

Credit Risks and Innovative Models in Commercial Bank Supply Chain Finance

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Abstract. This paper focuses on the credit risk of the commercial banks' supply chain finance business. It traces the concept, theory, and three stages of development of the supply chain finance, analyzes three main models for Chinese commercial banks—the inventory, accounts receivable, and prepayments—and identifies two core credit risks: excessive reliance on the credit of core enterprises and fluctuations in the value of collateralized inventory. Using the Agricultural Bank of China's "Chain-Link Loan" as an example, this paper analyzes its product content and risk control methods based on a "high entry threshold + electronic business platform," and proposes optimization suggestions. Commercial banks should accelerate the digitalization of their business, build risk control systems based on big data, raise the entry standards for core enterprises and financing enterprises, and improve their post-loan management systems. Through comprehensive risk control, they can reduce credit risk and promote the sustainable development of supply chain finance.

Keywords: Supply Chain Finance, Credit Risks, Financing Models

1. Introduction

Supply chain finance is an innovative financing model that integrates industrial scenarios and financial services, relies on the real business environment of the industrial chain and the credit transmission mechanism of core enterprises to integrate the logistics, information capital and so on in the supply chain process, effectively utilization the existing assets of small and medium-sized enterprises (SMEs) such as accounts receivable, inventory and orders, and solve the difficulties of financing for SMEs. It is an important practical carrier for the implementation of inclusive finance [1]. In the context of China's high-quality economic development, supporting the development of SMEs has been included in the national strategic layout. As a key financial tool for serving the real economy and smoothing the circulation of the industrial chain, the strategic value of supply chain finance is becoming increasingly prominent [2]. In recent years, the Chinese government has issued relevant documents to support the development of supply chain finance, such as the "Opinions on Standardizing the Development of Supply Chain Finance to Support the Stable Circulation and Optimization Upgrading of the Supply Chain Industry Chain" and "Several Measures to Accelerate the Integration of Domestic and Foreign Trade Development". They illustrate the importance of the development of supply chain finance, as they provide guidance for the standardized development

and innovation of supply chain finance, emphasizing the development of diversified financial support measures to achieve high-quality development of industrial finance.

Traditional supply chain finance relies on core enterprises, with commercial banks providing funds and linking upstream and downstream SMEs in the supply chain to launch suitable financing businesses. It utilizes the overall credit of the supply chain to improve capital turnover efficiency and enhance the stability of supply chain operation [3]. Although this model has alleviated the financing difficulties of some SMEs, the deficiencies in risk management and supervision of commercial banks as fund providers have become increasingly apparent. Credit risk is a common problem in commercial banks' supply chain finance business. Any link in supply chain financing may trigger this risk, such as high dependence on the credit of core enterprises and changes in the value of inventory collateral. Credit risk management for SMEs has become an important aspect of commercial banks' risk management. Establishing an effective credit assessment and risk warning mechanism is the key for commercial banks to manage the credit risk of SMEs in the supply chain [4].

This paper will review the relevant theoretical concepts of the development of supply chain finance in commercial banks, analyze the credit risks of commercial bank supply chain finance business, take the supply chain finance model of Agricultural Bank of China as an example, explore its business innovation methods, and provide suggestions for the credit risk prevention and management of supply chain finance financing models.

2. Relevant concepts and theoretical foundations

2.1. Definition of supply chain finance

Supply chain finance is a new financing model led by financial institutions, which exists between enterprises with transactional relationships in the industrial supply chain [5]. It is different from the traditional single enterprise credit evaluation model, but constructs an enterprise credit evaluation system that covers the entire supply chain. With the credit support of core enterprises, it binds the credit of small and medium-sized enterprises with the credit of core enterprises to carry out joint credit. Provide low-cost, high-efficiency, and security financing services for SMEs. Commercial banks should pay attention to long-term development trends in supply chain financial services and provide smoother financial services for transactions between core enterprises and their upstream and downstream enterprises [6].

2.2. Definition of supply chain finance risks

In the supply chain finance business of commercial banks, credit risk is obvious and the occurrence of risk is not limited by the business stage. Due to the high correlation between upstream and downstream enterprises of core enterprises in the supply chain, credit risk will have transmission characteristics following the development of business in the supply chain. Core enterprises, SMEs and logistics companies form a close network. Problems at any node may trigger systemic risk fluctuations. Any default behavior of the participants will increase the credit risk faced by commercial banks. This chain transmission characteristic makes risk management crucial [7]. Therefore, the credit risks faced by commercial banks mainly include: the deterioration of the credit of core enterprises leading to the invalidation of endorsements, the instability of SME operations, high default rates, false trade backgrounds, information asymmetry, and systemic credit risks caused by industry cycle fluctuations.

2.3. The theory of trade-backed financing

The theory of trade self-liquidating financing, also known as the real bill theory, is a short-term financing business provided by banks based on real trade background. The loan term matches the turnover cycle of the financing enterprise. The sales revenue and accounts receivable generated by trade behavior serve as the exclusive first source of repayment, and it has the characteristics of closed-loop self-liquidation. Its main feature is that when the financing enterprise itself has weak credit, if its upstream and downstream enterprises have good credit, sound finances, and low operating risks, it can obtain financing by relying on the credit of the core enterprise in the supply chain [8]. This theory has obvious defects. First, there is information asymmetry, such as intentional mutual guarantee or collusion in fraudulent behavior between core enterprises and their upstream and downstream enterprises, it will directly lead to financing arbitrage credit risk. Second, it excludes medium and long-term credit, and the timely and short-term credit needs of financing enterprises are more likely to face procyclical risks. Thirdly, both commercial banks and financing enterprises rely too much on the strength and credit rating of core enterprises.

3. The development of supply chain finance

The first stage is the initial stage of supply chain finance development, which is manifested in the traditional offline "1+N" model. Commercial banks take the credit of the core enterprise "1" as the core and review the financing needs of upstream and downstream SMEs "N" offline to achieve point-to-point to point-to-line financial supply chain service coverage [9]. This model relies entirely on manual offline approval, which is inefficient, difficult to verify information, and cannot accurately verify the authenticity of inventory and transaction background. It also has risks such as duplicate collateralization and false trade. Moreover, the business is overly dependent on the credit of the core enterprise, and the financing risk of the downstream SMEs is highly concentrated [10].

The second stage achieved an initial digital transformation of financing operations, manifested in an online "1+N" model. Commercial banks built dedicated online business systems, enabling the entire process of customer application, review, loan disbursement, and completion to be conducted online. Through electronic information processes, commercial banks obtained core enterprise operational data and real-time information on warehousing, transactions, and payments, effectively improving business efficiency and alleviating the information asymmetry problems of the offline model. However, the drawback of this phase was that the core logic of financing operations remained centered on the commercial bank's capital chain allocation, failing to achieve full-chain data connectivity, and credit risk control still had shortcomings.

The third stage is the mainstream innovation model of current supply chain finance business, which is mainly manifested in the digital "N+1+N" comprehensive model. Commercial banks deeply integrate the supply chain information flow, logistics and capital flow to build a full-dimensional online service system and realize the upgrade from single-point service to full-chain empowerment [11]. This model relies on big data and standardized processes to build an intelligent credit assessment system. It breaks down the data barriers of multiple entities of SMEs in the upstream and downstream of the supply chain, effectively reduces the risks of excessive reliance on the credit of core enterprises and information asymmetry, and realizes effective prevention and control of supply chain finance credit risk.

4. Supply chain finance models of Chinese commercial banks

4.1. Definition of supply chain finance

Inventory financing is a financing method offered by commercial banks to companies operating solely on their inventory. It is suitable for companies facing cash flow difficulties due to inventory backlog and slow product turnover. Commercial banks and other financial institutions use the core enterprise's credit as collateral and the financing company's inventory as collateral, providing loans through static mortgages, dynamic mortgages, and warehouse receipt pledges.

4.2. Inventory financing business model

The accounts receivable financing business model is that the financing enterprise transfers the outstanding accounts receivable generated by the real contract to the commercial bank as a repayment guarantee in order to obtain immediate financial support. It is suitable for upstream enterprises in the supply chain to have their accounts receivable collection hindered and their capital chain to have a phased gap due to sales on credit. Common models include factoring business and bill pool credit. The establishment of this model marks the transformation of the role of banks in the enterprise supply chain from traditional static credit approvers to deep participants in dynamic transactions in the industrial chain. Banks achieve closed-loop management and risk control through online methods [12].

4.3. Prepayment financing business model

Prepayment financing is a derivative model of inventory financing, suitable for financing companies with strong product sales and rapid inventory turnover. To cover the production and transportation time of upstream enterprises and alleviate the financial pressure on SMEs, commercial banks use the SMEs' right to take delivery of goods during the procurement stage as collateral to provide financial support to the financing companies.

5. Core credit risks in supply chain finance models

5.1. The risk of relying on the reputation of core enterprises

The supply chain finance business of commercial banks is based on the credit of core enterprises, with funds serving upstream and downstream enterprises in the supply chain and third-party logistics companies. In the accounts receivable financing model, the authenticity of accounts receivable is the key to the return of bank funds. However, core enterprises may conceal unfavorable information in trade activities in order to preserve their business interests. Commercial banks, as providers of funds, may face credit risks due to information asymmetry, which may result in the inability to recover loan funds. Therefore, the drawbacks of the self-liquidating trade financing theory are highlighted. Liang Bin, the former deputy general manager of the business department of the Shanghai branch of Bank of Communications, took advantage of the supply chain trade behavior of core enterprises to issue accounts receivable vouchers without real goods flow and used his position to obtain low-cost funds from commercial banks based on the credit rating of core enterprises. This case highlights the significant risk challenge brought about by the reliance on the credit of core enterprises [13].

5.2. Risk of fluctuations in the value of inventory collateral

If the core enterprise is a supply chain financing company and uses inventory as collateral, it will become a credit debtor. Commercial banks will face direct debtor credit risk and will no longer enjoy the credit guarantee of the core enterprise, threatening the traditional second source of repayment in case of debtor default. Meanwhile, the value fluctuation of the inventory collateral is the core risk of this model. The collateral accepted by commercial banks is mostly the financing company's merchandise inventory or fixed assets. The value of merchandise is greatly affected by market fluctuations, while fixed assets may experience a decline in realizable value due to the passage of time, force majeure, and other factors, both of which threaten the financial security of commercial banks.

6. Supply chain finance models in agricultural bank of China and credit risk management

6.1. Supply chain finance models

"Chain-Link Loan" is a credit service launched by Agricultural Bank of China (ABC) based on its online intelligent supply chain financing platform, which considers the credit limit of core enterprises and extends the intelligence of core enterprise credit to upstream and downstream enterprises for activity management. This business helps financing companies obtain factoring financing services at lower costs, more convenient processes, and higher efficiency. The main credit products of "Chain-Link Loan" mainly include three categories: accounts receivable electronic loans, factoring electronic loans, and bill electronic finance, as shown in Table 1.

Table 1. Main categories of "Chain-Link Loan"

Product	Business Nature	Credit Utilization	Data Integration	Product Type	Repayment Source
Receivable e-Loan	Accounts Receivable Pledge Financing	Borrower's credit line	Transaction data from the core enterprise	Short-term working capital loan	Borrower
Factoring e-Loan	Assignment of Accounts Receivable Bonds	Core Enterprise Credit Line	Trade Data for Individual Financing Transactions	Non-Recourse Factoring	Core Enterprise
Bill e-Finance	Bill Pledge and Discounting Services	Core Enterprise Credit Line + Dedicated Credit Line for Borrowing Enterprises	Single-transaction trade data	Short-Term Working Capital Loans + Discounting of Commercial Accepted Bills	Core Enterprise

6.2. Definition of supply chain finance

6.2.1. Raising the access criteria for core enterprises in the supply chain

The Agricultural Bank of China's "Chain-Link Loan" business sets five strict access criteria for core enterprises: First, they must be core clients (including holding subsidiaries) of the industry or the ABC's head office or first-tier branches. Second, as commercial bank clients, the core enterprise must be rated as Grade II, Level A or above in the support category (those without a rating can be recognized equally with a certificate from an authorized administrative department). Third, the core

enterprise must have a credit rating of A+ or above, and total assets $\geq$ RMB 1 billion or annual sales revenue $\geq$ RMB 2 billion. Fourth, if the core enterprise is a finance company, its registered capital must exceed RMB 1 billion, and its parent company must be a major industry client, a core client of the Agricultural Bank of China's head office, or a Fortune Global 500 company. Fifth, the core enterprise must be a core enterprise of an agricultural industrialization consortium supported by the Agricultural Bank of China's differentiated credit support program. If the core enterprise meets the access criteria for corporate clients, it only needs to meet the requirements for credit management, project eligibility, and the ABC's fixed asset loan support. Group clients implementing unified financial or procurement management can authorize qualified subsidiaries as core enterprises to handle "Chain-Link Loan" business for upstream clients. Core enterprises must occupy a dominant position in the supply chain, possess control capabilities, clearly define their partner list, and assume ultimate payment responsibility. Access can be based on the size of the group's consolidated financial statements.

Setting strict core enterprise access standards helps clarify the screening scope of supply chain financing clients from the source of financing activities. Under the premise that business relies on core enterprises, refined screening based on client qualifications, asset types, and industry levels accurately identifies high-quality core clients who meet trade self-liquidation requirements. Implementing a group client access strategy can not only meet the cross-regional financing needs of upstream and downstream clients of the core group, but also improve credit approval efficiency, save time costs, and enhance stickiness with key core clients, facilitating long-term win-win cooperation between banks and enterprises. Furthermore, under the group model, the core enterprise's member units assume ultimate payment responsibility for accounts payable, ensuring effective protection of commercial banks' accounts receivable even if the value of inventory collateral fluctuates.

6.2.2. Raising entry requirements for supply chain financing enterprises

"Chain-Link Loan" sets clear entry requirements for financing enterprises in the upstream and downstream of the supply chain. First, they must not belong to entities prohibited from intervention or subject to environmental and social risks. Second, they must have a factoring supervision account opened at the ABC and be subject to supervision; the core enterprise must play a dominant role and have a strong driving force in the consortium. Third, direct suppliers must be recommended by the core enterprise and have excellent qualifications, while indirect suppliers must have a good overseas track record. Fourth, the business conditions of related parties are not better than those of unrelated parties.

Setting high entry thresholds for financing enterprises and conducting qualification reviews as independent credit entities, with the core enterprise's credit only used as a supplementary credit enhancement factor, helps reduce commercial banks' excessive reliance on the core enterprise's credit. At the same time, when other links in the supply chain encounter funding problems, the financing enterprise can assume repayment responsibility as an independent entity, effectively protecting the commercial bank's capital security and creditor rights.

6.2.3. Building and utilizing electronic business platforms

The electronic platforms for the "Chain-Link Loan" business are divided into internal and external categories. The ABC e-Account platform is a decentralized accounts receivable management service platform built by ABC based on its internal intelligent blockchain platform. The open factoring e-

loan business operates in cooperation with external platforms on top of the internal intelligent blockchain platform. The use of electronic platforms enables credit penetration of core enterprises, effectively improving the issue of accounts payable confirmation. This not only reduces the high dependence on core enterprises but also alleviates information asymmetry. The electronic platform makes the entire supply chain financing process visible, further reducing information asymmetry between borrowers and commercial banks. Commercial banks no longer rely solely on offline financial statements, significantly shortening paper-based approval processes. While reducing time costs and improving the efficiency of capital supply, it also strengthens regulatory responsibility, ensures traceability of responsible parties, and effectively reduces the risk of overdue and unrecoverable loans.

In the agricultural industry chain sector, an ABC branch in Beijing, leveraging its "Chain-Link Loan" service, serves national-level leading agricultural industrialization enterprises. Addressing the challenges faced by SMEs in the agricultural sector, such as weak assets, difficulty in financing, and difficulty in managing movable asset pledges, the branch analyzes industry chain data, relies on the credit of core enterprises, and combines digital technologies to transform physical movable assets into digital assets. This solves the problems of difficult supervision and value verification of inventory pledges. "Chain-Link Loan" provides online financing services to Beijing-based enterprises in the industry chain. From 2023 to 2025, the branch cumulatively disbursed over 200 million yuan in industry chain loans, effectively mitigating credit risks in the agricultural industry chain.

In the science and technology manufacturing sector, ABC's Guangdong branch, relying on a strict product selection mechanism, collaborates with a local government to build a risk control ecosystem, promoting government-bank cooperation. It signed strategic cooperation agreements with the Guangdong Provincial Department of Science and Technology and the Guangdong Provincial Intellectual Property Office, and a strategic cooperation framework agreement with the Guangdong Provincial Department of Industry and Information Technology for cultivating and developing strategic industrial clusters. The branch also actively connects with risk compensation funds from various levels of government. Simultaneously, it expands cooperation with securities, venture capital, guarantee, and industrial park institutions to build a science and technology finance ecosystem, strengthening resource introduction and comprehensive services for technology-based enterprises. By leveraging the high-quality credit of core enterprises and implementing full-process data supervision, can break free from the excessive reliance on a single credit entity in traditional credit granting and eliminate risks such as fraudulent trade and overdue payments.

7. Conclusion

Supply chain finance is a crucial lending business for commercial banks serving the real economy and developing inclusive finance. However, credit risk arising from issues such as reliance on core enterprise credit, fluctuations in collateral value, and information asymmetry remains a persistent challenge to the business's development. This study finds that the risks in traditional supply chain finance stem from reliance on a single credit source, lagging offline risk control, and a lack of end-to-end supervision.

The Agricultural Bank of China's innovative "Chain-Link Loan" provides an effective method for optimizing industry risk control. A strict dual-entry mechanism for both core enterprises and financing companies screens high-quality industrial entities from the source of the funding chain, reducing reliance on a single credit source and mitigating the risk of default by financing companies. A digital online business platform breaks down data barriers, enabling visualized supervision of the

entire process of transactions, funds, and collateral, addressing the challenges of information asymmetry and effectively defending against risks arising from fluctuations in collateral value and fraudulent trade.

For commercial banks and other financial institutions, the future requires continuous strengthening of the digital transformation of supply chain finance, combining supply chain credit business with big data, IoT and AI technologies to build an intelligent risk management system, reduce reliance on traditional financial statements and real estate pledges, dynamically monitor changes in the value of the industrial chain, capital chain and pledged assets, and improve the whole-process post-loan management mechanism to achieve proactive prevention and dynamic management of credit risk, and promote the standardization, high quality and sustainable development of supply chain finance business.

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