

Review of Supply Chain Finance

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Abstract. With the rapid development of supply chain finance, related research has grown up to be a hot spot. In this paper, the definition and theoretical development of supply chain finance, the main financing tools of supply chain finance, and the risk control research of supply chain finance are summarized and summarized. The shortcomings of existing research are emphasized, and the future research direction is prospected on this basis.

1. Introduction

Since the end of the 20th century, in order to solve the problem of cost minimization, supply chain management has been incorporated into the financial activities of financing and borrowing. With the changes of international financial and trade environment, capital financing market demand and enterprise production and operation mode, supply chain finance, as a kind of liquidity capital foreign aid running through the whole value chain of supply chain, is favored by the market and enterprises. Supply chain finance is a type of value-added financing mode, which aims to alleviate the financing difficulties of small and medium-sized enterprises and reduce the overall supply chain cost. It can effectively integrate the logistics, information flow and capital flow in the supply chain to meet the financing needs of a single link or the whole, so as to decrease the final product cost and enhance the competitiveness of enterprises. According to the statistics of Yibao Research Institute, the scale of China's supply chain financial market was 17.5 trillion yuan in 2018, with an annual growth rate of 21.4%. It considers that the scale of China's supply chain financial market will reach 27 trillion yuan in 2020.

Traditional supply chain finance has problems such as separation of industry and finance, information asymmetry, etc., so members in the chain are easy to form data islands and information blind areas, which makes it difficult to establish a scientific credit evaluation system for the whole supply chain. In addition, traditional supply chain finance is often dominated by banks and relies on core enterprises to construct value chain and credit chain, which lead to lack of sufficient financing flexibility and autonomy of other supply chain members. At the same time, when the core enterprises can not fully grasp the complete information flow, logistics and capital flow, they also bear greater operational risks [2]. Once a certain link of supply chain finance goes wrong, the core enterprises and allied members in the chain will be affected.

2. Research on the concept and theory of Supply Chain Finance

2.1 Definitions of connotation

Supply chain finance, as a popular innovative financial business at home and abroad, not only improves the financial performance of the whole supply chain through the three dimensions of capital cost, financial maturity and total capital, but also reduces the risk of bankruptcy of supply chain participants, especially small companies, through factoring or reverse factoring (In order to improve their C2C cycle, many large companies act as liquidity provider, providing alternative financing for the supply chain partner companies with liquidity difficulties). In addition, supply chain finance can also increase the availability and accuracy of information, save the cost of information acquisition, and then help financial institutions reduce the misjudgment of SMEs (Small and Medium-sized Enterprises) and provide financing for SMEs.

2.2 Theoretical research backgrounds

Foreign research on supply chain finance is mostly based on the specific practice of dependable supply chain financial activities. In the 1940s, there were financial businesses such as bill discount and inventory financing and related research [3]. Timme, Santomero and others first put forward the concept of supplying chain finance. They think that the process in which the demanders and providers of financial services in the supply chain realize the value-added goal of the supply chain through cooperation and business activities is supply chain finance [4]. Subsequently, Pfohl and Berger put forward a hypothetical research framework on supply chain finance, and emphasized that a series of effective measures are needed to solve the financing problems of SMEs [5-6]. After entering the 21st century, the influence of Internet on supply chain finance is gradually expanding, and the related research is increasing. For example, Fellenz discussed the dynamic model and practice of capital flow in the global supply network, and studied the demand for improved solutions to supply chain financial challenges in the context of the Internet in view of the global credit crisis [7]. Emiliani, McIvor, Ellilan and others are more focused on exploring the role of Internet technology in supply chain management and supply chain finance, proving that the application of Internet technology can greatly improve the efficiency of information transmission and the competitiveness of supply chain [8-10]. Hartley et al. chose to elaborate on the Internet-based supply chain finance model from the perspective of globalization background and organizational optimization [11].

The rise of domestic supply chain finance practice and theoretical research appeared in the late 20th century, and more emphasis on the connotation of supply chain finance, constituent elements, model analysis and risk management research [12]. For example, Hu Yuefei and Huang Shaoqing analyzed the evolution of supply chain finance, and made it clear that its connotation was a series of financial transaction activities carried out by all members of the supply chain to meet the capital needs of production and operation [13]. Li Yixue, Yan Junhong, Ma Jia and others used different quantitative research methods to study the credit evaluation and risk management of supply chain finance, and provided the risk control scheme of supply chain finance [14-15]. With the rise of the Internet and the establishment of e-commerce platform, supply chain finance has gradually shifted online. Huang Yingxia proposed through research that online supply chain finance can not only use Internet technology for reliable credit reference business, but also effectively carry out the business layout through third-party e-commerce platform [16]. Song Hua believes that the main role of Internet-based supply chain finance is not limited to innovative financial means, but also to the development of an industrial economy, especially in solving the financing difficulties of small and medium-sized enterprises [17]. Qiu Hui, Xu Shuqin and others believe that the role of the Internet in supply chain finance is not only to amend its elements and information flow, but also to greatly improve the network structure of supply chain finance [18-19]. Zhao Xin and other people put forward the "N+1+ n" ecosystem of the Internet plus supply chain finance, which makes the credit and financing activities with more dynamic [20].

2.3 Comparative studies on the operation mode of Supply Chain Finance

The operation mode of supply chain finance, as a summary of business forms and the reference basis for subsequent development of supply chain finance business, has been most valued in this research field. For example, Huang Xiaomei summarized the mainstream views of supply chain finance at home and abroad, and divided financial services into four types of nodes dominated by core enterprises, e-commerce platforms, logistics enterprises and commercial banks [21]. Xie Shiqing and He bin discussed the mode of supply chain finance from the perspective of organization, and summarized three typical [22] organizational models of international supply chain finance. On the basis of summarizing the traditional supply chain financial model by many scholars, this paper draws the traditional supply chain financial model diagram by extracting its common characteristics, as showed in Figure 1.

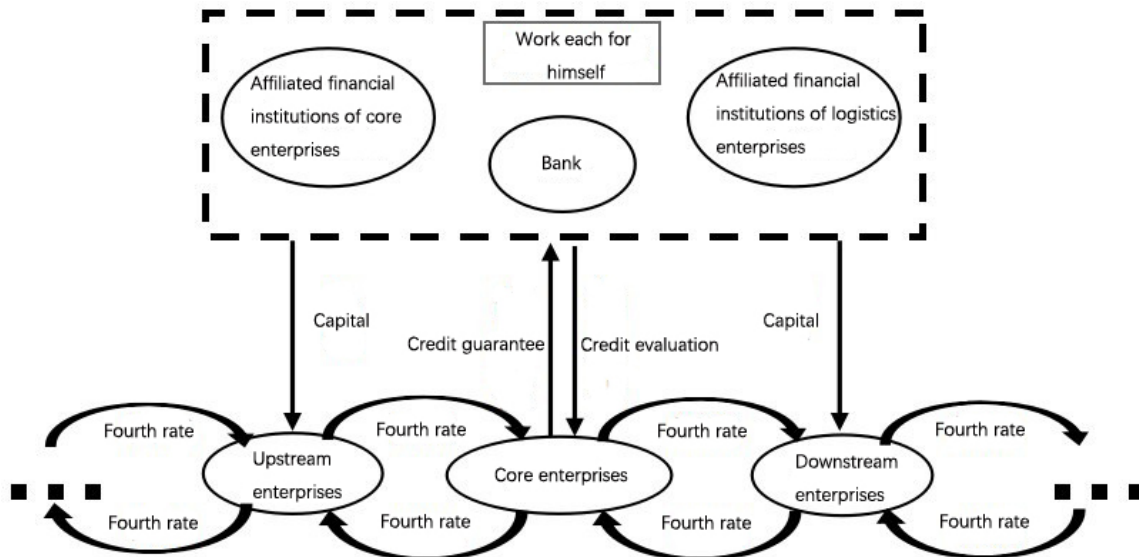


Figure 1 Traditional supply chain finance model

In the traditional supply chain financial model, for the capital demand side, the core enterprises can not only rely on their dominant position to occupy the output and capital of the upstream enterprises of the supply chain, but also use their own reputation to provide credit guarantee for the upstream and downstream small and medium-sized enterprises to financial institutions, and transport operating funds to partners in the chain through banks, so as to achieve the purpose of rapid expansion. In this mode, the information between the members of the supply chain is not fully interconnected, and it needs the connection of the core enterprises to realize the resource sharing, which is an inefficient chain type value transmission mode. From the perspective of the supply side of funds, outdated supply chain finance mainly includes banks, logistics enterprises and their affiliated financial institutions, core enterprises and their affiliated financial institutions, etc. [22]. Its sole source of funds, lack of financial products and slow capital flow are far behind the demand of the supply chain financial market. At the same time, the fund supply object is not aware of the importance of data information sharing, and is limited to maintain their own advantages, resulting in information blind area, which directly leads to the difficulty of credit investigation and the increase of transaction cost.

With the help of the Internet, we can break the chain structure of supply chain finance, and cover the whole supply chain financial system in a network mode. Lambert, Cooper, etc. respectively from the elements, process management, network structure and other dimensions, elaborated that the supply chain financial model under the background of the Internet has comprehensively improved the circulation efficiency of information and capital [23]. Zheng Chengfeng and others put forward the idea of "Internet plus" to reshape supply chain finance, which can link the financial industry and the real economy to form [24], a financial ecosystem with multiple connections and mutual benefits. Through the summary of the existing literature on the supply chain finance mode under the background of the Internet, we can get the innovative operation mode of supply chain finance, as showed in Figure 2.

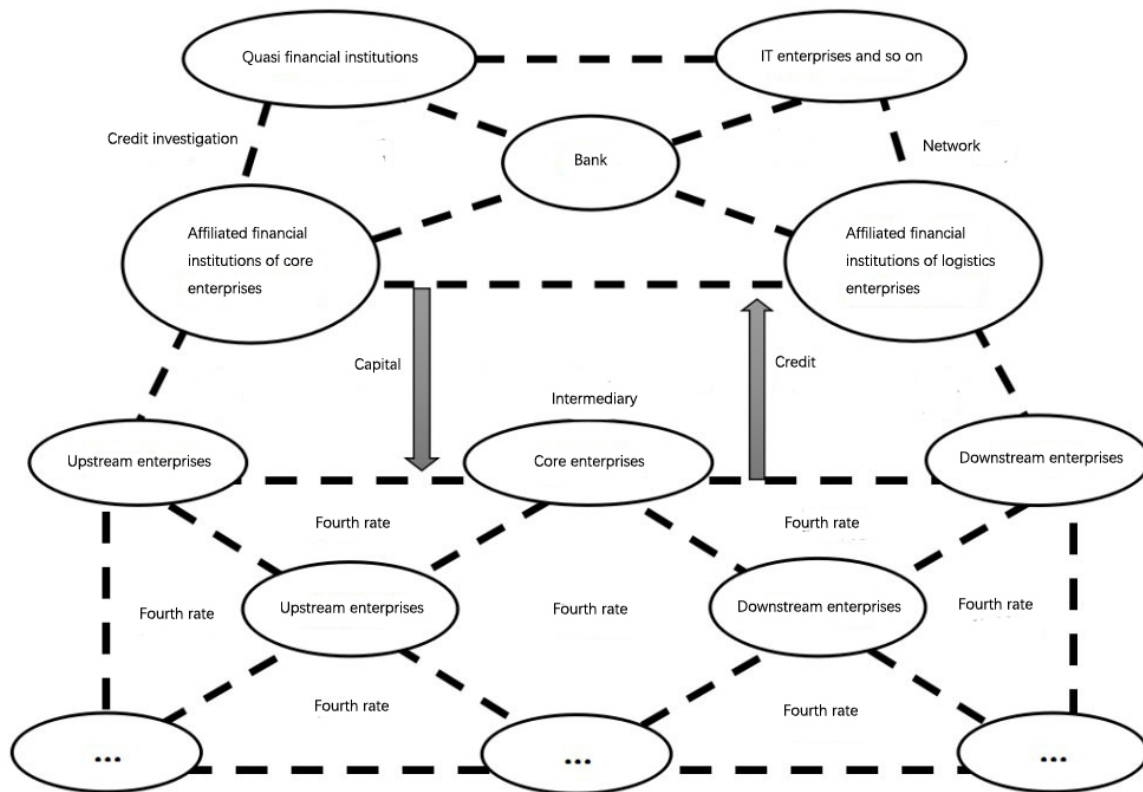


Figure 2 Supply chain finance model based on Internet

From the perspective of participants, the types of enterprises and industrial sectors in the Internet supply chain financial ecosystem are more diversified and diversified, which can be roughly divided into three categories: the supply side, the demand side and the intermediate service end of funds [25]. In the future, various industries will be a symbiotic, mutually generated and regenerated business ecology in the context of the Internet. Therefore, only by actively introducing participants, exchanging resources and creating value together can we truly achieve the objective of all parties involved in the industrial supply chain [26]. From the perspective of the whole industry, supply chain finance is gradually becoming a platform, which can not be only aggregate all participants in an efficient network structure, but also realize the exchange of information among its various elements and business processes [27]. In such a platform based on open ecological network system, each member can enjoy the convenience of low-cost value sharing, the sensitivity of market change perception, the efficiency of resource integration and allocation, and the opportunity of industrial innovation and development [28].

3. Supply chain financing tools

With the formation of global buyer's market, credit sale has become the mainstream settlement method of universal trade. According to statistics, credit trade has accounted for 80% of global trade. Along with this, the demand for bank credit intermediary of both sides of the transaction has decreased, and the loan between enterprises has become more frequent. Asset backed loans such as factoring, accounts receivable financing and inventory pledge financing have become the main financing tools of supply chain [13]. Therefore, this paper focuses on the representatives of emerging supply chain financing tools: Factoring and trade credit.

3.1 Factoring

Factoring originated from the rise of industrial organizations, and then in the mid-1990s, many documents appeared to explain the motivation and application of factoring. Sopranzetti proposed that accounts receivable financing can alleviate the problem of under investment in SMEs. Smith and Scnucker believe that vertical integration and reduced transaction costs are the decisive factors in the

use of accounts receivable. Sopranzetti tested the key factors of whether suppliers use recourse to use factoring. It was found that suppliers with low quality accounts receivable tend to use factoring with recourse, suppliers with high quality accounts receivable tend to use factoring without recourse, and those with medium quality accounts receivable use both factoring, which ultimately depends on the result of risk assessment. Nearly ten years later, based on the factoring data of the United States, Klapper reveals the operation mode of factoring and its effect on small and medium-sized enterprises. Small enterprises can obtain real-time cash flow by discounting accounts receivable with reputation. Unlike loans, factoring does not increase corporate debt. Unlike fresh working capital financing, factoring does not involve credit unions. As a comprehensive financial service, factoring includes information collection, credit guarantee and bookkeeping tracking of accounts receivable [29]. Soufani conducts an empirical study based on the factoring data of the UK. The results show that the lower the availability of communal credit provided by banks, the more likely it is to use factoring. However, factoring is generally only used for small and medium-sized enterprises that have developed to a certain stage. At this time, SMEs are determined to have definite development confidence and have proven track records on the generation or provision of qualified products or services, payment systems or inventory experience. However, small and micro enterprises and newly established companies are unable to utilize factoring due to lack of experience and tracking records. In addition, production and related industries tend to use factoring.

From the perspective of the development opportunities and challenges of global factoring in emerging markets, the environment and atmosphere provided by emerging market economy for the rapid development of factoring are both beneficial and harmful. Demirguc - kunt et al. from the sample data of 39 countries, found that countries with imperfect legal environment tend to use inter enterprise loans rather than bank loans for trade financing owing to the difficulties in contract conclusion and implementation, which provides favorable conditions for the development of factoring. Borgia demonstrated the hypothesis that factoring is more popular in countries with weak governance. Mol Gomez Vaquez and others surveyed 4348 SMEs in 15 developed countries and 10 emerging countries in Europe, and further demonstrated that factoring financing is more preferred in legal environment countries with weak lender protection, political instability and high implementation costs. However, based on the factoring data of 48 countries, factor chain International (FCI) believes that international factoring is mainly developed in developed countries and developing countries with credit rating agencies. The main reason is that these countries have relatively perfect credit information to ensure the development of factoring market, which is missing in many emerging countries. Moreover, in some emerging market countries, small and medium-sized enterprises are more inclined to use non alliance lending, because "core enterprises" can use their market sound right to refuse to pay for goods before confirming the quality of their products. At the same time, some small and medium-sized enterprises in developing countries also face many problems when they wish to convert the accounts receivable of trustworthy customers into working capital. For instance, the lack of laws makes it difficult to obtain and protect intangible assets, and the judicial system cannot execute contracts quickly and efficiently.

3.2 Trade credits

Since the origin of trade credit, scholars at home and abroad have been arguing whether trade credit is an expensive substitute for bank loans or a low-cost financing source. The motivation of enterprises to use trade credit is mainly discussed from the perspective of supply side and demand side. From the perspective of supply side, there are seven motives: helping buyers to obtain funds, representing the market position of products to a certain extent, differences in price elasticity conducive to increasing overall income, advantages in collateral value, preferential use of credit information, and protection of irretrievable assets. From the perspective of the demand side, the main motivation is: reducing transaction costs through contracts, limited bank credit rationing, and preferential protection provided to maintain a lasting and stable product market relationship.

As for the role of trade credit in supply chain operation, there are mainly the following studies: kouvelis and Zhao compared supplier financing (trade credit) with bank financing without financial

distress cost, and found that under certain technical conditions, when suppliers can only choose one of the two channels, supplier financing is the best choice. Babich and Tang, Rui and Lai demonstrate how trade credit can reduce the moral hazard of suppliers. Cho D demonstrates how trade credit can alleviate the principal-agent problem by restricting retailers from deviating from optimal inventory. They also believe that trade credit can control the buyer's speculative behavior by linking physical transactions with financing. Peura et al. found that the use of trade credit helps to improving the profitability of enterprises in price competition.

4. Risk control research

With the acceleration of globalization, the financial risk of the supply chain has been aggravated by the activities related to globalization, such as onshore, offshore, complex outsourcing, and more and more mergers and acquisitions. The research on the risk management of supply chain finance is becoming ever more popular, and the related literature review is also increasing. This paper mainly expounds the latest relevant literature from three aspects of risk identification, risk measurement and risk prevention.

4.1 Risk identification

There are for two ways to achieve the goal of supply chain financial management: high efficiency or effectiveness. High efficiency emphasizes the minimum input of financial resources to achieve the goal, and effectively emphasizes the availability of financial resources and the function of the supply chain process needs to be guaranteed. Most of the papers focus on efficiency, mainly on cost and profit, and seldom consider the effectiveness such as service level. Risk exposure: according to the source of risk, supply chain financial risk can be divided into endogenous risk and exogenous risk. Since the supply chain is usually composed of different interconnected companies, even the internal risk is beyond the boundary of a single company, waters distinguishes the internal risk source of the external risk source beyond the control of the manager according to the controllability of risk. Christopher and Peck found three different types of supply chain risk network interrelated sources: lack of ownership, confusion and inertia.

4.2 Risk measurements

In order to assess and compare different solutions designed to limit the level of risk, decision makers need to quantify the risk (in some way). The common measurement methods of supply chain financial risk are deviation, downside risk and not further quantified (NFQ). 1) Standard deviation, mean variance method, value at risk, conditional value at risk or premium are risk measures designed to describe the interaction between uncertainty and the degree of damage or benefit associated with it. Variance or standard deviation is widely used as a measure of financial risk, although controversial, it has been used all the time (Bell, 1996; Cox, 2008; Pedersen, 1998). Both concepts to evaluate the breadth of distribution and consider not only negative bias but also positive deviation from the expected return. 2) Downside risk. In financial engineering and financial risk management, positive deviation and negative deviation are called upper and lower limits respectively. In this sense, downside risk compensates for the risk associated with adverse consequences, namely loss. Value at risk (VaR) and conditional value at risk (CVaR) is used as percentages of downside risk in portfolio theory. Value at risk (VaR) and conditional value at risk (CVaR) is used in portfolio theory as percentages of downside risk. Both concepts describe different parts of the profit or loss distribution, and their use is given in the decision maker's objectives and the availability and quality of the distribution estimates. Soleimani et al. considered the risk standard by using three popular and well performing risk measures: mean absolute deviation, value at risk and conditional value at risk (CVaR). 3). When supply chain risk is understood as the uncertainty of input parameters, some researchers do not quantify the risk degree related to the solution, and this kind of method is called no further quantification (NFQ).

4.3 Risk prevention

In view of the complexity and lack of visibility of supply chain financial disruption, especially the uncertainty of demand and pricing, both buyers and suppliers are confronted with the risk of shortage, delay and financial loss. Risk sharing contract is one of the principal means of risk mitigation. Therefore, many literature focus on how to design risk sharing or sharing contract. Tang stressed the need for new approaches to reducing vulnerability risks and potential losses. Kima et al. studied the reduction effect of supplier dependence and the financial risk of over dependence on supplier by assuming the inverted U-shaped curve of return on assets ROA, return on sales ROS, asset turnover rate and gross profit rate, as well as the U-shaped curve of inventory level and sales, general expenses and administrative expenses. Based on the rights and independence of buyers and suppliers, Ghadge designs a risk sharing contract that helps to mitigate the supply chain risk, so as to alleviate the demand uncertainty and price fluctuation related risks in the global business environment. Yang and Birge believe that trade credit can improve supply chain efficiency by partially sharing the demand risk faced by suppliers by retailers. Inspired by Ford and GM's subsidies to ailing suppliers in 2005, Babich analyzed the joint decision-making based on reserve capacity and the risk management motivation of providing financial assistance to suppliers to prevent supply disruption.

Aepfel analyzes another risk management motivated financing case, caterpillar, a heavy equipment manufacturer, launched a reverse factoring program after the 2008 credit crisis as part of its strategy to secure its "gear" base supply. Similarly, Rolls Royce uses reverse factoring to enhance the flexibility of its supply chain and improve its ability to respond to customer demand. Boeing uses reverse factoring as a tool to help SMEs suppliers maintain highly skilled expert work.

5. Future research prospects

Based on the current research situation of supply chain finance abroad and the summary of previous articles, this paper makes the following deficiencies of supply chain finance and the future research direction.

5.1 The overall framework theory of supply chain finance has not been formed yet

The biggest gap of overseas supply chain finance research lies in the lack of the overall theoretical framework of supply chain finance research, which is also the main reason for the deviation between the existing theory and practice of supply chain finance. Although the concept of supply chain finance is relatively new and relatively complex, the research perspectives of "finance as the center" and "supply chain as the center" are separated from each other, resulting in a negative impact on the effectiveness of the research results. Therefore, we should transfer the concept research which determines the effectiveness and importance of supply chain finance to all kinds of basic research which is committed to solving supply chain finance methods, and expand the practical research tools and solutions of supply chain finance, so as to comprehensively define the definition and research scope of supply chain finance. Although the research perspectives of "finance centered" and "supply chain centered" try to have a general vision of supply chain finance, their research is relatively scattered due to the lack of integrated framework and structure, and their views are not fully developed and continued. Future research should have a more comprehensive classification of various solutions to supply chain finance, and should take into account the practical characteristics of supply chain finance, so as to make the concept of supply chain finance more practical. Of course, just like the theory of supply chain management, these definitions and concepts also need to go through diverse research stages to gradually form the cornerstone of the overall theoretical framework.

5.2 Empirical analysis of supply chain finance needs further development

Although there are some empirical studies on the solutions of supply chain finance, such as factoring (reverse factoring), trade credit and VMI in the existing literature, the evidence is only based on one aspect and perspective, and there is still no empirical analysis to solve the supply chain financial problems from the overall perspective. Of course, the existing empirical evidence can also

be used to test existing models and hypotheses. Despite the fact that it is still unclear to evaluate the effectiveness of decentralized supply chain financial solutions and their different application processes with data, More and Basu typically use Indian enterprise data to investigate and study financial solutions. Wuttke has designed more comprehensive practical methods (such as reverse factoring, inventory financing, letter of credit financing), but it is still limited to the upstream of the supply chain to solve application problems of supply chain finance. Therefore, future research should use more empirical research to test the development of hypotheses and models, not only to use more innovative supply chain financial solutions (such as dynamic discount or reverse factoring evolution), but also pay more attention to the downstream research of supply chain.

5.3 Research on the evaluation model of the impact of Supply Chain Finance on the financial performance of the whole supply chain is insufficient

Regardless of the fact that the problem of how to link the concept of supply chain finance with the financial sustainability of the supply chain has been solved, there is little research on the impact of Supply Chain Finance on the financial performance of the whole supply chain. Of course, it is much more complicated to study the entire supply chain organization than to study the pure relationship between the buyer and the seller.

Although the results of financially oriented research on supply chain financial solutions have shown that these solutions have a positive impact on the financial performance of all participants in the supply chain, more evaluation models are needed to better evaluate innovative solutions. For example, reverse factoring solutions certainly have a positive influence on the financial performance of suppliers, but there are few quantitative evaluations on the effectiveness of reverse factoring solutions (the existing quantitative evaluations are mainly based on pure buyer seller relationship). For example, in the articles on trade credit management, many authors will focus on many factors and influences of monetary variables of all parties in the supply chain (capital cost, each participant in the supply chain, etc.). Although some trade credit management has also considered multiple scenarios involving typical supply chain and logistics decisions (such as joint inventory strategy, trade credit decision-making and its integration with supply chain), it only takes into account the dual factors, while the overall multi-element organization of the supply chain is not taken into account. Therefore, this is the next research direction.

Supply chain oriented research has already analyzed the joint inventory management strategy in detail for a long time, and even studied the supply chain financial solutions that involve complex and diversified supply chain organizations and take the supply chain as the center in the more complex network organization. However, there are little mention and research on the financial performance evaluation of the whole supply chain. In this regard, Xu et al. have done a very meaningful and pioneering study -- analyzing how VMI can make supply chain participants reduce the probability of bank failure. However, research on financial performance evaluation is very basic, and the subject in this area should be further studied, especially many details need to be discussed in depth. In the future, the research on supply chain finance should focus on more complex supply chain scenarios (especially solutions based on financial attributes), or more comprehensive analysis on the impact of Supply Chain Finance on financial performance (especially solutions based on the nature of Supply Chain Management).

5.4 Lack of analytical tools with differentiated supply chain finance solutions for different supply chains

Existing research also lacks effective practical guidance and tools to help managers identify supply chain financial solutions that meet their needs. Although some literature has mentioned some managerial implications, especially those from the empirical studies of Wuttke et al., these tools have not been further developed and studied. These tools should continue to develop based on the advantages and disadvantages of different supply chain financial solutions, as well as the characteristics of the supply chain and the relationship between separate supply chain financial solutions. As Wuttke and others believe, these variables (such as strategic importance, market

complexity, company constraints) actually play a decisive role in the effective operation of distinct supply chain financial solutions. The representative is for discrete supply chain financial solutions. The financial performance of the supplier base composed of small and medium-sized enterprises and that of large companies may be the same, but the response may be different.

5.5 Effective and more refined supply chain financial risk management methods need to be developed

With the diversification and characteristics of the financing model and products of the supply chain, the financial environment, process and participants in the supply chain are becoming more complex and changeable, and various uncontrollable factors are strengthened. For example, when the accounts receivable or even the restored goods are delayed, the risk transfer occurs at the same time, which needs to be controlled objectively (such as the correct pricing of relevant collateral). Specific supply chain financial measures can prevent the liquidity constrained supplies from falling into a desperate situation. Therefore, how to correctly identify and evaluate the risks from the convoluted supply chain financial business and timely prevent the risks put forward more refined and complex requirements for the supply chain financial risk management methods. The academic community needs to conduct in-depth and systematic analysis of this issue.

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