Research on SMEs’ Credit Risk Evaluation of Supply Chain Finance Based on the Third-party B2B Platform
Zhen-hong XIAO\(^1,a\) and Mei-gui TAN\(^1,b,\ast\)

\(^1\)Harbin Engineering University, Harbin, Heilongjiang, China
\(^a\)xzh6030795@sina.com,\(^b\)mgtan1916@163.com
\(\ast\)Corresponding author

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Abstract. Under the impact of the Internet finance, big data and cloud computing, supply chain finance began to extend into e-commerce. The cooperation between the banks and the third-party B2B platform, making supply chain financing model based on third party B2B platforms came into being. But with the innovation of the financing mode, banks are facing new risks. The paper establishes the evaluation index system by analyzing the main risks of the participants in this financing mode and the mode of credit risk by using the entropy, AHP and fuzzy TOPSIS model of left and right score. Finally, the paper applies the mode to the concrete instance and carries out the credit risk ordering. The result shows the reasonable and feasibility of the evaluation model, providing a basis for the choice of credit targets for Banks and other financial institutions.

Introduction

With the development of Internet financial innovation in China, Banks and other financial institutions have cooperated with third-party B2B platforms to promote the transformation of supply chain finance from offline "1+N" mode to online mode. In this financing mode, the third-party B2B platform helps Banks explore and filter the target customers through mass transaction data and information monitoring technology. The bank relies on the SMEs’ transaction information and electronic credit rating to provide comprehensive financial services for upstream and downstream enterprises in the supply chain, and realizes the effective combination of logistics, capital flow, information flow and commercial flow, which further improves the financing efficiency and reduces the financing cost. However, due to the increase of participants in this mode, the risks of financial institutions have changed, and the most important is credit risk. Therefore, this paper studies the credit risk of SMEs based on this financing model.


To sum up, the current research focuses on the discussion and risk identification of the supply chain financing mode of e-commerce platform, but the research on credit risk assessment and
empirical research is lacking, and the research on the third-party B2B platform is more lacking in these two aspects. This paper will start from the weak points of the research, and based on the perspective of financial institutions such as Banks, establish an evaluation index system, and combine the qualitative and quantitative methods to make up for the deficiencies of the current model, so as to provide certain reference for the theoretical circle and the industry.

**Construction of credit risk evaluation index system for SMEs**

In terms of index system construction, the relevant literature in the traditional supply chain financing mode is mainly discussed in terms of SMEs' qualification, core enterprise qualification, supply chain operation and financing project status. However, considering the impact of third-party B2B platform and the weakness of the financing risk of traditional supply chains in this mode, we improved the former credit risk evaluation index system. For the specific risk in the model, we use expert research to supplement the initial index. At the same time, referring to the previous literature, the relevant initial indicators are finally obtained.

Next, through the expert scoring method, the obtained indexes were filtered through the questionnaire survey to senior bank account managers and university experts. Through the summary statistics of valid questionnaires, the corresponding score frequency, mean value and variation coefficient were calculated, and 32 indexes with the mean value greater than 4 and the variation coefficient less than 20% were selected. Finally established the index system as shown in table 1.

**Table 1. Credit risk evaluation index system of small and medium-sized enterprises in supply chain financing of third party B2B e-commerce platform.**

<table>
<thead>
<tr>
<th>Level indicators</th>
<th>The secondary indicators</th>
<th>Level 3 indicators</th>
<th>attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application for enterprise qualification</td>
<td>Profitability</td>
<td>Profit rate of sales</td>
<td>quantitative</td>
</tr>
<tr>
<td>Development potential</td>
<td>Total return on assets</td>
<td>Total return on assets</td>
<td>quantitative</td>
</tr>
<tr>
<td>Debt paying ability</td>
<td>Sales revenue growth rate</td>
<td>Sales revenue growth rate</td>
<td>quantitative</td>
</tr>
<tr>
<td>Quality of an enterprise</td>
<td>New product development capability</td>
<td>New product development capability</td>
<td>qualitative</td>
</tr>
<tr>
<td>Operation ability</td>
<td>Corporate governance level</td>
<td>Corporate governance level</td>
<td>qualitative</td>
</tr>
<tr>
<td>Qualification of core enterprise</td>
<td>Debt paying ability</td>
<td>Current ratio</td>
<td>quantitative</td>
</tr>
<tr>
<td>Development potential</td>
<td>Asset-liability ratio</td>
<td>Asset-liability ratio</td>
<td>quantitative</td>
</tr>
<tr>
<td>Credit level</td>
<td>Profit rate of sales</td>
<td>Profit rate of sales</td>
<td>quantitative</td>
</tr>
<tr>
<td>Industry status</td>
<td>Credit rating</td>
<td>Credit rating</td>
<td>qualitative</td>
</tr>
<tr>
<td>E-commerce platform risk</td>
<td>Total assets turnover</td>
<td>Total assets turnover</td>
<td>quantitative</td>
</tr>
<tr>
<td>The degree of cooperation between enterprises</td>
<td>Accounts receivable turnover rate</td>
<td>Accounts receivable turnover rate</td>
<td>quantitative</td>
</tr>
<tr>
<td>Operational risk of supply chain</td>
<td>Strength of the platform</td>
<td>Platform turnover</td>
<td>quantitative</td>
</tr>
<tr>
<td>The degree of cooperation between enterprises</td>
<td>Platform transaction rate</td>
<td>Platform transaction rate</td>
<td>quantitative</td>
</tr>
<tr>
<td>Condition of logistics</td>
<td>Staff quality and ability</td>
<td>Staff quality and ability</td>
<td>qualitative</td>
</tr>
<tr>
<td>Financing project risk</td>
<td>Legal rate of membership</td>
<td>Legal rate of membership</td>
<td>quantitative</td>
</tr>
<tr>
<td>Condition of logistics</td>
<td>The timeliness of transaction information feedback</td>
<td>The timeliness of transaction information feedback</td>
<td>qualitative</td>
</tr>
<tr>
<td>The degree of information management</td>
<td>The completeness of the information system</td>
<td>The completeness of the information system</td>
<td>qualitative</td>
</tr>
<tr>
<td>Information sharing level</td>
<td>Information sharing level</td>
<td>Information sharing level</td>
<td>qualitative</td>
</tr>
<tr>
<td>Operational risk of supply chain</td>
<td>Status of the industry</td>
<td>Macroeconomic situation</td>
<td>qualitative</td>
</tr>
<tr>
<td>The degree of cooperation between enterprises</td>
<td>Industry growth rate</td>
<td>Industry growth rate</td>
<td>quantitative</td>
</tr>
<tr>
<td>Condition of logistics</td>
<td>Frequency of cooperation</td>
<td>Frequency of cooperation</td>
<td>qualitative</td>
</tr>
<tr>
<td>Condition of regulatory system</td>
<td>Percentage of default</td>
<td>Percentage of default</td>
<td>quantitative</td>
</tr>
</tbody>
</table>

The construction of evaluation model

Because of the ambiguity and incompleteness of non-financial indicators, this paper uses the vague TOPSIS method to give the decision-making matrix and the first index weight to the triangle. However, in view of the difficulty of applying fuzzy TOPSIS directly to the multi-level index system, it is solved by referring to Zhou Wenkun (2015) based on the fuzzy TOPSIS of left and right scores. [11]

The combination of evaluation indicators

According to the advantages and disadvantages of entropy method and analytic hierarchy process,
this paper selects the combination weighting to determine the final weight. The entropy method is used to determine the objective weight, the analytic hierarchy process determines the subjective weight, and finally, the combined weight coefficient is determined based on the deviation square and the minimum model, so that the expert opinion can be retained, and the result is effectively combined with the actual data.

Using a vague TOPSIS score to make a general assessment

The steps are as follows:

1. To construct fuzzy decision matrix and fuzzy weight matrix for each financing enterprise under the grade 1 index.
2. To normalize the triangulation in the fuzzy decision matrix.
3. By the standardization of the fuzzy decision matrix and standardization about fuzzy weight matrix to score interval matrix.
4. Calculate the distance from solution i to positive and negative ideal solutions.
5. To calculate the average degree of proximity of each solution, and the ranking of the pros and cons.

Application analysis

In this paper, a case study of five enterprises in the supply chain financing on the third party B2B platform is used to analyze the application of the above risk assessment model. Through the investigation of the B2B platform and the bank, Ping An bank and its two third-party B2B e-commerce platforms are selected. The supply chain situation is: two core businesses C and D, and C is in the industry of appliances, and D is in the chemical industry. Among them, there are three SMEs(C1, C2, C3) in the core enterprise C supply chain, which provide various electronic components. In the core enterprise D supply chain, there are two enterprises D1 and D2. They are respectively in the upstream and downstream of the D supply chain, and respectively provide raw material supply and mechanical manufacturing. C2 and D1 are financed through accounts receivable, and the rest are financed by means of pledge. On the basis of obtaining relevant financial data and expert grading, this paper sorts out credit risk of five small enterprises. The quantitative data of e-commerce platform is obtained through China e-commerce data center.

1) The acquisition of the three-level index and the determination of the weight of entropy method.

The quantitative data are obtained through multiple surveys and questionnaires of SMEs in the supply chain. In view of the experts' understanding of these enterprises, this paper selects the bank credit department manager and credit staff to score the qualitative indicators. The obtained data is calculated by the entropy method.

2) The determination of index weight of analytic hierarchy process.

42 questionnaires are issued to the institutional experts in each region by way of a working email, and 34 questionnaires are issued to each bank credit manager engaged in the field by means of working emails and mailing. Eventually to recover a total of 22 questionnaires survey. The questionnaire consists of two parts, the first part is the scoring of the importance degree of the secondary index, and the second part is the scoring of the fuzzy weight of the level-one index.

3) Determination of the combined weight.

The combined weight of the secondary index relative to the primary indicator is weighted by the results obtained above.

4) Determination of initial fuzzy decision matrix.

The evaluation set is set to seven grades, and the second level indicator is scored by the bank credit manager and the credit personnel. Thus, the fuzzy average score of the secondary index is obtained. Then the fuzzy scoring of the first level index is obtained, which is to get the initial fuzzy decision matrix.

5) Calculate the fuzzy weight of primary index.

All the experts grade the fuzzy weight by referring to the first grade index, and finally get the fuzzy weight score of the first-level indicators.
Use the fuzzy TOPSIS of left and right score to calculate and sort. The obtained fuzzy decision matrix is programmed by using MATLAB software so as to obtain the interval matrix of the fuzzy weight matrix $Q_i$.

$$Q_i = \begin{bmatrix} (0.84, 0.96) & (0.79, 0.93) & (0.73, 0.86) & (0.77, 0.91) & (0.88, 0.98) \end{bmatrix}$$

Then use the lingo software to solve it, and get the average degree $C^m_i$ of the solution.

$$C^m_i = (C_1 \cdot C_3 \cdot D_1 \cdot D_2) = (0.86, 0.79, 0.82, 0.84, 0.78)$$

Thus, the ranking status of enterprises is $C_1 > C_3 > C_2 > D_2$, Among them, the optimal financing object is $C_1$, This is consistent with the bank's eventual choice of credit, and it tests the usefulness of the model.

Summary

According to the characteristic of SMEs’ supply chain financing model based on the third-party B2B e-commerce platform, we established the evaluation index system of credit risk, combined with the fuzzy data and actual data, the quantitative and qualitative analysis, effectively assessing the credit risk of SMEs. Meanwhile, based on the application of MATLAB and LINGO software, the workload of calculation is greatly reduced.

Based on the above process, we also have the following conclusions: First, the risk of e-commerce platform is an important factor influencing the credit risk of SMEs. Next, The risk of financing project, application for enterprise qualification still have significant influence on the credit risk of SMEs in this mode.

In view of the conclusions drawn, the following recommendations are made to promote the development of the financing model. First, The financial institutions should improve the corresponding credit risk evaluation system, and make early warning and preventive measures in case of crisis. Secondly, The e-commerce platform should strengthen the supervision, strictly control the access of SMEs. Finally, the SMEs should maintain a good credit status.

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References


