

Supply Chain Finance and High-Quality Development of Specialized, Sophisticated, Distinctive, and Innovative Enterprises: A Discussion from the Perspective of "Capital + Technology" Dual-Wheel Drive

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ABSTRACT

As vanguards of industrial chain innovation, the high-quality development of specialized, sophisticated, distinctive, and innovative enterprises relies on the synergistic advancement of capital guarantee and technological breakthrough. By activating credit resources in the industrial chain, supply chain finance can not only alleviate financing constraints on the capital side of enterprises but also optimize resource allocation on the technology side through digital technologies, forming an enabling path of "capital + technology" dual-wheel drive. From the perspective of dual-wheel drive, this paper systematically analyzes the mechanism by which supply chain finance promotes the high-quality development of specialized, sophisticated, distinctive, and innovative enterprises, and proposes targeted optimization strategies based on practical status and bottlenecks, aiming to provide theoretical reference for addressing the dual predicament of "difficult financing" and "slow technology transformation" faced by these enterprises.

KEYWORDS

Supply chain finance; Specialized, Sophisticated, distinctive, and innovative enterprises; High-quality development

1 Introduction

Against the backdrop of the country's in-depth implementation of the innovation-driven development strategy, specialized, sophisticated, distinctive, and innovative enterprises, as a core force in "strengthening weak links" and "forging strong points" in the industrial chain, have seen their high-quality development elevated to a national strategy. At the policy level, the Central Financial Work Conference explicitly regarded sci-tech finance as the top priority among the "five key areas." Documents such as *Opinions on Regulating and Developing Supply Chain Finance to Support the Stable Circulation and Optimal Upgrading of Supply Chains and Industrial Chains* require strengthening credit transmission in the industrial chain through supply chain finance. Meanwhile, special policies issued by Shenzhen, Xiamen, and other regions have further detailed the implementation paths, such as the construction of digital supply chain finance platforms and credit empowerment of core enterprises.

However, due to their characteristics of "light assets, high R&D investment, and strong integration into the industrial chain," specialized, sophisticated, distinctive, and innovative enterprises face pain points in financing, such as insufficient traditional collateral and difficulty in quantifying technological value. The "capital + technology" dual-wheel drive model of supply chain finance precisely addresses this predicament: on the one hand, it realizes transaction data penetration and multi-level credit circulation relying on technologies such as blockchain and big data, alleviating enterprises' financing constraints; on the other hand, it links the technological needs of core enterprises through supply chain platforms, promoting precise alignment of R&D achievements with application scenarios and accelerating technology transformation.

2 Explanation of relevant concepts

2.1 Supply chain finance

Supply chain finance is a model that provides precise financial services for upstream and downstream enterprises by relying on real transaction scenarios in the industrial chain and integrating capital flow, information flow, and logistics. Its core lies in addressing the financing difficulties of small and medium-sized enterprises caused by light assets and information asymmetry through credit transmission of core enterprises. Common forms include accounts receivable financing, inventory financing, and prepayment financing. With the development of digital technologies, in-depth integration of blockchain, big data, and the Internet of Things has enabled penetrative management of transaction data, multi-level credit circulation, and dynamic risk monitoring, giving rise to innovative models such as digital warehouse receipts, bill pools, and supply chain ABS. It not only alleviates the short-term capital pressure of small and medium-sized

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enterprises but also optimizes the efficiency of capital allocation, strengthens industrial chain collaboration, promotes the formation of a symbiotic ecosystem between core enterprises and supporting enterprises, and thus serves as an important financial tool for smoothing the domestic circulation and stabilizing industrial and supply chains.

2.2 Specialized, sophisticated, distinctive, and innovative enterprises

Specialized, sophisticated, distinctive, and innovative enterprises refer to small and medium-sized enterprises with the characteristics of "specialization, sophistication, distinctiveness, and innovation." They focus on niche markets, master core technologies, and serve as key links in the industrial and supply chains. "Specialization" is reflected in their focus on specific niche areas with high precision in products or services; "sophistication" manifests in lean and efficient production management and strict quality control; "distinctiveness" refers to their possession of unique technologies, techniques, or products with differentiated competitive advantages; "innovation" highlights their high R&D investment, large number of patents, and ability to break through key technological bottlenecks. Most of these enterprises are deeply engaged in manufacturing and strategic emerging industries. Though not necessarily large in scale, they hold a high market share in niche markets and serve as an important force in "strengthening and supplementing industrial chains." Particularly in fields such as chips, high-end equipment, and new materials, they undertake the mission of solving "bottleneck" problems. Through policy systems such as cultivating "little giant" enterprises (specialized, sophisticated, distinctive, and innovative), the state promotes them to become a new force in innovation-driven development, which not only activates the vitality of market entities but also provides solid support for the upgrading of China's industrial chains to the high end.

3 The "capital + technology" dual-wheel drive mechanism of supply chain finance

3.1 Capital drive: breaking financing constraints through industrial chain credit

Supply chain finance has established a differentiated financing path for specialized, sophisticated, distinctive, and innovative enterprises through multi-level transmission of core enterprises' credit. Relying on models such as accounts receivable confirmation, these enterprises can convert transaction credit with core enterprises into financing credit, breaking the financing bottleneck of "light assets and lack of collateral." For the "short, frequent, and urgent" capital needs in R&D and production, scenario-based products like order financing and R&D equipment leasing achieve precise matching between capital supply and demand. Moreover, the replacement of traditional collateral by industrial chain credit further reduces the risk premium in pricing, optimizing enterprises' financing costs at the source.

3.2 Technology drive: activating innovation momentum through digital technologies

Digital technologies provide key support for supply chain finance to empower innovation in specialized, sophisticated, distinctive, and innovative enterprises. Big data and the Internet of Things integrate transaction data across the industrial chain, enabling accurate evaluation of technological elements such as enterprises' patent value and R&D progress, thus solving the problem of difficult pricing of technological assets. The immutability of blockchain realizes efficient confirmation and splitting of accounts receivable, accelerating capital turnover to support technological iteration. Furthermore, supply chain platforms connect the technological needs of core enterprises with the supply capacity of specialized, sophisticated, distinctive, and innovative enterprises, promoting the rapid transformation of R&D achievements into industrial application scenarios.

3.3 Dual-wheel synergy: building a dynamic balanced cycle of capital and technology

The synergistic interaction between capital and technology forms a sustainable development loop. The stable capital flow provided by supply chain finance injects continuous "blood" into enterprises' R&D investment, ensuring the long-term advancement of technological innovation. In turn, the improvement of enterprises' technological innovation capabilities enhances their credit status in the industrial chain, which feeds back into increased financing availability and quota. Supply chain finance acts as a bridge through digital platforms to realize dynamic matching between capital flow and technology flow—for example, phased financing based on R&D stage achievements, aligning the rhythm of capital input with the nodes of technological breakthroughs.

4 Practical bottlenecks in supply chain finance empowering high-quality development of specialized, sophisticated, distinctive, and innovative enterprises

4.1 On the capital side: limited effectiveness of financing empowerment

Obstacles on the capital side directly restrict the support of supply chain finance for specialized, sophisticated, distinctive, and innovative enterprises. Firstly, there is a structural disruption in credit transmission. Core enterprises, due to risk aversion and management costs, generally have low willingness to provide credit endorsements for upstream and downstream specialized, sophisticated, distinctive, and innovative enterprises, making it difficult for industrial chain credit to extend to the end. Meanwhile, small and medium-sized enterprises often face problems such as lengthy processes and delayed confirmation from core enterprises when confirming accounts receivable, due to fragmented transaction documents and lack of standardized records of cooperative relations, leading to frequent interruptions in the credit transmission chain. Secondly, there is a mismatch between product systems and enterprise needs. Traditional supply chain financial products are mostly designed based on tangible asset collateral, focusing on short-term capital turnover in the production link, which cannot match the characteristics of specialized, sophisticated, distinctive, and innovative enterprises, such as long R&D cycles, large investment, and high risks. For instance, the R&D stage lacks stable cash flow support but requires continuous capital input, while existing products fail to provide full-cycle coverage. Thirdly, the risk management system is lagging. Rapid technological iteration and volatile market demand are prominent features of specialized, sophisticated, distinctive, and innovative enterprises. However, financial institutions lack quantitative evaluation models for technology obsolescence risks and R&D failure risks, still relying on traditional financial indicators for risk pricing. This excludes some high-potential but temporarily unprofitable enterprises from services, exacerbating financing exclusion.

4.2 On the technology side: weak foundation for digital empowerment

Shortcomings on the technology side weaken the catalytic role of supply chain finance in enterprise innovation. Firstly, there is a "last-mile" obstacle in digital infrastructure. Most specialized, sophisticated, distinctive, and innovative enterprises are small and medium-sized enterprises. Restricted by capital and talent, their digital transformation progress is slow, and production and R&D data have not been systematically accumulated. At the same time, enterprises are reluctant to open data to supply chain platforms due to concerns about leakage of commercial secrets, making it difficult to form a complete closed loop of industrial chain data and lacking basic support for big data analysis. Secondly, technological assets are difficult to convert into financing credit. Intangible assets such as patents and proprietary technologies are the core value of specialized, sophisticated, distinctive, and innovative enterprises. However, these assets have characteristics such as difficulty in valuation, realization, and rapid depreciation. The existing evaluation system lacks unified standards, making it difficult for financial institutions to include them in the collateral system, and thus technological advantages cannot be effectively converted into financing capacity. Thirdly, there is fragmentation in the platform ecosystem. Data interfaces between supply chain finance platforms, enterprise R&D management systems, and industrial chain collaboration platforms are incompatible, resulting in prominent information silos. This prevents key information such as R&D progress and technological achievements from being transmitted to financial institutions in real time, making it difficult to dynamically match capital support with technological innovation needs.

4.3 In terms of dual-wheel synergy: lack of systematic synergy

Insufficient synergy between capital and technology hinders the full release of the dual-wheel drive effect. On one hand, policy tools lack linkage mechanisms. Current fiscal subsidies mostly focus on technological R&D links (such as additional deductions for R&D expenses), while financial support emphasizes the expansion of financing scale. There is a lack of connection between the two in support nodes and intensity. For example, if follow-up capital fails to keep up after enterprises receive R&D subsidies, technological achievements may be aborted. Meanwhile, financial institutions lack fiscal risk-sharing support, limiting their enthusiasm for lending to high-risk R&D projects. On the other hand, there are barriers to collaboration among market entities. An effective mechanism for benefit sharing and risk co-sharing has not been established among financial institutions, core enterprises, and specialized, sophisticated, distinctive, and innovative enterprises. Financial institutions tend to tighten credit due to concerns about bad debts caused by technological failure; core enterprises are unwilling to bear joint liability, resulting in low participation in industrial chain finance; specialized, sophisticated, distinctive, and innovative enterprises, due to weak negotiating positions, struggle to secure favorable cooperation terms. This fragmented pattern makes it difficult for capital flow and technology flow to form a mutually reinforcing virtuous cycle, severely undervaluing the systemic value of supply chain finance.

5 Optimization paths for supply chain finance to empower high-quality development of specialized, sophisticated, distinctive, and innovative enterprises

5.1 Governments should build a policy synergy ecosystem

Governments need to play a core role in policy guidance and ecosystem building to form a multi-dimensional support system. In terms of policy tool innovation, a special risk compensation fund for supply chain finance should be established to share bad debts for financial institutions' financing businesses supporting R&D of specialized, sophisticated, distinctive, and innovative enterprises. Meanwhile, interest subsidy policies should be implemented for eligible R&D-oriented financial products to reduce enterprises' financing costs and financial institutions' risk exposure. In digital infrastructure, governments should take the lead in building an industrial chain-wide data sharing platform, integrating government data from taxation, customs, and intellectual property sectors with industrial chain transaction data. By enabling "data to flow instead of enterprises to run," the problem of information silos can be solved. Additionally, national standards for evaluating the technological value of specialized, sophisticated, distinctive, and innovative enterprises should be formulated promptly, clarifying the evaluation processes, parameter systems, and realization mechanisms for intangible assets such as patents and proprietary technologies. This provides institutional basis for financial institutions to accept technological assets as collateral, promoting the conversion of technological advantages into financing credit.

5.2 Financial institutions should innovate dual-wheel enabling products

Financial institutions need to break through traditional service models and build a financial product system adapted to the characteristics of specialized, sophisticated, distinctive, and innovative enterprises. Targeting these enterprises' long R&D cycles and light-asset features, technology-oriented products such as "R&D-stage order financing" and "financing based on expected proceeds from patent licensing fees" should be developed. These products move the financing node forward to the early R&D stage, with expected returns from technological achievements as the source of repayment. Financial institutions should deepen the application of digital technologies in risk control and services. AI models can be used to integrate enterprises' R&D data, patent data, and industrial chain transaction data, dynamically evaluating the speed of technological iteration and commercialization potential. This realizes a shift in risk control from "focusing on collateral" to "focusing on technology and data." Meanwhile, a multi-party risk-sharing mechanism should be built: signing risk-sharing agreements with core enterprises, introducing professional guarantee institutions to enhance credit for R&D projects, and dispersing risks of R&D failure and market fluctuations through the "financial institution + core enterprise + guarantor" risk-sharing model.

5.3 Enterprises should enhance dual-wheel synergy capability

Specialized, sophisticated, distinctive, and innovative enterprises should proactively strengthen internal management and external collaboration to improve the effectiveness of using supply chain finance. In internal management, standardized management systems for transaction and R&D data should be established, regulating processes such as contract signing, invoice issuance, and R&D progress recording. Through data traceability, credit transparency can be enhanced, providing clear basis for financial institutions' evaluation. In industrial chain collaboration, enterprises should take the initiative to integrate into core enterprises' supply chain systems, leveraging their technological problem-solving capabilities to secure long-term cooperation agreements with core enterprises. This converts technological advantages into credit endorsement resources, enabling access to financing support through core enterprises' credit transmission. Enterprises should accelerate digital transformation, deploy industrial internet platforms, and realize data interconnection and sharing across R&D, production, and supply chain transactions. This not only improves their own operational efficiency but also provides real-time data support for supply chain finance platforms, facilitating precise matching between capital flow and technology flow.

5.4 Industrial chains should build collaborative development networks

All parties in the industrial chain need to break down barriers and form a symbiotic and win-win collaborative ecosystem. Core enterprises should play their role as "chain leaders," proactively opening up credit resources to provide credit support such as accounts receivable confirmation and order certification for upstream and downstream specialized, sophisticated, distinctive, and innovative enterprises. Meanwhile, through supply chain platforms, core enterprises should release lists of technological needs, promoting precise alignment between supporting enterprises' R&D directions and industrial chain upgrading needs. Efforts should be made to cultivate third-party professional service institutions: supporting technology evaluation institutions to develop intangible asset valuation businesses, encouraging data credit

reporting institutions to build credit evaluation models for specialized, sophisticated, distinctive, and innovative enterprises, and guiding supply chain management companies to provide integrated services covering logistics, information flow, and capital flow. Through professional division of labor, the cost of industrial chain collaboration can be reduced, enabling the capital and technology empowerment of supply chain finance to achieve synergy in a more efficient ecosystem.

6 Conclusion

Supply chain finance empowers the high-quality development of specialized, sophisticated, distinctive, and innovative enterprises through the "capital + technology" dual-wheel drive. It is not only a key path to address enterprises' financing constraints and technology transformation dilemmas but also an important link to strengthen industrial chain collaborative innovation. Currently, bottlenecks such as poor credit transmission on the capital side, weak digital infrastructure on the technology side, and insufficient dual-wheel synergy restrict the full release of this empowering effect. To address these issues, multi-dimensional measures are needed: governments building a policy synergy ecosystem, financial institutions innovating dual-wheel enabling products, enterprises enhancing internal and external collaboration capabilities, and industrial chains creating symbiotic networks. Only in this way can capital flow and technology flow be efficiently coupled in the industrial chain. This not only provides a new paradigm of financial support for the innovative development of small and medium-sized enterprises but also holds significant practical significance for consolidating the resilience of industrial and supply chains and facilitating the implementation of strategies for building a strong manufacturing country and a strong science and technology country.

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