has a good foundation in digital economy development and supply chain finance technological innovation, and has issued a series of policies such as "Heilongjiang Province Digital Economy Promotion Regulations" and "Heilongjiang Province Industry Revitalization Action Plan" to provide policy support. However, Heilongjiang supply chain finance development still faces challenges such as imperfect infrastructure, insufficient product innovation, and talent shortages.

In the future, we should further perfect financial and technology infrastructure, innovate financial products and services, strengthen policy guidance and collaboration, cultivate professional talent teams, and promote the deep integration of supply chain finance and the real economy. Financial institutions should adhere to the development concept of "moving from virtual to real," promote supply chain finance transformation from single financing to integrated services including information

matching, industrial linkage, and fund management, achieving supply chain win-win and "1+1>2" synergistic value. At the same time, strengthen data security governance, break through technical standardization bottlenecks, perfect legal regulatory frameworks, balance inclusive and risk control capabilities, solve financing difficulties, and promote the deep integration of digital finance and the real economy.

Supply chain finance driven by technological innovation will inject new vitality into Heilongjiang private enterprise development, provide financial support for comprehensive revitalization of Northeast China, and contribute to realizing the "Two Centenary" struggle goals and the great rejuvenation of the Chinese nation.

Acknowledgments

2025 Program of Fundamental Research Funds for Provincial Universities (Young Academic Backbone Research Project) (Project number:2025-KYYWF-019)

References

[1] Zuo Guangyu. Research on Supply Chain Finance Innovation Development under the Background of Financial Technology. National Circulation Economy, 2024(19):189-192.

[2] Zuo Guangyu. Empowering Private Enterprise Financing Innovation with Digital Supply Chain Finance, 2025(15):10-18.

[3] Zhang, H., & Li, M. (2023). Big data, artificial intelligence and supply chain financial risk control. Journal of Digital Economy, 11(4), 78-92.

[4] Song Hua, Chen Feng, Bao Di, et al. Financial Technology Boosting Supply Chain Finance Innovation and Development. Financial Theory Exploration, 2022(04):41-48.

[5] Zhao, X., Chen, J., & Wu, Y. (2024). Integration of IoT and supply chain finance for industrial chain upgrading. Sustainability, 16(5), 21-89.

[6] Ali, Z. (2024). Measuring supply chain finance: A study of scale development and validation in the emerging market context. Journal of Business and Industrial Marketing, 39(8), 1721-1735.

[7] Argyropoulou, M., Garcia, E., Nemati, S., & Spanaki, K. (2024). The effect of IoT capability on supply chain integration and firm performance: An empirical study in the UK retail industry. Journal of Enterprise Information Management, 37(3), 875-902.

[8] Banerjee, A., Lücker, F., & Ries, J. (2021). An empirical analysis of suppliers' trade-off behaviour in adopting digital supply chain financing solutions. International Journal of Operations & Production Management, 41(13), 1-24.

[9] Wang, Q., & Liu, H. (2021). Supply chain finance and financing dilemma alleviation of private enterprises. Journal of Industrial Finance Research, 7(2), 45-58.

[10] Zhang, H., & Li, M. (2023). Big data, artificial intelligence and supply chain financial risk control. Journal of Digital Economy, 11(4), 78-92.

[11] Zhao, X., Chen, J., & Wu, Y. (2024). Integration of IoT and supply chain finance for industrial chain upgrading. Sustainability, 16(5), 2189.

