Research on the Evaluation of Supply Chain Finance Credit Risk of Small and Medium-Sized Enterprise Based on System Dynamics

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Abstract
Supply chain finance is an efficient method to solve small and medium-sized enterprise's financing problem. An important issue is to simulate the supply chain finance system's credit risk. This paper will use the method of system dynamics, basing on the small and medium-sized enterprise finance credit risk, through analysing the effect of financial risk, non-financial risk and environmental risk on credit risk. Building system dynamics model and simulation in Vensim PLE, according to the factors that affect the credit risk, the risk management and avoidance methods are put forward.
Key words：*supply chain finance; small and medium sized enterprises; system dynamics; credit risk; assessment of risk*

1 Introduction

The small and medium-sized enterprise creates about 60% of GDP of import and export. It is the basis of economic status in the country, plays an important role in the stable employment and expand domestic demands and so on. Small and medium-sized enterprises due to the low transparency of financial information and financial indicators is difficult to meet the criteria and mortgage assets less reasons, has been difficult to the traditional methods to obtain financing. With the expansion of economic scale, supply chain finance become effective way for deals with the small and medium-sized enterprise financing difficult to the entire supply chain caused by "short barrels edge" and "cost depression effect". In addition, in recent years has attracted much attention of big data to supply chain finance brings new opportunities and challenges.

Dmitry Krass[1]studied several important aspects of using environmental taxes to motivate the choice of innovative and "green" emissions-reducing technologies as well as the role of fixed cost subsidies and consumer rebates in this process. Fairchild, Alea[2] do a certain research on the integration efficiency of the financial supply chain intelligent matching. Silvestro, R. & Lustrato. P. (2014)[3]analysis in the supply chain finance in the supply chain in the integration of financial and physical supply chain. Hartley-Urquhart[4]. Roland research on the global supply chain finance outsourcing and logistics.

Supply chain finance is based on the core enterprise, with the supply chain overall control

credit risk instead of medium and small businesses are not controllable credit risk to reduce bank lending to the uncertainty of the small and medium-sized enterprises, so as to effectively alleviate the financing problem of small and medium-sized enterprises of the new financial model. Therefore, credit risk is the core problem of the supply chain finance. At present, the typical personal credit scoring system includes FICO system, Zest Finance and sesame.

System dynamics can solve a wide variety of complex social problems, and in the case of insufficient data, it can still be simulated. At present, the domestic and foreign credit risk evaluation of the traditional methods ignore the complex nature of the supply chain, dynamic evolution, and the complex system from the point of view of the study are the lack of "enterprise based on certain preference for the local world preferential partner selection" description. At the same time, the existing research on the measure of the whole supply chain credit risk is not comprehensive considering the influence of all enterprises and compare the status of each enterprise, the deviation caused by the evaluation results. In addition, in the big data environment, for risk assessment data with greater depth and breadth, therefore, using the system dynamics in this paper, the qualitative and quantitative analysis on Supply Chain Finance may exist in credit risk and puts forward risk. And propose solutions to risk management.

2. Model building

In the past, enterprise credits evaluation indicators are character, capacity, capital, collateral and condition. These indicators are too general to effectively reflect the risk of bank investors. Because the financial system is not perfect and the enterprise financial information distortion is serious, using financial index simply is not accurate to evaluate the credit risk. It needs to add the non-financial indicators and environment indicators. The causal loop diagram like Fig.1.

2.1 Financial risk

The financial risk is the visual expression of the enterprise management and development, reflecting the business situation of the past and the future of the enterprise. This paper through the profit growth rate and inventory turnover rate to assess the financial indicators.

2.2 Non financial risk

Non-financial risk through the management quality, technical personnel proportion, new product development ability, market share to evaluate the risk.

2.3 Environment risk

There are three important factor influence environment risks: economic risk, government support and industry risk.

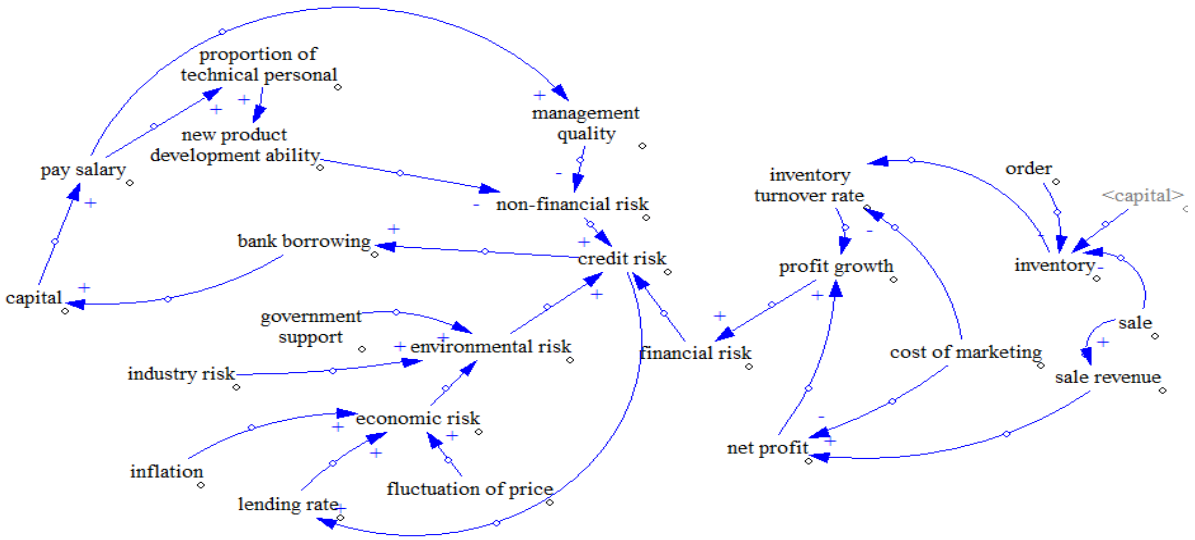

Fig. 1 – Causal loop diagram of the model

There are three main feedbacks on the loop. Something can be known from the Fig.1:

a) When financial risk, non-financial risk and environment risk increase, the credit risk will increase.

b) When credit risks to increase, bank borrowing will increase, capital will increase, so enterprise can have more capital to pay salary. Then enterprise can development more newer product to reduce non-financial risk. If have low non-financial risk, the credit risk can also reduce.

c) When inventory's sale increase, inventory turnover will fast and profit will increase, so the financial risk will reduce.

d) If credit risk increase, bank will increase the lending rate, which will increase economic risk. So the environmental risk increases, which lead to credit risk increase. This is a vicious cycle.

3. Simulation and result analysis

Make a system dynamics flow diagram (Fig.2)

By entering the risk factors and dynamics equations into the simulation software Vensim PLE, click on the run, we can get the credit risk, financial risk, non-financial risk and environmental risk.

According to the general characteristics of small and medium enterprises, this paper selects three set of data. Because the simulation process is mainly qualitative analysis, the specific numerical changes do not affect the conclusions of this paper.

3.1 change in inventory turnover

With the change in sales, inventory turnover will change，and financial risk is changing

regularly. There are three situations in the simulation: (1) the enterprise sales have been unchanged, (2) the monthly increase of ten percent and (3) the monthly increase of twenty percent. We can get the graph for credit risk (as Fig.3)

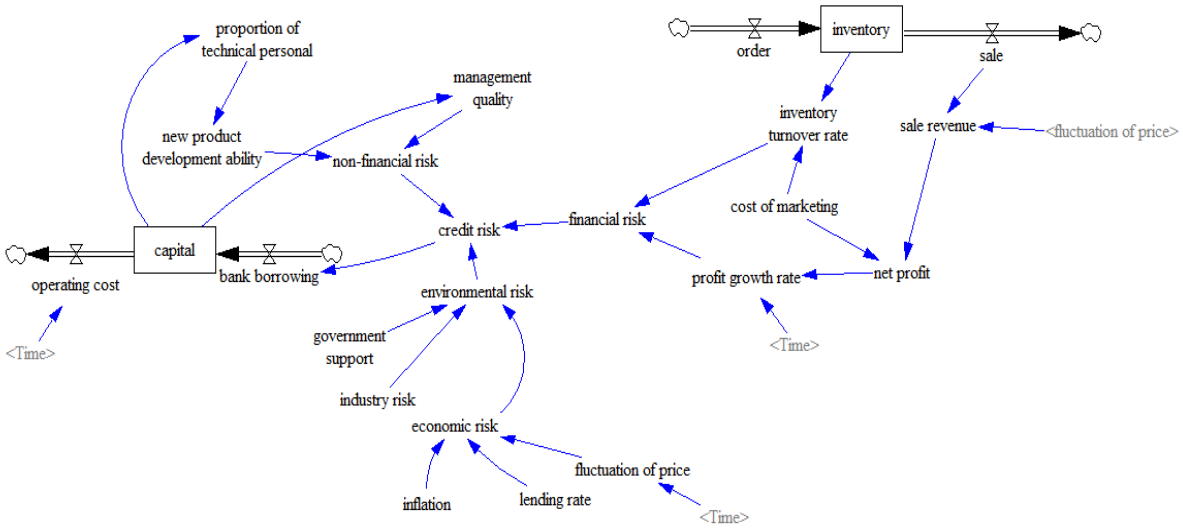

Fig. 2 – flow diagram of credit risk

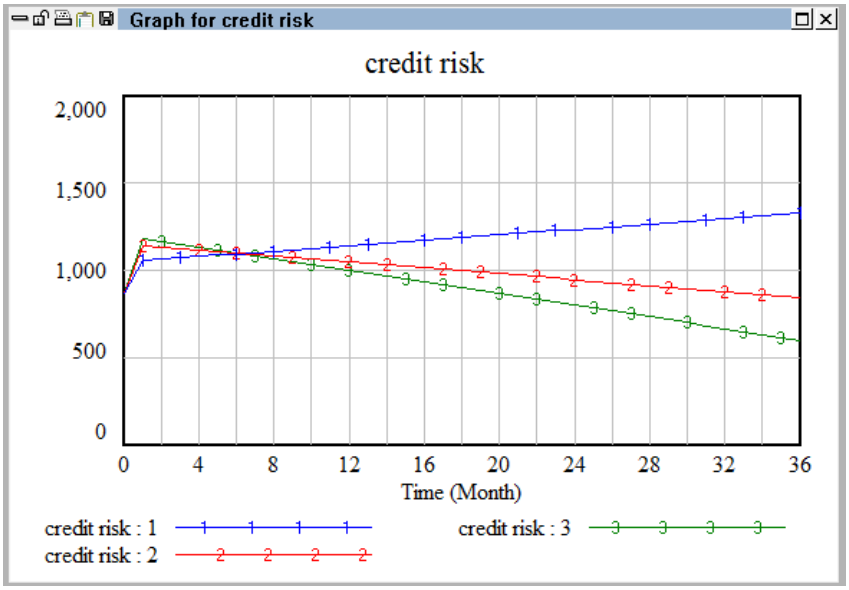

Fig.3 – grapg for credit risk in three sets

It is seen from the simulation results, when there is no change in the sales, proportional to the credit risk increases (curve 1). When increasing sales 10 percent, can obviously see risk began to decrease (curve 2). When increasing sales 20 percent (such as curve 3), credit risk reduces more, in the first month of credit risk highest, because there may be no sales.

3.2 change in environmental risk

When also change of government support (the amount of product is energy saving, the

government's strong support), industry risk and economic risk, we can see the change of environmental risk. Slope variation in the risk environment change will not affect the credit risk, but will influence risk is parallel to the move.

There are three situations in the simulation:（1）no change, (2) Government support increased by ten percent,（3）industry risk increased by ten percent, (4) lending rate increased by ten percent, (5) lending rate reduced by ten percent(as Fig.4).

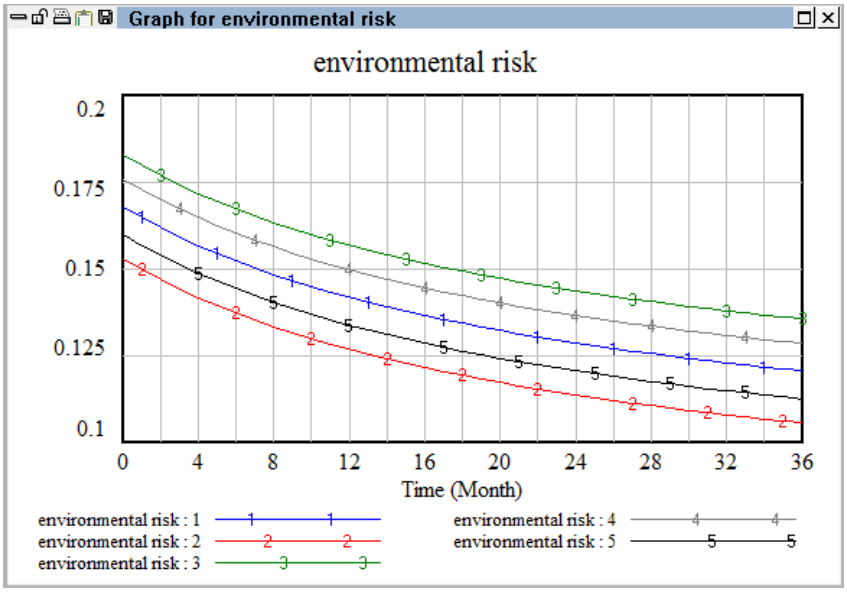

Fig.4 – environmental risk in five sets

In the same parameters, the environmental risk is gradually reduced, the single never reduced to 0 (such as curve 1). When increasing government support ten percent, the environmental risk of parallel moving down, lower risk (such as curve 2). That is to say the government more support enterprise, environment risk is low when the industry risk. When industry risk increased by ten percent, the highest environmental risk (such as curve 3). That is to say, the environmental risk of sunset industry will be higher, in the evaluation of credit risk, credit risk is the highest of the sunset industry. When the lending rate increased to ten percent (such as curve 4), the environmental risk is higher than that of no change, less than a ten percent increase in the risk of industry when the lending rate is reduced by ten percent, the environmental risk is higher than that of the government support is increased by 10%, lower than the change.

4. Conclusion

This paper will evaluate the application of system dynamics in the process of credit risk, with qualitative and quantitative analysis of influence of thinking of small and medium-sized enterprises in the supply chain finance credit risk. Based on the analysis of the financial risk, non-financial risk and environmental risk module, this paper established the credit risk of the

stock flow diagram, and simulated by Vensim PLE. The simulation results show that the support of the government, industry risk, loan interest rate and have indirect impact on credit risk, and credit risk will not affect the overall trend. The inventory turnover ratio impacts on the credit risk of the strong. But enterprise can't just look at the isolated financial risk without considering the non-financial risk and environmental risk. At the same time, enterprises need most the risk management of financial risk control, the development of their own products, try to choose the government supporting industries and new industries, improving their own influence in the industry.

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