Research on Credit Evaluation of 3PL Enterprises Based on FAHP

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Abstract: The credit lack of third-party logistics enterprises has severely hampered the healthy development of the industry. This article establish the credit evaluation index system for third-party logistics enterprises based on the analysis of factors influencing the credit for a comprehensive, objective, scientific credit level evaluation. The authors determine the weight of every evaluation index with Fuzzy Analytic Hierarchy Process (F-AHP) and present the methods and steps of evaluating credit level for third-party logistics enterprises. Finally, four actual examples of third-party logistics enterprises are presented to demonstrate the proposed method and get the comprehensive credit level evaluation values which can be compared each other.

Keywords: Fuzzy-AHP method, 3PL, index system, credit evaluation

1 Introduction

As the development of economic, third-party logistics (3PL) serves a more and more important role. Different from the traditional private logistics, 3PL is typical contract logistics. For the demand-side and supply-side, it is very important to trust each other in case of different time and space when doing business. A 3PL provider should build a close relationship with customers and trust each other, in order to know the customers better and offer better service and reach a win-win situation at last. This kind of close relationship is based on the sincerely manage of the logistics enterprise and good credit. Credit is of fundamental importance to the development of 3PL. However, in recent time, third-party logistics enterprise is known for its lack of credit, which severely hampers its development. It is very important to evaluate the level of credit comprehensively, objectively and scientifically. As the development of credit evaluation, people have gained a lot of experience, including expert judgment (e.g., 5C, 5P, financial ratio analysis method), multivariate statistical models based on statistic descriminant technique (Z-Score model, ZETA model, Logit model), credit evaluation model based on artificial intelligence (e.g., artificial neural nets)(Yu,2008) and net comprehensive evaluation(Jharkharia and Shankar,2007).

In this paper, we set up the credit evaluation index system of third-party logistics enterprises based on the analysis of factors influencing the credit of third-party logistics enterprises. Then, we obtain the evaluation target weight by using the Fuzzy Analytic Hierarchy Process (F-AHP)( Liu and Wang,2009). Compared to the Analytic Hierarchy Process (AHP), the F-AHP overcomes the difficulty of dependence on the subjective judge of the experts and has advantage when doing consistency check. Finally, we present the methods and steps of evaluating credit level for third-party logistics enterprises.

2 Factors Influencing the Credit of Third-party Logistics Enterprises

2.1 Credit philosophy
Credit philosophy which reflects the business philosophy of credit service and fulfills the wishes of the contract, includes three aspects: the quality of personnel, team structure and credit culture. The third-party logistics provides services to the logistics client, meanwhile, it bears the risk of transportation, storage and other services. Some non-financial indicators, such as the central idea of business managers, experience, education, law-abiding behavior, the age structure of business team, educational
background and business culture and so on. All of the above factors affect the level of their overall credit.

2.2 Credit ability
Credit ability is mainly based on the information of the financial indicator of third-party logistics, inflecting the ability of business development. It includes four aspects: ability of repay debt, ability of operations, profitability and ability of future development. Ability of repay debt is referred to the information of corporate debt rate, liquidity ratio, debt to equity ratio and cash flow and other information. Ability of Operations includes inventory turnover ratio, accounts receivable turnover ratio and total asset turnover ratio and other information. Profitability includes return on equity, total assets profit margin and so on. Here we introduce the indicator of future development ability. In the evaluation system for the credit of the 3PL enterprises, the business prospects for the future development has a certain influence on credit rating. Unclearness of the direction of future development of enterprises and gloomy market conditions will influence the level of corporate credit. The ability of future development includes industry experience, strategy implementation, system construction, the cycle of service innovation and so on.

2.3 Credit environment
Credit environment, which is third-party logistics enterprises face external business environment, mainly reflects the government's relevant policies and market developments and includes two aspects, the intensity of government regulation and market competition. As third-party logistics market started later in China, many companies did not compare with brand, but compete for lower prices, and expand the responsibility for vicious price competition blindly. Government regulation can regulate the market order, control the macro regulation, enhance the transparency of information of logistics market and construct the credit system of logistics industry and supervision of incentive system. The situation of market competition mainly refers to the chaotic situation of the third party logistics market, and whether vicious competitions exacerbates the risk of corporate default.

2.4 Credit history
The credit history of third-party logistics provider mainly reflects the quality of enterprises services. Here we select three aspects: the customer satisfaction, contract compliance rate and the accident rate of compensation. The construction of credit of the third party logistics is almost from scratch. If we can meet with the requirements of the customers, the enterprises would not only win the favor of the customers again, but also increase the level of business credit. If the business contract compliance rate is too low to meet customers’ requirements, the customers would be bound to select other enterprises, which would not only lead to lose of customers, but lose of credit as well. The demander of logistics will entrust all the goods to the third party logistics. If the whole goods can arrive safely or will not lose or have no other quality issues, the initiative will stand by the third party logistics. To a certain extent, accident rate of compensation will reflect the level of business credit.
3 Construction the Credit Evaluation Index System of Third-party Logistics Enterprises

Generally, the credit evaluation index system of business includes two types of qualitative and quantitative indicators. The third party logistics enterprise establishes relationship of cooperation and trust with their customers, and adheres to the principles of customer-oriented, focusing on customer evaluation of third-party logistics services \(^6\). Therefore, this article increases the relevant indicators of customers’ evaluation of third-party logistics services from the credit history. Based on the analysis of factors influencing the credit of third party logistics enterprises and the principles of systematic, scientific, comparability, feasibility and objectivity, we construct the credit evaluation system for third-party logistics enterprise as figure 1, by selecting the relevant credit evaluation indicators from four aspects: credit philosophy, credit ability, credit history and credit environment.

4 The Methods And Steps of Credit Evaluation For 3PL Enterprises
4.1 F-AHP model
Fuzzy AHP (F-AHP) is an integrated evaluation method, which combines fuzzy mathematics with the AHP, and is an extension of AHP method under the fuzzy environment. F-AHP transforms the ‘Construction Matrix’ into ‘construct fuzzy consistent matrix’ of AHP\textsuperscript{[7]}. Evaluation based on fuzzy consistent matrix program with a fuzzy optimal selection of the preferred can obtain relatively satisfied results. The key steps are as follows:
1. Transform the priority relationship matrix into fuzzy consistent matrix. Sum the fuzzy complementary matrix $R = (r_{ij})_{n \times n}$ by row:
\[ r_i = \sum_{k=1}^{n} r_{ik}, \quad i = 1, 2, ..., n \]
Be mathematical transformed as follows:
\[ r'_i = \frac{(r_i - r_j)}{2n + 0.5} \quad (1) \]
The transformed matrix is a fuzzy consistent matrix\textsuperscript{[1]}.
2. Fuzzy consistent matrix consistency test.
   - Step one, Determine one element which importance comparing with the rest is confident. Without loss of generality, suppose the policy-makers have good judgments on $r_{11}, r_{12}, \ldots, r_{1n}$.
   - Step two, the first row elements of $R$ minus the second line of the corresponding elements. if the differences of $n$ is a constant, there is no need to adjust the second row. Otherwise, it is necessary to adjust the second row, until the differences of the first row elements minus the second row of the corresponding elements are constant.
Repeat the above steps, until the differences of the first row elements minus the corresponding elements of the nth row of are constant.
3. Weight calculation. If $R$ is a fuzzy consistent matrix, then there be an n-dimensional non-negative normalized vector $W = (w_1, w_2, \ldots, w_n)^T$ and a positive number $a$, to ensure $r_i = a(w_i - w_j) + 0.5 \quad \forall i, j$
   - be established \textsuperscript{[9]}.
   - fix $i$, $w_i = \frac{1}{a}(r_{ii} - \frac{1}{2}) + w_i, \quad k = 1, 2, \ldots, n$
   - then sum for $k$:
\[ nw_i = \frac{1}{a} \sum_{k=1}^{n} r_{ik} - \frac{n}{2a} + \sum_{k=1}^{n} w_k, \]
Because the normalization condition $\sum_{i=1}^{n} w_i = 1$ , we get the formula for weight calculation:
\[ w_i = \frac{1}{n} - \frac{1}{2a} + \frac{1}{na} \sum_{k=1}^{n} r_{ik}, i = 1, 2, \ldots, n \quad (2) \]
Here, the smaller $a$ is, the greater is the difference of weight, indicating that policy makers attach greater importance to an important degree of difference between elements. Practically, we generally take $a = (n - 1)/2$. In fact, this is the method that attach most importance to the difference between elements\textsuperscript{[4]}.

4.2 Analysis of example
This article selects four typical third-party logistics enterprises that located in Nanjing, and respectively records Enterprise 1, Enterprise 2, Enterprise 3 and Enterprise 4. We evaluate the credit level of the four 3PL enterprises follow the steps and methods given above.
Step one, we establish the Credit Evaluation System shown in Figure 1, whose criteria level contains four criteria guidelines. The Index layer constitutes 12 specific targets.

Step two, the delphi method is used to collect opinions of nine experts, obtain the average scoring of criteria level and index level indicators.

<table>
<thead>
<tr>
<th>A</th>
<th>(Target layer)</th>
<th>Credit Evaluation of 3PL Enterprises</th>
</tr>
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<tbody>
<tr>
<td>B</td>
<td>(Criteria layer)</td>
<td>Credit Philosophy</td>
</tr>
<tr>
<td>C</td>
<td>Evaluation index</td>
<td>QP</td>
</tr>
<tr>
<td>D</td>
<td>Enterprise 1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Enterprise 2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Enterprise 3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Enterprise 4</td>
<td>8</td>
</tr>
</tbody>
</table>

from expert, the results are shown in Table 1. We established the priority relation matrixes of different levels. (fuzzy complementary matrix) and A-B relationship matrix is shown in Table 2.

| B-C priority relation matrix (for B1), B-C priority relation matrix (for B2), B-C priority relation matrix (for B3), B-C priority relation matrix (for B4) are not listed.

Step three, In accordance to the conversion formula (1), transform the above matrix of priority relations (fuzzy complementary matrix) into a fuzzy consistent matrix, and check the consistency of the converted matrix. The results are shown in Table 3.

<table>
<thead>
<tr>
<th>Table 2: A-B relationship matrix</th>
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<tbody>
<tr>
<td>Index A</td>
</tr>
<tr>
<td>B1</td>
</tr>
<tr>
<td>B2</td>
</tr>
<tr>
<td>B3</td>
</tr>
<tr>
<td>B4</td>
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<table>
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<th>Table 3: A-B fuzzy consistent matrix</th>
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<tbody>
<tr>
<td>Index A</td>
</tr>
<tr>
<td>B1</td>
</tr>
<tr>
<td>B2</td>
</tr>
<tr>
<td>B3</td>
</tr>
<tr>
<td>B4</td>
</tr>
</tbody>
</table>
Step four, According to the weight formula (2), calculate the weight value of each factor at every level, and evaluate the credit level of each third party logistics enterprise, according to experts scoring. 

B₁, B₂, B₃, B₄ about the weight value for A: 
\[ W = (0.283, 0.217, 0.183, 0.317)^T \].

C layer weights value of 1-12 elements relative to B₁, B₂, B₃, B₄:

\[ W_1 = (0.333, 0.383, 0.283)^T; \]
\[ W_2 = (0.342, 0.267, 0.308, 0.408)^T; \]
\[ W_3 = (0.45, 0.55)^T; \]
\[ W_4 = (0.333, 0.383, 0.283)^T; \]

When weights have been determined, experts score the four third-party logistics enterprises, according to Table 1. Indicators of the importance degree of the C level about logistics enterprises are \( C_{ijk} \) (i is the Policy objectives, j is the sub-objective decision-making, k is the third-party logistics enterprise), then we can calculate the value of comprehensive credit rating for each third-party logistics enterprises \( D_{ik}(k=1, 2, 3, 4) \). For example, the important degree of the enterprise 1 for policy objectives is \( D_{11} = (6,8,8)^T \ast W_1 = 7.326 \), and same values can be calculated for \( D_{12}, D_{13}, D_{14} \). The result is \( D_{1} = (7.326, 9.008, 7.55, 6.71)^T \), then we can calculate the integrated evaluation weight values of each enterprises:

\[ D_2 = (7.659, 10.675, 8.1, 7.609)^T; \]
\[ D_3 = (7.176, 10.433, 6.7, 3.76)^T; \]
\[ D_4 = (7.709, 9.608, 7.55, 7.093)^T. \]

Then according to the weight \( W \), calculate the integrated value of the credit level for each third-party logistics enterprises:

\[ M_k = D_k \ast W \quad k = 1, 2, 3, 4 \]

The results are: \( M_1 = 7.537, M_2 = 8.377, M_3 = 7.731, M_4 = 7.897 \). We can be seen that the logistics enterprise 2 has the highest value of the credit.

5 Conclusion

Using F-AHP model, we can combine qualitative assessment with quantitative analysis, and convert third-party logistics enterprise credit evaluation problem into a simple and practical evaluation system model. The data of evaluate process can reflects the enterprise's credit weaknesses and can help enterprises improve their credit levels, thus to promote the healthy and rapid development of the industry. We hope discuss above can provide a new credit level evaluation method of third-party logistics enterprises for logistics industry supervisor organization and logistics demanders. (This paper is sustained by Fund of Jiangsu Philosophy and Social Science ("third-party logistics enterprise's credit evaluation studies", ID: 08SJB6300013).

References


