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Risk evaluation model building of logistics financial business for the bank and empirical research

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ABSTRACT

The information asymmetry between banks and enterprises and imperfect mechanism bring some risk to banks carrying out the logistics and financial business. Based on the study of the logistics financial risk indicators, the risk evaluation index system of logistics finance from the pledge risk, financing enterprise credit risk, logistics enterprise risk and regulatory risk is set, and the risk evaluation model of logistics financial business for the bank, which supports one or more project risk assessment, is established by using fuzzy mathematics theory and analytic hierarchy process. At last, the collaborative projects between the Zhongshan branch of Bank Guangfa and finance enterprises are chosen as examples to indicate the feasibility of the model, which maximum controls the risk factors of logistics and financial services and maximizes the benefits of supply chain finance.

KEYWORDS

Logistic finance; Risk evaluation model; Risk prevention; Fuzzy mathematics theory; Analysis hierarchy process.

INTRODUCTION

The Logistics Finance is the product of the combination of logistics and financial development, which is a way of financing which provides financing, settlement, insurance and other financial business in the supply chain by the bank and the third-party logistics enterprises[21]. The logistics finance is mainly about the banks and logistics enterprises. With the financial innovation, the logistics corporation use their product or the right of the product as guarantee, finance enterprises invests and regulates the cash flow, then the cash flow from the trade in goods under the regulatory system repays the banks.

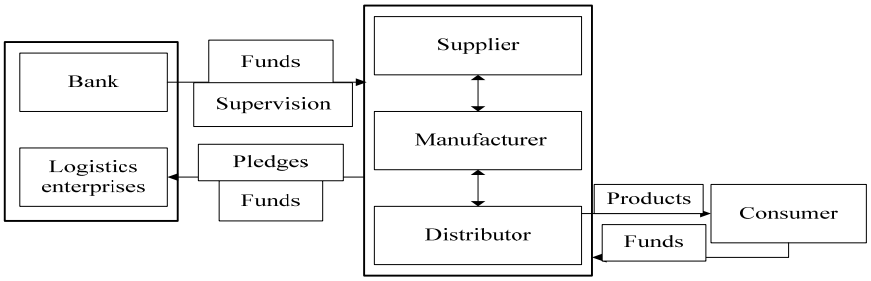

Figure 1 : Logistics and financial cooperation mode. This shows specific cooperation.

Logistics financial business is developed by the warehouse receipt pledge. The warehouse receipt pledge is a credit operation in which the financer takes the warehouse receipt issued by the logistics enterprise as the pledge. It's a pledge of rights business with the logistics enterprises take part in[24]. Logistics financial business has high risks as a new business form because of its imperfect mechanism design. The bank should increase its efforts to the risk prevention and control in the logistics finance. In order to manage the market risk, the bank have to know the risk in the logistics financial business clearly. An effective disruption management strategy that enhances supply chain resilience is a necessary component of a firm's overall hedging strategy. Firms that do not account for the risk of disruptions are susceptible to the risk of severe financial and market-share loss[12]. The banks are facing the enterprise repayment risk, market risk, regulatory risk and liquidity risk, they should take the evaluation method of optimized decision and justify the feasibility of the project scientifically[11]. This article summarizes the risk classification of the logistics finance, sets the risk index system based on the risks faced by the bank, determines the risk evaluation model 'multi-person, multi-criteria', and provides a referable risk evaluation system for the bank to carry out the logistics finance.

Shaolin Tang[17] and Huanhuan Yang[7] pointed out the corresponding risk with the Game Theory, and control the risk through the standardized management system. Through the game risk model analysis, Hongdi Wan[10] found that the bank and the core enterprise could achieve the supply chain financial expectations if they gave full play to their advantages. Guangpei Yuan[6] analyzed the logistics financial business risk from the perspective of third-party logistics enterprises, and showed the optimal choice and the measures should be selected during the risk. The literatures[7,10,17,26] determine the reason for the formation of logistics financial risk, and determine the specific logistics financial risk. Yang Yu[26] and Xiaoyuan Zou[22] qualitatively discussed the risk of logistics finance. On the basis of the risk evaluation index system, Junhong Yan[13] evaluated the risk of supply chain finance using the multi-level grey comprehensive evaluation method. Nan-nan Shan[16] used the structural equation modeling to evaluate the logistics financial business risks. Yaodong Bao[25] judged the risk evaluation with the AHP method, determining the optimal risk evaluation program by the weight of the total ranking. Chuansong Wang[5] studied the risk with the fuzzy evaluation method. Huiping Dong, Dingtao Zhao[8] gives the analysis of China's regional tourism industry efficiency evaluation. The study of the above literatures determines the classification of the risk, provides support to the risk index system. Xiuzhi Zhang[23] used the factor analysis method, the reviewers scoring method and triangular fuzzy number to calculate the weight and the total sorts of each index to evaluate the risk. Yu Hu[27] put forward the model of a risk factor fuzzy complementary judgment matrix ordering based on the fuzzy ordered weighted averaging, to control the risk.

At the present stage, the study of the logistics financial risk is mainly about the study of third-party logistics enterprises, game theory, the specific risk and risk integration from the growing

prominence of top-down and bottom-up risk integration perspectives according to the evolution of financial markets and the enforcement of international supervisory requirements[2-4,14,15,19,20], and less study of how the banks should strengthen the control of the logistics financial risk. This article summarizes the logistics financial risk classification in the bank's perspective at the base of the existing research of the fuzzy risk theory. The risk index system is set based on the existing research of the literatures[6,13, 16,22], and use the fuzzy mathematical theory and analytic hierarchy process to control and avoid the risks of the logistics finance.

LOGISTICS FINANCIAL RISK EVALUATION INDICATOR SYSTEM

The logistics financial risk is an abstract concept, which must be studied qualitatively and quantificationally, and demand a well-bedded, clear and objective indicator system. And the integrity and independence of the indicator should be kept.

According to the process of logistics financial business, the risks of banks can mainly be classified as: the pledge risk, financial enterprise credit risk, logistics enterprise credit risk, regulatory risk and other risks. Considering the unpredictability of the market, other risks will not be analyzed.

The detailed Classifications of risks above can be seen in TABLE 1. This secondary indicators of the risk are main factors of level indicators. This paper summarizes main factors of evaluation indicators at the base of the results of the literatures. The scientificity of factor indicators can be measured by reliability analysis. Literature[6] studied the rationality of the system of indicators initially, using coefficient alpha to judge the system of indicators, a higher alpha means a stronger relevance and a more reasonable system of indicators. This paper sets data in SPSS, the ones whose alpha below 0.7 will be altered or deleted.

Based on the study of the logistics financial risk indicators above, combining analytic hierarchy process, deleting indicators with low reliability of alpha, the indicator system of evaluating risks of logistics finance can be set. The secondary risk categories have different weights below level indicator, which constitute level indicator, shown as TABLE 1.

TABLE 1 : Logistics financial risk indicator system

Level Indicator	Secondary Indicator			
Pledge Risk	Legitimacy	Stability	Liquidity	Natural Attribute
Financing Enterprise Risk	Corporate Credit	Credit of Executives	Management Structure	Development Prospect
Logistics Enterprise Risk	Corporate Reputation	Information Platform	Hardware Facilities	Service Capability
Regulatory Risk	Management of Warehouse Receipt	Rules and Regulations	Early Warning Mechanism	Professional Quality

The upper norms of level indicator are $t_i^1(i=1,2....4)$, the lower norms of secondary indicator are $t_d^2(d=1,2....16)$. The secondary indicator can increase the number of indicators, included to level indicator. This paper obtains the number of secondary indicator based on main factors of level indicator.

THE ESTABLISHMENT OF THE LOGISTICS FINANCIAL RISK EVALUATION MODEL

By using fuzzy mathematics theory, multi-person and multi-criteria risk fuzzy evaluation method are proposed to evaluate the risk of the logistics finance project irregularly, which provides a good mechanism and model for greatest extent possible to reduce the risk for banks and logistics enterprises in business, concentrate superior resources of banks and logistics enterprises, and conduct supervision and improvement.

Because risk evaluation relates to the objective and subjective factors, that would cause fuzziness, it is better to design a model that transfers fuzzy message into certain message. This paper is based on fuzzy mathematics theory[9], applies analytic hierarchy process and fuzzy variable decision-making method comprehensively, in order to set the risk evaluation model of logistics financial business for the bank.

The N reviewers ($P_1, P_2 \cdots P_N$) are set, the upper indicators $t_i^1(i=1,2....4)$ are supposed, and based on the lower indicators $t_d^2(d=1,2....16)$, the logistics finance project are evaluated, which can evaluate the m projects($\lambda_1, \lambda_2 \cdots \lambda_m$).

The weights of the upper indicators are determined by analytic hierarchy process, which synthesizes subjective factors of the reviewers, making the decision uncertain and fuzzy. Therefore this paper uses triangular fuzzy number to describe the weights of the upper indicators.

The specific weights of the upper indicators weights describes as:

$$S_i^1 = [A_i, B_i, C_i] \quad \textbf{(1)}$$

$$A_i = \min\{S_{in}\} \quad \textbf{(2)}$$

$$B_i = \{\prod_{i=1}^{n} S_{in}\}^{1/n} \quad \textbf{(3)}$$

$$C_i = \max\{S_{in}\} \quad \textbf{(4)}$$

In which, S_i^1 means the weights of the upper indicators, S_{in}^1 means the evaluation of the importance from the n reviewer to the S_i^1 upper indicator.

Due to the complicated lower indicators, the decision objects are uncertain and fuzzy. Therefore, we introduce triangular fuzzy number and variables of degrees to emphasize importance and satisfaction in evaluation. Reviewers take the weight set of H = (low, mid, high) to evaluate the importance of indicators, level set of F = (bad, medium, good) to express satisfaction of different criteria. The specific fuzzy variable and fuzzy numbers are shown in the TABLE 2.

TABLE 2 : The fuzzy numbers of fuzzy variables

Grade variable	Fuzzy number
Bad	(0,0.25,0.5)
Medium	(0.25,0.5,0.75)
Good	(0.5,0.75,1.00)

The fuzzy weights of lower indicators and satisfaction of each project expressed through the fuzzy variables in TABLE 1, including the reviews of the reviewers by average algorithm. The fuzzy integration method of lower indicators weights and the integration method of satisfaction of projects to be evaluated is shown as follows:

$$S_d^2 = (\prod_{i=1}^{n} S_{id})^{1/n} \quad \textbf{(5)}$$

$$P_{jd} = (\prod_{i=1}^{n} P_{jd})^{1/ij} \quad \textbf{(6)}$$

In which, S_d^2 means the geometry average weight of the lower indicators, S_{di}^2 means the weight distribution from the i reviewer to the lower indicator S_d^2, P_{jd} means the geometry average fuzzy satisfaction based on the evaluation project λ_j of lower indicator S_d^2, P_{jdi} means the satisfaction grade distribution from the reviewer i to the project λ_j under the lower indicator S_d^2. This to be reviewed project λ_j aiming at the upper indicator satisfaction R_{tj} can be integrated with P_{jd} and S_d^2:

$$R_{tj} = 1/k\{(P_{j1} * S_1^2) + (P_{j2} * S_2^2) + (P_{jk} * S_k^2)\} \quad (7)$$

Suppose: $P_{jdi} = (f_{jdi}, g_{jdi}, h_{jdi})$ and $S_{di}^2 = (u_{di}, v_{di}, w_{di})$ are triangular fuzzy function, R_j can be expressed to $R_j = (a_{tj}, y_{tj}, c_{tj})$, in which

$$a_{tj} = \sum_{d=1}^{k=4} f_{jd} * u_d / k \quad (8)$$

$$f_{jd} = (\prod_{i=1}^{n} f_{jdi})^{1/n} \quad (9)$$

$$u_d = (\prod_{i=1}^{n} u_{di})^{1/n} \quad (10)$$

In a similar way, other projects can be known.

After knowing the weight of the upper indicator S_i^1, and the satisfaction to the upper indicator R_j from the projects to be evaluated at the same time. Now, the fuzzy evaluation to each project is: $w_j = R_j * S_i^1 = (q_j, q_j, t_j)$.

THE EMPIRICAL STUDY

The collaborative projects between the Zhongshan branch of Bank Guangfa and finance enterprises are chosen as example[18], such as: the pledge of Mulan Daily Medical, Hanjia Steel Pipe Limited Company, Jieda Timber Produets and Junyi Pneumatic Parts Company. The collaboration between the Zhongshan branch of Bank Guangfa and the four enterprises meet with success all, but there are also differences about the degree of collaboration and the economic benefit achieved. The degree of collaboration will be discussed based on the model.

Four reviewers are chosen to evaluate the four projects. The weight evaluation of upper indictor can be get firstly, based on the steps of the model, which is shown in TABLE 3.

TABLE 3 : Evaluator on the project the satisfaction of upper indicators

	P_1	P_2	P_3	P_4
S_1^1	0.13	0.10	0.09	0.11
S_2^1	0.32	0.35	0.29	0.33
S_3^1	0.21	0.20	0.18	0.20

S_4^1	0.20	0.19	0.23	0.23

Using the fuzzy algorithm and combining four reviewers' evaluation, the fuzzy weight of upper indicators are shown in TABLE 4.

TABLE 4 : The fuzzy weights of the upper indicators

	Fuzzy weights
S_1^1	(0.11,0.10,0.12)
S_2^1	(0.33,0.30,0.32)
S_3^1	(0.19,0.20,0.21)
S_4^1	(0.21,0.20,0.22)

The weight of lower indicator S_{di}^2 and the to be evaluated satisfaction of projects P_{jdi} are evaluated separately with the grade variable and the fuzzy number above. Every fuzzy satisfactory degree indicator of lower indicator can be reached using the formula above, as is shown in TABLE 5.

TABLE 5 : The lower indicators of fuzzy satisfaction indicators

(0.36,0.73,0.92)	**(0.36,0.73,0.95)**	**(0.39,0.76,0.95)**	**(0.40,0.78,0.90)**
(0.46,0.85,1.00)	(0.45,0.83,0.94)	(0.42,0.80,1.00)	(0.39,0.77,0.96)
(0.45,0.83,0.94)	(0.39,0.78,0.92)	(0.40,0.78,0.96)	(0.42,0.80,1.00)
(0.37,0.76,0.93)	(0.38,0.77,0.93)	(0.40,0.79,0.95)	(0.41,0.79,0.99)

The overall evaluation of the project is made out using formula R_j and S_i^1 as is shown in TABLE 6.

TABLE 6 : Project overall fuzzy evaluation form

	Overall fuzzy evaluation
λ_1	(0.36,0.78,0.95)
λ_2	(0.40,0.83,0.97)
λ_3	(0.30,0.72,0.88)
λ_4	(0.28,0.69,0.84)

According to the table above, the operability of the four projects can be ranked as $\lambda2>\lambda1>\lambda3>\lambda4$. The conclusion is Hanjia Steel Pipe's project is better than Mulan Daily Medical's, and the model's method accords with reality in terms of the reference[27]. With the credit risks get higher, the bank can draw up the grade indicator of fuzzy weight, like(0.35, 0.75, 0.95), to choose the cooperative project.

CONCLUSION

The establishment of the evaluation system of risk indicators is consistent with the scientific principles of the index system, which removes indicators with lower alpha coefficient, making the relevancy of the entire indicators high, which can evaluate and predict the risk factors of logistics finance, then reduce and avoid the occurrence of logistics financial business risks.

Based on the analytic hierarchy fuzzy comprehensive evaluation model, many people can be chosen to judge the logistics financial business, and the risk evaluation and control of individual or a number of logistics financial projects can be processed. The study maximum controls the risk factors of logistics and financial services, and maximizes the benefits of supply chain finance.

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