Study of Three-Dimensional Financial Risk Early Warning Positioning of Food Enterprises Based on Macroeconomic Risk Identification

YU ZHANG, ZHE WANG and YING PENG

ABSTRACT

The operation of food enterprises cannot be separated from the influence of the macroeconomic factors. This paper discussed food enterprise financial risk early-warning index and corresponding macroeconomic indicators, and then designed three dimensions of the preparation of risk early warning index including operating, investing and financing. We also put forward the three-dimensional financial risk prevention and control measures. This analysis provides effective path for food enterprise to cope with complex macroeconomic environment risk.

KEYWORDS

Macroeconomic factors, food enterprise, financial risk, entropy method, risk early warning positioning.

INTRODUCTION

Macroeconomic risk is an important factor affecting the positioning of early warning in the process of financial risk early warning of food enterprises. In recent years, domestic and foreign scholars have noticed the impact of macroeconomic factors on corporate financial risk, and made a useful exploration. Ren Huiguang and Banbo (2007) used Logit regression model and the neural network model to demonstrate the consumer price index. The growth rate M1 and M2 has a significant impact on corporate financial risk. Wu Xingze (2011) reconstructed the framework of corporate financial crisis early warning from the aspects of embedded stakeholders and the impact on corporate financial situation. Lu Yongyan (2013) used the panel Logit model to demonstrate the GDP growth rate and the loan interest rate has a significant effect on the corporate financial risk.

Although the academia has recognized the important impact of macroeconomic risks on corporate financial risk financial risk early warning, the existing literature does not identify the risk state of food enterprises through the effective identification of macroeconomic risk. Therefore, this paper identifies the macroeconomic risk factors of the business activities, investment activities and financing activities of food enterprises, prepares a risk early warning index, effectively locates the level of risk and provides an effective reference basis for decision-making.

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ANALYSIS ON FINANCIAL RISK EARLY WARNING MECHANISM OF FOOD ENTERPRISES

The goal of maximizing the profitability of food enterprises is to revolve around the circulation of cash flow. Cash flows in food enterprises through business activities, investment activities and financing activities, and this constitutes a dynamic cash flow. Therefore, this paper divides the macro environment risk into three aspects: business environment risk, investment environment risk and financing environment risk.

Analysis on business environment risk identification
It is necessary to consider the industry average cash sales net profit rate, the whole society raw material purchase price index and the whole society wage growth rate in the process of risk early warning analysis of the business activities.

2) Analysis on investment environment risk identification
It is necessary to consider the industry average ROE and the purchase price index of the fixed assets of the whole society in the process of risk early warning analysis of the investment activities.

3) Analysis on financing environment risk identification
It is necessary to consider the annual interest rate of central bank loan in the process of risk early warning analysis of the financing activities.

MEASUREMENT OF FINANCIAL RISK EARLY WARNING INDEX OF FOOD ENTERPRISES BASED ON MACROECONOMIC RISK IDENTIFICATION

The Financial Risk Early Warning Index System of Food Enterprises

Based on the above analysis, the author selected macroeconomic risk index combined with financial risk index of food enterprises, as shown in Table 1 and Table 2.

Three-Dimensional Financial Risk Warning Index of Food Enterprises
The core idea of three-dimensional positioning model of food enterprise financial risk early warning is to compare the financial risk monitoring indexes at the enterprises level with the macroeconomic indexes and obtain the three-dimensional financial risk warning indexes. Assume that the financial risk index based on the cash flow is $X_{ij}(i=1, 2, 3$, representing business activities, investment activities and financing activities respectively), the macroeconomic index is $Y_{ij}(i=1, 2, 3$, representing macroeconomic index related to business activities, macroeconomic index related to investment activities and macroeconomic index related to financing activities respectively). For positive correlation indexes, using the formula $Z_{ij}= (X_{ij}-Y_{ij})/Y_{ij}$ to obtain three-dimensional financial risk warning indexes. Otherwise using $Z_{ij}= (Y_{ij}-X_{ij})/Y_{ij}$ to obtain three-dimensional financial risk warning indexes. The specific formula is shown in Table 3.
### TABLE 1. FINANCIAL RISK INDEXES OF FOOD ENTERPRISES BASED ON CASH FLOW.

<table>
<thead>
<tr>
<th>Criteria Layer</th>
<th>Index Name</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business</strong></td>
<td>Net profit margin on cash sales</td>
<td>Cash Earning Value (CEV) / Sales revenue</td>
</tr>
<tr>
<td></td>
<td>Growth rate of cash for purchase of goods and labor service</td>
<td>(Cash for purchase of goods and labor service this year - Cash for purchase of goods and labor service last year) / Cash for purchase of goods and labor service last year</td>
</tr>
<tr>
<td></td>
<td>Growth rate of cash paid for employees</td>
<td>(Cash paid for employees this year - Cash paid for employees last year) / Cash paid for employees last year</td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td>Cash yield for net assets</td>
<td>Cash Earning Value(CEV)/ Owners' equity</td>
</tr>
<tr>
<td></td>
<td>Growth rate of cash for purchase of fixed assets, intangible assets and other long-term assets</td>
<td>(Cash for purchase of fixed assets, intangible assets and other long-term assets this year - Cash for purchase of fixed assets, intangible assets and other long-term assets last year) / Cash for purchase of fixed assets, intangible assets and other long-term assets last year</td>
</tr>
<tr>
<td><strong>Financing</strong></td>
<td>Actual interest rate of food enterprises</td>
<td>Cash paid for dividends and profit distribution or interest payment / (Short-term loan + Long-term loan)</td>
</tr>
</tbody>
</table>

Note: Cash Earning Value (CEV) = Cash net flow in business activities + Cash of dividends and profit + Cash of interest on bonds + Cash of disposal of long-term assets - Cash of interest and financing expenses

### TABLE 2. MACROECONOMIC RISK INDEXES.

<table>
<thead>
<tr>
<th>Criteria Layer</th>
<th>Index Name</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Related to the business activities</strong></td>
<td>Net profit margin in the industry’s cash sales</td>
<td>Average value of net profit margin in the industry’s cash sales</td>
</tr>
<tr>
<td></td>
<td>Growth rate of producer price of raw materials</td>
<td>(Producer price index of raw materials this year - Producer price index of raw materials last year) / Producer price index of raw materials last year</td>
</tr>
<tr>
<td></td>
<td>Average wage growth rate of employees</td>
<td>(Average wage of employees this year - Average wage of employees last year) / Average wage of employees last year</td>
</tr>
<tr>
<td><strong>Related to the investment activities</strong></td>
<td>Standard value of enterprise performance evaluation ROE</td>
<td>Standard value of enterprise performance evaluation</td>
</tr>
<tr>
<td></td>
<td>Growth rate of investment price of fixed assets</td>
<td>(Fixed asset investment price index this year - Fixed asset investment price index last year) / Fixed asset investment price index last year</td>
</tr>
<tr>
<td><strong>Related to the financing activities</strong></td>
<td>Central bank lending benchmark interest rate</td>
<td>People’s Bank of China website</td>
</tr>
</tbody>
</table>
TABLE 3. THREE-DIMENSIONAL FINANCIAL RISK WARNING INDEX OF FOOD ENTERPRISES.

<table>
<thead>
<tr>
<th>Early Warning Indexes</th>
<th>Calculation Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Warning Indexes of Financial Risk of Business Activities</td>
<td>( Z_1 = \frac{\text{Net profit margin in cash sales} - \text{Net profit margin in the industry’s cash sales}}{\text{Net profit margin in the industry’s cash sales}} )</td>
</tr>
<tr>
<td>Early Warning Indexes of Financial Risk of Business Activities</td>
<td>( Z_2 = \frac{\text{Growth rate of producer price of raw materials} - \text{Growth rate of cash for purchase of goods and labor service}}{\text{Growth rate of producer price of raw materials}} )</td>
</tr>
<tr>
<td>Early Warning Indexes of Financial Risk of Business Activities</td>
<td>( Z_3 = \frac{\text{Average wage growth rate of employees} - \text{Growth rate of cash paid for employees}}{\text{Average wage growth rate of employees}} )</td>
</tr>
<tr>
<td>Early Warning Indexes of Financial Risk of Investment Activities</td>
<td>( Z_4 = \frac{\text{Cash yield for net assets} - \text{Standard value of enterprise performance evaluation ROE}}{\text{Standard value of enterprise performance evaluation ROE}} )</td>
</tr>
<tr>
<td>Early Warning Indexes of Financial Risk of Investment Activities</td>
<td>( Z_5 = \frac{\text{Growth rate of investment price of fixed assets} - \text{Growth rate of cash for purchase of fixed assets, intangible assets and other long-term assets}}{\text{Growth rate of investment price of fixed assets}} )</td>
</tr>
<tr>
<td>Early Warning Indexes of Financial Risk of Financing Activities</td>
<td>( Z_6 = \frac{\text{Central bank lending benchmark interest rate} - \text{Actual interest rate of food enterprises}}{\text{Central bank lending benchmark interest rate}} )</td>
</tr>
</tbody>
</table>

Weight of Three-Dimensional Financial Risk Location Monitoring Indexes Based on Entropy Method

1) Standardization of indexes

In order to facilitate the calculation and analysis of financial risk indexes, the data should be co-oriented and standardized. For the financial risk warning index \( Z_{ij} (j=1,2,3,4,5,6) \), using the formula \( r_{ij} = \frac{Z_{ij} - Z_{\text{min}}}{Z_{\text{max}} - Z_{\text{min}}} \) for processing. The indexes are between 0 and 1 after processing, and the following data matrix \( R=(r_{ij})_{m \times n} \) is formed where \( r_{ij} \) expresses the three-dimensional financial risk early warning index of the i-th company under the j-th index.

\[
R = \begin{bmatrix}
    r_{11} & r_{12} & \ldots & r_{1n} \\
    r_{21} & r_{22} & \ldots & r_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    r_{m1} & r_{m2} & \ldots & r_{mn}
\end{bmatrix}
\]

2) Calculation of index information entropy

① Calculate the proportion of the three-dimensional financial risk warning index of the i-th food enterprise under the j-th index

\[
P_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}}
\]

② Calculate the information entropy of the j-th three-dimensional financial risk warning index

\[
E_j = -\ln(m)^{-1}\sum_{i=1}^{m} P_{ij} \ln P_{ij}
\]
③ Calculate the entropy of the j-th three-dimensional financial risk warning index

\[ w_j = \frac{(1 - E_j)}{\sum_{j=1}^{n}(1 - E_j)} \]

**A Positioning Model of Three-Dimensional Financial Risk Early Warning of Food Enterprises**

Calculate the three-dimensional financial risk early warning indexes of food enterprises

The financial risk early warning index of business activities:

\[ RI_1 = (Z_{i_1} \cdot w_1 + Z_{i_2} \cdot w_2 + Z_{i_3} \cdot w_3) / \sum_{j=1}^{3} w_j \]

The financial risk early warning index of investment activities:

\[ RI_2 = (Z_{i_4} \cdot w_4 + Z_{i_5} \cdot w_5) / \sum_{j=4}^{5} w_j \]

The financial risk early warning index of financing activities:

\[ RI_3 = Z_{i_5} \]

2) Determine the critical value of three-dimensional financial risk early warning index of food enterprises

Different types of cash activity of food enterprises have different financial risk evolution characteristics which are divided into “No Warning”, “Mild Warning”, “Moderate Warning” and “Severe Warning” in this paper. It is necessary to determine the critical value of each stage to determine the stages of financial risk evolution.

The critical value of warning is determined by the following steps:

① Calculate the three-dimensional financial risk early warning index \( RI_{ij} \) and obtain the maximum value \( RI_{jmax} \) and the minimum value \( RI_{jmin} \) of financial risk early warning indexes of different types of cash activities.

② Calculate the average value of the financial risk early warning indexes of food enterprises, i.e. \( \bar{RI} = \frac{1}{2} (RI_{max} + RI_{min}) \).

③ Calculate the critical of different levels of financial risk early warning indexes of food enterprises.

Among them, the critical value of “No Warning”, “Mild Warning” and “Moderate Warning” are:

\[ \eta_{j1} = \frac{1}{2} (\bar{RI} + RI_{max}) \quad \eta_{j2} = \bar{RI} \quad \eta_{j3} = \frac{1}{2} (\bar{RI} + RI_{min}) \]

The risk level is as shown in Fig.1.

![Figure 1. Critical Value of Three-Dimensional Financial Risk Early Warning Index.](image-url)
3) Build the positioning model of three-dimensional financial risk early warning index of food enterprises

This paper constructs the three-dimensional financial risk early warning model of food enterprises which achieve the purpose of analyzing the financial risk level of different food enterprises. The three dimensions X axis, Y axis and Z axis are composed of RI1, RI2 and RI3 respectively. At the same time, three warning thresholds are set for each dimension in this paper. \( \eta_{11}, \eta_{12}, \eta_{13} \) are set as the thresholds of the X axis, \( \eta_{21}, \eta_{22}, \eta_{23} \) are set as the thresholds of the Y axis, \( \eta_{31}, \eta_{32}, \eta_{33} \) are set as the thresholds of the Z axis. According to this standard, the three-dimensional cubic model is divided into 64 different modules, representing the different levels of risk, as shown in Fig.2.

In this paper, \( \{A, B, C, D\} \) is used to express the warning set of different dimensions. The risk levels of RI1, RI2 and RI3 are indicated by the first, the second and the third letters respectively. For example, if the financial risk early warning location code of a food enterprise is \( \{CAC\} \), then the RI1, RI2 and RI3 of this enterprise are “Moderate Warning”, “No Warning” and “Moderate Warning”.

**ANALYSIS AND CONTROL MEASURES OF THREE-DIMENSIONAL FINANCIAL RISK OF FOOD ENTERPRISES**

The causes of risk early warning and control measures are as follows.

1) Business risk of food enterprises. The increase of raw material and average wage of employees and the decrease of cash sales by macroeconomic downturn lead to the appearance of “Mild Warning” and “Severe Warning” in business risk. The corresponding control measures are to actively expand the product market especially overseas market and reduce cost by technological innovation.

2) Investment risk of food enterprises. The investment risk is impacted by both business risk and macroeconomic environment. The cash yield for net assets is subject to constraint of business risk and macroeconomic factors lead to a decline of long-term asset investment. All these lead to the appearance of “Mild Warning” and “Severe Warning” in investment risk. The corresponding control measures are to demonstrate strictly the feasibility of the project and adjust the operation of loss project.

3) Financing risk of food enterprises. Affected by economic downturn, although the central bank lending rate comes down, the actual rate of previous loans of food enterprises doesn’t decrease. The business downturn leads to the appearance of “Mild
Warning” and “Severe Warning” in financing risk. The corresponding control measures are to restructure debt and optimize capital structure.

REFERENCES