Analysis of Logistics Financial Business Based on Game Theory

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Abstract

In recent years, logistics finance as a new concept appeared in people's line of sight, and the related logistics financial business has brought considerable profit for each enterprise, at the same time it also brought unprecedented credit risk challenge. Whether it can effectively control of these risks is a key factor of the logistics financial business development smoothly. This paper start from three main body which conclude bank, the third party logistics enterprises and financing enterprises, analysis of the relationship between the three parties from the perspective of game theory and financing enterprises to choose the probability of the normal production and bank supervision probability. From the perspective of game equilibrium, the risks of various game situations are analyzed in order to provide an effective strategy for the development of logistics financial business.

Key words: Logistics finance; Game theory; Risk; Financing enterprise

INTRODUCTION

In China, logistics finance is a new term that only appeared in recent years. About the concept of logistics finance, there have some different statement of the academia. This paper argues that the logistics finance is facing the whole process of logistics operation in a broad sense, application of a variety of financial products, achieve the effective integration of logistics, capital flow, business flow and information flow, organization and regulation the currency movement in the process of supply chain operation, so as to improve the operational efficiency of funds in a series of activities. In a narrow sense, it is the settlement and financing service provided by the logistics provider in the process of logistics business, which often requires the participation of bank. As a kind of new business, logistics finance business involves three main bodies of the bank, third party logistics enterprise and the financing enterprise, involving a wide area, but each subject has its own position and interest requirements, so the corresponding risk also presents a complex and changeable characteristics. Therefore, how to effectively avoid risks has become the key to the smooth development of the logistics financial business, but also the focus of attention of all parties concerned.

Dong, Zhang, Wu, Li, and Zhou (2011) start from the three aspects of the bank, logistics enterprises and financing enterprises, analysis of the game between them, and discuss the game in the profit impact factor and the corresponding risk. Based on the present situation and problems of logistics finance (Liu, 2015) put forward the development trend of logistics finance in the future. Shearer and Diamond (1999) pointed out that with the change of market environment and market structure, especially in the logistics business and financial services integration under the new environment, enterprises are faced with the risk of changes in the financing need to use more scientific and reasonable methods of

quantitative analysis based on the specific situation. Tang and Qiao (2006) using game analysis method from the point of view of risk control demonstrates to the small and medium-sized enterprise to carry out feasibility of logistics finance, and points out that the corresponding risk can be through the use of standardized management system and new management tools. Yang (2010) analysis and recognize of the existing credit risk in the logistics financial business, analysis of the principal-agent relationship between logistics finance main body of the third party, using the game theory to measure the analysis of the logistics finance credit, mainly including the probability of corporate financing fraud in logistics financial specific business and the probability of collusion financing enterprises and logistics enterprises, analyzing the influencing factors of financing corporate defaults. Xu (2006) proposed to carry out the logistics financial services to the real demands of the third party logistics enterprises, finance companies and financial institutions, analysis the function and significance of the implementation of the logistics financial business, through the game analysis of small and medium-sized enterprises, and then put forward the relevant development of logistics financial practice strategy. In inventory financing, asymmetric information between banks and the third party logistics enterprises may incur moral risks, often causing economic losses of banks, it is found that the pure incentive model is not applicable to practical conditions, (Sun, Chu, & Wu, 2014) given in this paper offer theoretical instruction and a practical method for effective regulation of banks from example analysis. Based on the benefit of small and medium-sized enterprise, logistics enterprises and bank from logistics finance, (Wen & Dong, 2008) proposed the risk due to lack of fiduciary duty, inefficient data to choose in favor of its own strategies.

1. LOGISTICS FINANCIAL BUSINESS DEVELOPMENT PROBLEMS

In recent years, logistics financial business has developing at a fast speed in China, which has become the financial institutions, logistics enterprises and financing enterprises to improve the core competitiveness of a hotly contested spot. But the logistics finance in China starts late, the development is not enough comprehensive, so there also has some problem, mainly concludes the following several points:

(a) Although the logistics financial business in China has developed for nearly ten years, but compared with foreign countries, there still have a big gap. In China, non financial institutions shall not engage in financial activities, so Chinese third party logistics enterprises cannot be as UPS as the acquisition or investment of a bank specialized in financial business operations, they must choose to cooperate with bank. Therefore, bank is

the only one credit subject in the third party of logistics financial business, but bank lack of the real situation of financial enterprises and logistics enterprises, so the risk of the overall business of the logistics finance to control capacity is insufficient.

(b) As a new business, logistics finance has brought unprecedented risk; therefore, the current biggest problem is lack of a sound risk control system. Because of the information asymmetry between the bank, the logistics enterprise and the financing enterprise, that is, there is a certain gap between the bank's understanding of the financing enterprise and the real situation of the financing enterprise. So, for the bank, the risk of ex-assessment, in the matter of control and post processing is still a big problem.

(c) Recently, although the rapid development of the logistics industry, but the improvement of relevant laws and regulations have not kept pace with the development of the logistics industry, therefore, the lack of industry regulation is also a major problem in the development of logistics financial business.

2. GAME ANALYSIS ON THE THREE PARTY OF LOGISTICS FINANCE

This paper chooses the warehouse receipt pledge mode as the example to analysis the relationship between bank a, logistics enterprise b and financing enterprise c.

2.1 Basic Assumptions

1) Financing enterprise loans from bank, time is one year, agreed in a year to repay the principle A and interest R. And during the period of the loan, stored goods as collateral in the warehouse of logistics enterprise designated by bank, assuming the collateral value is S.

2) Bank supervision cost of logistics enterprise is C_1, supervision cost of financing enterprise is C_2. Logistics enterprises on mortgage financing company the value of the goods cost evaluation is K_1, stored in the inventory management cost is K_2, assessment costs and inventory management costs are paid by the financing enterprise.

3) Financing business loans for the normal production of the probability is p_1, revenue is R_1, use the loans for investment project with high risk probability is $1-p_1$, revenue is R_2. The probability of success of investment project with high risk is p_2, the probability of failure of investment is $1-p_2$, when investment failure enterprise revenue was 0 and loss all loans. Bank supervision strategies for adopting probability is p_3, adopting probability of no supervision is $1-p_3$.

4) Collusion in the logistics enterprise and the financing enterprise costs are C_3 and C_4, obtain illegal interests are F_1 and F_2, in the financing of the logistics business enterprise and collusion does not occur evaluation cost and inventory cost.

5) Cooperation between banks and logistics enterprises is based on the integrity, so this paper assumes that when the logistics enterprises and banks choose to cooperate, the bank adopts non supervision strategy to the logistics enterprise.

6) When bank adopts supervision strategy to the financing enterprise, it can monitor the flow of capital financing enterprise, to understand whether the financing

enterprise has investment high risk projects. In this case, the bank can force the financing business to choose normal production, otherwise cancel the contract.

2.2 Model Building

1) Logistics companies do not cooperate with the financing business, nor with the banks, banks do not need to take a supervisory strategy. Game tree as shown in Figure 1.
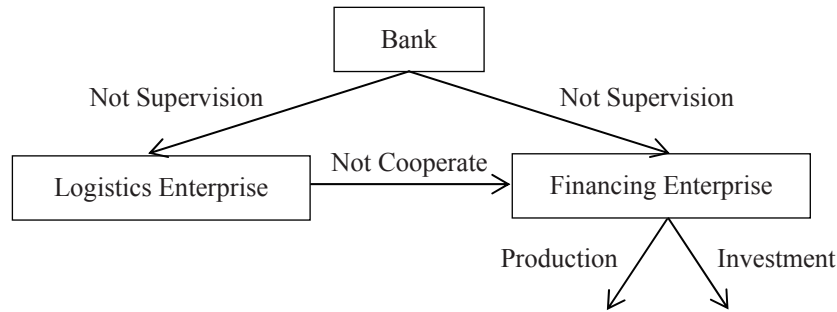

Figure 1
Game Tree

This model is the most ideal mode; it is a win-win situation. Financing enterprise choose normal production to obtain the production of income, repayment of bank loans and interest pay the cost of logistics enterprise inventory management costs. Bank get interest income, logistics enterprise obtains assessment and inventory management benefits.

$$R_a = R$$

$$R_b = K_1 + K_2$$

$$R_c = R_1 - R - K_1 - K_2$$

zoccasion, each subject can get the expected benefits; the only risk is the risk of the production and operation of financing enterprises.

2) Logistics enterprises choose to cooperate with the bank, and the cooperation between them is based on the integrity of the foundation, not with the financing of enterprises to cooperate. In this case, the bank adopts non supervision strategy to the logistics enterprise, the game tree as shown in Figure 2.
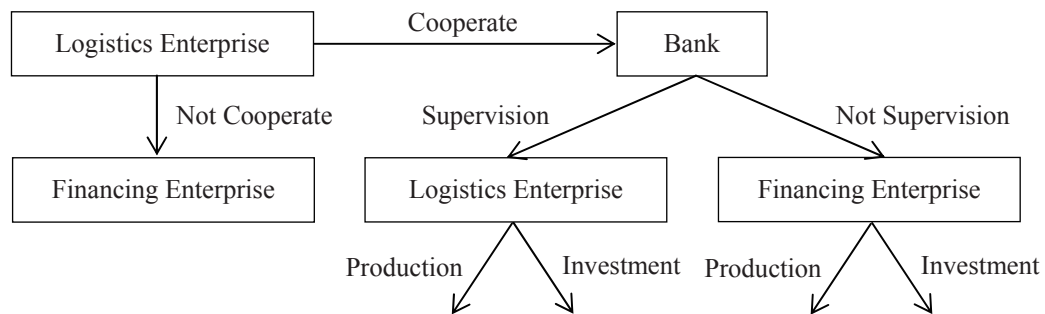

Figure 2
Game Tree

① Bank adopts supervision strategy to the financing enterprise; financing enterprise can only choose normal production. The same with the first case, only banks pay more cost for financing enterprises of supervising C_2.

$$R_a = R - C_2$$

$$R_b = K_1 + K_2$$

$$R_c = R_1 - R - K_1 - K_2$$

In this occasion, only banks pay a cost of supervision on enterprise financing, bank operating condition and the information system of perfect degree directly affects the size of the supervision cost, so this risk is information risk and financing enterprises operating risks.

② Bank adopts non supervision strategy to the finance enterprise.

a. Financing enterprise choose the normal production, this situation is the same as the first case.

$$R_a = R$$

$$R_b = K_1 + K_2$$

$$R_c = R_1 - R - K_1 - K_2$$

In this occasion, although there have the same income with the first kind of the most ideal situation, the risk is indeed different. Because when banks choose non supervision strategy, financing enterprise choose according to the contract to production probability is determined in corporate finance credit status, so at this time the risk is the credit risk which is the biggest risk in logistics financial business.

b. Financing enterprise choose to invest in high-risk projects and success.

$$R_a = R$$

$$R_b = K_1 + K_2$$

$$R_c = R_2 - R - K_1 - K_2$$

In this occasion, financing enterprise choose to invest in high-risk projects, which exist probability of success, and at this time the financing enterprise does not in accordance with the contract to choose normal production. So this risk is the risk of credit risk and investment of financing enterprise.

c. Financing companies choose to invest in high-risk projects, but investment failure. At this time the proceeds of the financing business is 0 and loss all loans. The bank can only be realized as a pledge to stop losses. For logistics enterprise, collateral value assessment is

in the early period of the implementation, so this part is the revenue of the logistics enterprise, and inventory management costs is in the end, so this part of is the loss of logistics enterprise. Financing enterprise loss the value of original mortgage and the assessment of the cost to logistics enterprise.

$$R_a = S - A$$

$$R_b = K_1 - K_2$$

$$R_c = -S - K_1$$

In this occasion, the financing enterprises choose to invest in high-risk projects, but failure, showing that there exist credit risk and operational risk of financial enterprise. Banks rely on cash pledge to stop losses, the collateral value of the property is the key factors affecting the income of the bank, so the logistics enterprises confront charge level of assessment of the accuracy and level of inventory management has a direct impact on bank earnings and confrontation charge level of the assessment of the accuracy and logistics enterprise inventory management level which belongs to the technical risk. So at this time the risk is credit risk, operation risk and technical risk.

3) Logistics enterprise choose to cooperate with financing enterprise to cheat bank loans, and gets illegal gains.

① Bank take the supervision strategy to logistics enterprise and financing enterprise, financing enterprises can only choose normal production. At this time the game tree as shown in Figure 3.
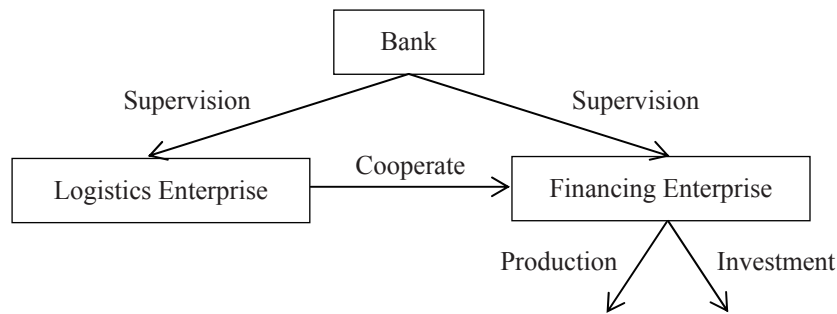

Figure 3
Game Tree

$$R_a = R - C_1 - C_2$$

$$R_b = K_1 + K_2$$

$$R_c = R_1 - R - K_1 - K_2$$

In this occasion, the bank needs to pay more supervision costs, and the level of bank supervision costs

affect the income of the bank, so the risk is the risk of information and business risk.

② Bank take the non supervision strategy to logistics enterprise and financing enterprise, at this time, the logistics enterprise and financing enterprise pay the cost of collusion are $C3$ and $C4$, obtain illegal income respectively $F1$ and $F2$, and at this time does not occur assessment costs and inventory management costs, the game tree as shown in Figure 4.
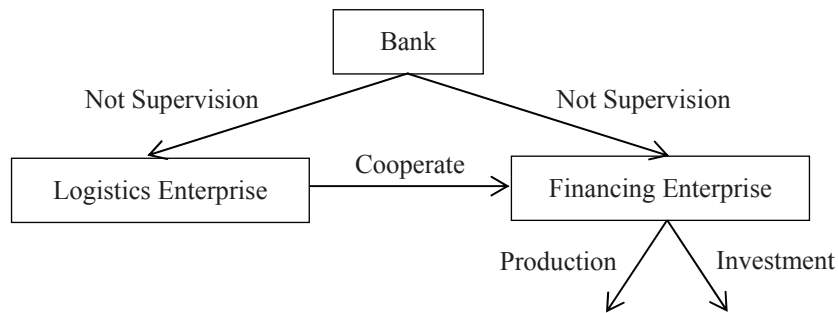
Figure 4
Game Tree

a. Financing enterprise choose the normal production.

$$R_a = R$$
$$R_b = F_1 - C_3$$
$$R_c = R_1 + F_2 - R - C_4$$

In this occasion, bank do not take the supervision strategy, logistics enterprise and financial enterprise choose to cooperate, then there is the credit risk, and financing enterprise choose the normal production, so the risk is the management risk of the financing enterprise.

b. Financing enterprise choose to invest in high-risk projects and success.

$$R_a = R$$
$$R_b = F_1 - C_3$$
$$R_c = R_2 + F_2 - R - C_4$$

In this occasion, facing the credit risk of financing enterprises, and there is uncertainty with the probability of success of high risk investment projects, at this time the risk is investment failure business risk.

c. Financing enterprise choose to invest in high-risk projects but failure. Because logistics enterprises and financing business choose to cooperate, so there is no collateral, and the bank's loss is the total amount of loans.

$$R_a = -A$$
$$R_b = F_1 - C_3$$
$$R_c = F_2 - C_4$$

CONCLUSION

According to the above game analysis, we can get the following two points:

(1) The financing enterprise choose the normal production or high risk investment project earnings are R_c^1 and R_c^2.

$$R_c^1 = 2p_1 p_3 \left(R_1 - R - K_1 - K_2\right)$$
$$+ 2p_1\left(1 - p_3\right)\left(R_1 - R - K_1 - K_2\right)$$
$$+ p_1\left(1 - p_3\right)\left(R_1 + F_2 - C_4 - R\right)$$

$$R_c^2 = \left(1 - p_1\right)\left(1 - p_3\right)\left[p_2\left(R_2 - R - K_1 - K_2\right)\right.$$
$$+ \left(1 - p_2\right)\left(-S - K_1\right)\right]$$
$$+ \left(1 - p_1\right)\left(1 - p_3\right)\left[p_2\left(R_2 + F_2 - R - C_4\right)\right.$$
$$+ \left(1 - p_2\right)\left(F_2 - C_4\right)\right]$$

(2) The choice of bank supervision and not supervision earnings are R_a^2 and R_a^2.

$$R_a^1 = p_1 p_3\left(R - C_2\right) + p_1 p_3\left(R - C_1 - C_2\right)$$
$$R_a^2 = 3p_1\left(1 - p_3\right)R + \left(1 - p_1\right)\left(1 - p_3\right)\left[p_2 R + \right.$$
$$\left(1 - p_2\right)\left(S - A\right)\right]$$
$$\left(1 - p_1\right)\left(1 - p_3\right)\left[p_2 R + \left(1 - p_2\right)\left(-A\right)\right]$$

From the above two points, we can get the game equilibrium income of financing enterprise and bank.

$$R_c^1 = R_c^2$$
$$R_a^1 = R_a^2$$

Among them, in R_c^2, *p2(R2-R-K1-K2)+(1-p2)(-S-K1)* and *p2(R2+F2-R-C4)+(1-p2)(F2-C4)*; in R_a^2, *p2R+(1-p2)* *(S-A)* and *p2R +(1-p2)(-A)* are the expected return of financing enterprises to choose high risk projects under different circumstances. In this paper due to the many variables involved in the complicated calculation, so that the expected return of the enterprise financing investment in high-risk projects were *E1, E2, ... , E4*.

By the above simplified,

$$p_1 = \frac{(1-p_3)(E_1+E_2)}{2(R_1-R-K_1-K_2)+(1-p_3)(E_1+E_2+R_1+F_2-R-C_4)}$$

$$p_3 = \frac{3p_1R+(1-p_1)(E_3+E_4)}{p_1(5R-3C_1)+(1-p_1)(E_3+E_4)}$$

(3) Result analysis

It is not difficult to see from the above results p_1 and p_3 is proportional, when the probability of bank supervision is bigger; the probability of financing enterprise to select the normal production is greater. From the analysis of the results, In order to reduce the risk of loans, bank can increase the punishment, reduce the risk of collusion. Actively cooperate with logistics enterprises to reduce the information asymmetry in the loan activities, so as to improve the probability of financing enterprises to select the normal production. The higher the probability of success of the investment risk project, the greater the possibility of financing companies choose to invest in high-risk projects, the probability of selection of normal production is smaller, So p_1 and p_2 inversely, so p_2 and p_3 is inversely proportional too, that is, the greater the probability of success of the investment risk project, the lower the probability of the normal production of financing companies choose to produce, the greater the probability of the bank's choice of supervision. In this case, the bank should actively improve their business level, grasp the market trends, understand the financial market investment tendency, and reduce the probability of enterprises to choose high risk projects.

Through the above analysis of the three party logistics financial business, the main body of the game is determined in different cases, the main income, which provides a basis for the development of logistics finance business. Each subject can be determined by analyzing the interests of different situations. For banks, we should always strengthen supervision, to guard against the emergence of conspiracy to fraud on the market. For logistics enterprises, we should improve the inventory management capabilities; reduce inventory costs, so that even in the case of financing enterprises default can also guarantee their own interests. And for the main risk sources of financing enterprises, still should choose to normal business activities, as the opportunity cost of commercial fraud caused is unpredictable.

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