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Literature Review and Prospects on Risk Management of Logistics and Supply Chain Finance

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***Abstract*—The rise of supply chain finance provides new opportunities for small and medium-size enterprises (SMEs) who are facing a funding cliff, it also sets higher requirements for the risk management of supply chain financial system. This paper summarizes domestic and international research tendency from three aspects: risk identification, risk assessment and risk control. According to the study, this paper also proposes relevant research prospects in order to show clear direction for future research on risk management of logistics and supply chain finance.**

***Index Terms*—logistics and supply chain finance; financial risks; risk identification; risk assessment; risk control**

I. INTRODUCTION

All along the expansion of SMEs makes great contributions for China's economic development. But in recent years, this group of special enterprises are commonly facing financing difficulties.The root cause of the disadvantage of SMEs in credit market is congenital deficiency and small scale. Compared with large enterprises, SMEs lack information superiority for credit financing. To solve the problem of credit defects of SMEs, we can not only proceed from its internal structure, but also focus on the division system between small and medium-size enterprises and large enterprises in the supply chain, make full use of the information superiority of large enterprises in the credit market to make up the credit defects of SMEs, so as to pull up the credit ability and credit level of SMEs. In order to solve the contradictions between banks and small and medium-size enterprises, logistics and supply chain has sprung up.

Supply chain finance link together all participants of supply chain nodes in the perspective of capital flow, building a new type of strategic cooperative relation. The coordinated development of finance and supply chain not only can solve the plight of SMEs, realizing the value added of supply chain, but also can help the financial enterprises to carry out business innovation and enhance the competitiveness of enterprises. But it is the characteristics of supply chain (multi-member, cross-industry, cross-regional, etc.) make the risk management of supply chain finance different from traditional financial risk management. This paper attempts to review the domestic and foreign dynamics from three perspectives, risk identification, risk assessment and risk control, hoping to offer a broad reflection and relevant reference for research on risk management of the supply chain logistics finance.

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II. LITERATURE REVIEW

A. Risk Identification of Logistics and Supply Chain Finance

Effective risk identification is the first and the most critical step in risk management. It is a process in which economic entities use various methods and techniques to recognize and identify the risks that may exist in economic activities.

Besanko (1987)[1] studied the impacts of guaranteed loan interest rates, believing that as different enterprises may have different risk levels, banks could reduce risk by setting different combinations of collateral and loan interest rates. Rajan (1995)[2] argued that the number of borrowers' collateral should be determined based on the risk of repayment, and they are positively related. Siskin (1997)[3] analyzed the risks in the financial business of dealers downstream in the supply chain and proposed a series of monitoring measures, including working with professional third parties, regularly assessing the value of inventory and other related assets. Prate et al. (2001)[4] concluded that the risks in the supply chain financing business originated both internally and externally. Internal risks were due to the internal links of the supply chain are not sensitive to uncertainties. External risks were attributed to the complexity of resources and transport and uncertainty of demand and forecast. Hallikas et al. (2002)[5] attributed the uncertainty of risk to supply chain financing's excessive reliance on core enterprises. Peter Finch (2004)[6] argued that in the case of no improvement in the information system, the risk of commercial banks has increased due to their participation in supply chain finance, particularly when the proportion of small micro-enterprise supply chain finance has increased. Demica (2009)[7] pointed out that the development of the supply chain was tailored to meet the demands of industry developed to a certain stage, but the supply chain finance depended on the degree of integration of the supply chain. While the risks of supply chain were directly linked with banks, which also enlarged the one-to-one risks in the traditional business of banks , turning into one-to-many risks. Chih-Yang Tsai (2011)[8] pointed out that one of the largest risks of supply chain finance is the risk of depreciation of collateral, thus many

scholars regard mortgage rate as a key research direction. Ghadge A (2012)[9] proposed the concept of supply chain risk and its management. He thought management risk is manifested in the management of the supply chain, as well as the management of the funds involved in the supply chain processes. Chinese scholar Yanzhong Yang (2007)[10] conducted an in-depth analysis about major manifestation manifestation of risk of supply chain finance. Hongdi Wan (2008)[11] started from the characteristics of the supply chain financial business, expounded the possibility of supply chain financial risks. He believed information asymmetry between banks and enterprises shall cause moral hazard in supply chain finance. Qingma Guo (2010)[12] pointed out that because supply chain finance has a large number of participants, flexible financing model and complex contract design, main operational risks were characterized by moral hazard of the core enterprise, the misconduct risks of logistics enterprise and the guarantee risks of SMEs' property etc..Yinglei Tong (2010)[13] concluded that the risks of supply chain finance mainly include natural environment risk, policy risk, market risk, credit risk, legal risk, corporate culture risk, risk of information transmission and behavior risk etc.. Yixue Li (2011)[14] took sources of risk as a basis, divided the complex risks of supply chain finance into two main categories, system risk and non-systematic risk. System risks could be divided into macroeconomic system risks, systemic risks in the supply chain industry and systemic risks of the supply chain itself. Non-system risks could be divided into credit risks, inventory realization risks and operational risks. Jing Tian et al. (2015)[15] pointed out that online supply chain finance brings new operational risks to commercial banks and divides risk into human risk, business process risk, network system risk and external event risk according to service process. Yaqi Li (2015)[16] compared the online supply chain financial business with offline business, that were warehouse receipts/inventory pledge financing and electronic warehouse receipts financing, receivables/prepayment financing and electronic order financing. And also effectively identified that online supply chain finance based on the B2B platform was facing greater risks coming from credit, operation, market and false trading financing and other aspects.

The existing literature on risk identification of supply chain finance has been relatively comprehensive and complete, we can see that the risks of supply chain finance mainly originate from the systematicness, cyclicality and moral hazard of the chosen core enterprises. Combined with the background of big data and the tend of rapid development of supply chain finance, we can also manly divide risks of supply chain finance into: the online supply chain financial risks and offline supply chain financial risks.

B. Risk Assessment of Logistics and Supply Chain Finance

Risk assessment is the second step in risk management, means the the process of using scientific methods to quantitatively analyse the probability and loss of risk occurrence. Risk assessment is mainly focused on the credit risk assessment of the borrowing enterprises, that is using various risk measurement techniques and models to estimate the credit status of the loan enterprises, and provide reference for credit decisions of financial institutions such as banks.

Generally foreign scholars collect the data of enterprises' financial reports and market to quantify the risk of enterprises, and correspondingly develop proper data model adjusted to the actual situation of the enterprises for quantitative assessment. Shearer (1999)[17] pointed out that in the traditional commercial bank financing business, the management method of risk rating played an important role. However, under the new model of supply chain finance and logistics finance, there shows many new features of risk. The traditional method of risk assessment can not meet current needs, banks and other aspects need to adopt more targeted and more accurate measurement method to evaluate and control business risks. Jokivuolle (2003)[18] studied the loan value ratio in the secured loan, established the model between the collateral value and probability of default. On this basis he also analysed the relationship among loan value ratio, volatility of collateral value and the borrower's default probability. Cossin (2003)[19] argued that credit risk pricing should be based on the price risk of the collateral security, provided credit risk pricing models under different circumstances. Alan White and John Hull (2004)[20] assumed that market risk and default risk are independent, built many spread valuation models applied to the swap spread of credit defaults. Matoussi and Hamadi (2010)[21] verified the unique advantages of the neural network approach in assessment. Credit risk is the basic risk of financial activities with large impacts. It is difficult to measure accurately. Therefore, many domestic scholars conducted a lot of research on credit risk assessment of supply chain finance, mainly from two aspects: the evaluation system construction and risk assessment method. Junhong Yan (2007)[22] constructed the credit risk evaluation index system for SMEs. He also evaluated the risks using multi-layer gray evaluation method, then put forward the idea of using credit spread option to transfer and manage credit risk of supply chain finance. Jia Ma (2008)[23] used Logistic regression to evaluate the credit risk of borrowing enterprises and proposed a business strategy of supply chain finance based on hedging. According to the characteristics of supply chain finance. Qi Wang (2010)[24] constructed the credit evaluation model of SMEs based on decision tree , and provided an effective solution for banks to evaluate the credit risk of SMEs. Changyi Liu et al. (2011)[25] used the clustering analysis and the extended AHP model to evaluate the credit of SMEs. Combined with the fuzzy comprehensive evaluation method he also obtained credit value of the object and proved its effectiveness. Liming Xia et al. (2011)[26] established the conceptual model of credit risk evaluation of SMEs in supply chain, claiming that the order of credit risk evaluation should be: core enterprise evaluation, supply chain evaluation, trade evaluation, and evaluation of SMEs themselves. Haiqing Hu (2012)[27] established a credit risk assessment model using machine

learning method. He also proved its effectiveness and superiority compared with credit risk assessment model based on BP neural network algorithm. Wenliang Li (2012)[28] combined game theory with multi-agent simulation theory into supply chain financial credit risk research, providing a new perspective for credit business risk management of banks. Man Li (2012)[29] compared advantages and disadvantages of five models, found that the LOGISTIC model is more suitable for credit risk measurement under the immaturity status of supply chain financial business. Sihu Niu et al. (2015)[30] took SMEs, core enterprises and supply chain status into consideration, constructed risk index system and risk evaluation model of pre-entry stage and early warning stage respectively. Can Wang (2015)[31] constructed the index system of corporate credit risk assessment from three aspects: enterprise quality, enterprise ability and enterprise capital. He also introduced the least squares support vector machine (LSSVM) into evaluation of enterprise credit risk, overcoming the subjectivity and randomness of traditional method. In the view of influences enterprises with same and different credit rating and core enterprises have on SEMs' credit rating. Jian Han (2015)[32] concluded that in the perfect supply chain network, credit evaluation of SMEs will be improved to a certain extent. Wen Liang (2015)[33] analyzed risk factors of the third party logistics from following aspects: collateral risk, financing side evaluation and moral hazard, bank contract and legal risk, internal management and operational risk and environmental risk. She also built a TPL risk assessment model using AHP-fuzzy comprehensive evaluation method. Yaqin Fan (2016)[34] built the credit risk index of electronic warehouse receipt financing model according to combination of common and unique features. Common features were shared by online and offline enterprise in supply chain finance, unique feature came from the joining of platform enterprises.

Looking from the existing literature, mathematical methods based on mathematical modeling occupy the dominant position and the empirical analysis methods are few. When constructing evaluation system, we should combine the macroscopic and micro level, subject evaluation and debt evaluation. When selecting credit risk assessment methods, we can refer to AHP and other experts scoring method, we can also learn from the mature credit risk assessment model, like Logistic model. However, these two types of risk assessment methods still have some limitations, such as expert scoring method has strong subjectivity. Logistic regression model is usually based on financial data of small and medium-sized listed companies, which can not reflect the non-financial indicators of the measurement.

C. Risk Control of Logistics and Supply Chain Finance

The ultimate goal of supply chain financial risk management is risk prevention and control. Risk control involves many aspects: the choice of collateral and guarantee methods, setting of pledge rate and loan interest rate of guaranteed goods, strategy and mechanism of risk early warning etc.. Diercks (2004)[35] argued that it is highly necessary for banks to tightly monitor risks in supply chain finance business, affirmed the cooperation with professional third-party logistics companies. Blome C and Schoenherr T (2011)[36] used specific case of European company explained how to successfully transform risk management from both theoretical and practical perspectives. Jean Francois (2011)[37] pointed out that in order to completely change the control of supply chain financial credit risks, not only should we control borrower's financial operation condition, but also should expand the management of entire supply chain credit risk, including risk control of core business and third party logistics enterprise. Chinese scholar Yanzhong Yang (2007)[10] put forward risk control measures for commercial banks from the macro level, emphasizing that strengthening internal control is an important means to prevent financial risks in supply chain finance. Jianglin Xie, Yijing He and Tao Chen (2008)[38] used data mining techniques to obtain characteristics of the dealer with low repayment capacity for repayment risks caused by dealer. Thus banks can identify dealers with different repayment capacity and developed different financial policies to control and avoid financial risks correspondingly. Sheng Fang (2009)[39] took Bank of China Hunan Branch as an example to summarize the problems existing in risk control of supply chain finance and put forward suggestions of risk control. Qingma Guo(2010) [12] pointed out that during risk control of supply chain finance, we should be concerned about the specificity of core enterprises as a decision variable. Xianfeng Xu (2010)[40] pointed out that in order to achieve control of supply chain financial credit risks, China should integrate credit management into risk management, accelerate technological innovation, build technology platform for supply chain financial credit management. Shengsheng Guo (2011)[41] constructed the operational model of confirming storage business, quantitatively studied important parameters in contract design of business participants, and put forward risk control suggestions for periods of preliminary negotiation and late contract execution. Yixue Li (2012)[42] took the pledge supervision of Jiangxi Post Express Logistics Company as an example to systematically analyze risk control during the process of business contract design. Dong Ke (2013)[43] provided idea for building risk control platform among financial institutions, logistics enterprises, financing enterprises on the basis of case study. Zhihao Zhang (2013)[44] studied the reasons for default risks in the specific financing model of supply chain finance in the view of banks. He also constructed the default risk assessment index system and put forward corresponding preventive measures. Kun Fan (2013)[45] focused on the credit risk of financing enterprises in supply chain financial business, and constructed line of credit limit control model. Yong Luo(2015)[46] discussed game behaviors of regulators and borrowers based on game theory, found that when increase incentives or punitive measures into contract the two sides will choose a greater probability of cooperation, which will effectively reduce risks of supply chain finance.

As can be seen from above literature, the key points of risk control in supply chain finance is to enhance scrutiny of financing enterprises, guarantee core enterprises, or

cooperative factoring companies, including their own ability, contract authenticity and moral hazard.

III. CONCLUSION AND OUTLOOK

As a kind of financial innovation service under the new economic form, the credit system of China's supply chain finance market is not perfect yet.There are benefit deviation among relevant entities in supply chain finance, which leads to the build-up of risks. At present, there are following inadequacies of previous studies on supply chain financial risk management: First, most studies focused on the main behavior subjects (financing enterprises, banks, logistics service providers), only a small part of literatures focused on the action object (pledge) and institutional environment of logistics and supply chain financial operation. But the number of pledges, pledge duration and value change will have a substantial impact on capital flow. Also different institutional environments will have a significant impact on the operation of logistics and supply chain finance. The subsequent risks can not be underestimated. Second, most studies started with display form of single risk, focused on credit risks of relevant subjects. Few studies are involved in other risks, such as market risk and operational risk. Third, most related literature on risk management started from the overall point of view, ignoring the analysis of specific risk under each financing model.

On the basis of studying a mass of literature, i think future research of supply chain finance will be aimed at following aspects: First, make full use of the advantages of large data. Intelligent analysis of large data can support the fine management of business and improve decision-making level of enterprises. Second, strengthen research about risk integration. Supply chain involves plenty and complex risk nodes, making the risk prevention and supervision more difficult. Third, strengthen research on market risk and operational risk. Under Basel Agreement, credit risk, market risk and operational risk are three major risks faced by commercial bank. For now, there are many researches about credit risk assessment, but few is about market and operational risk. With the supply chain financial business from line to line, the operational risk gradually dominated, therefore, for the market and operational risk research need to pay attention. Fourth, most scholars only qualitatively analyzed the risk assessment of supply chain finance rather than constructing models to carry on quantitative analysis for risk evaluation. This requires the scholars to make further efforts. Fifth, most existing research was involved in general analysis of overall risk of supply chain finance rather than targeting risks analysis under specific pattern. This area still has great study space. Sixth, establish comprehensive idea of risk management. Supply chain financial business involves many subjects, complex contracts and business process. It is highly necessary to strengthen risk consciousness from all business staff and processes.

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