Evaluation on the Competitiveness of High-tech Entrepreneurial Enterprises

Wang Yanrong\textsuperscript{a}, Liu Yu\textsuperscript{a*}, Liu Kang\textsuperscript{b}

\textsuperscript{a}School of Management and Economics, North China University of Water Conservancy and Electric Power, Zhengzhou, 450011, P.R. China
\textsuperscript{b}School of Economics, Zhongnan University of Economics and Law, Wuhan, 430073, P.R. China

Abstract

Taking the characteristics of high-tech entrepreneurial enterprise into account, this paper establishes the fuzzy comprehensive evaluation model of the competitiveness based on the fuzzy comprehensive evaluation method and builds competitiveness evaluation index system which contains six one class indexes such as R&D ability, entrepreneurial ability, financing ability, marketing ability, profitability ability and growth ability. Then it evaluates the competitiveness level of an example enterprise, providing scientific basis for high-tech entrepreneurial enterprises when doing quantitative evaluation on the competitiveness and formulating competitive strategy.

Keywords: High-tech entrepreneurial enterprise; Enterprise competitiveness; The fuzzy comprehensive evaluation method;

1. Introduction

Compared with high-tech mature enterprise, High-tech entrepreneurial enterprise is in the stage of growth. With its characteristics such as technology-intensity, high investment, high risk, and high yield, it requires enterprises should have strong competitiveness in technical aspects, master the high technology, monopoly technology before others entering the market, form barriers, take the cost rapidly and then obtain high profits. Different from general enterprises, high-tech enterprise invests more in human resources and R&D funds, technology innovation is the key element to its survival and development. This paper forwards...
competitiveness evaluation index system based on its characteristics, which helps the enterprises grasp its competitiveness level quantitatively, analyze its advantages and disadvantages, formulate competitive strategy, better management, and make the enterprise expand unceasingly.

2. Related Research

WEF, the World Economic Forum, believes that the competitiveness of enterprise refers to that the current and future enterprises in their respective environment have more price and quality superiority than domestic and foreign competitors to design, produce and sell goods, and have the ability and opportunity to offer services. Jin Bei [1] thinks, in competitive market, enterprise competitiveness is the comprehensive quality an enterprise has to continue to provide products or services to market (consumer, including productive consumer) more effectively than other enterprises, and get profits and its own development. Michael E. Porter [2] argues, enterprise competitiveness, equal to enterprise competitive advantage, is activities of enterprise which have contributed to its behavior benefit, such as innovation, cohesive culture, orderly implementation process and so on. Lu Ying [3] involves evaluation indexes such as asset management, enterprise strategy and human resource in her evaluation on the comprehensive competitiveness of enterprise. Ding Yu Fang [4] puts the two indexes enterprise culture and resistance to risk of enterprise applied into core competitive power evaluation. Yang Mei Ying [5] thinks that evaluation system should also include three aspects such as enterprise scale, social contribution and market performance. And Wang Hui Qing [6] put the liabilities into consideration when doing the research on evaluation of high-tech enterprise competitiveness. This paper establishes the competitiveness evaluation indexes and evaluation model of high-tech entrepreneurial enterprise based on the summary of other researches.

3. Evaluation Index and Model of High-tech Entrepreneurial Enterprise Competitiveness

3.1. Selection of evaluation indexes

Following principles such as scientificness, systematicness, feasibility, comparability and the combination of quantitative and qualitative analysis, this paper selects the following evaluation indexes:

- R&D ability. It mainly includes six secondary indexes such as the number of patented technologies, success ratio of new product development, proportion of advanced technology product, rate of R&D funds, proportion of R&D staff and advanced equipment level.
- Entrepreneurial ability. It mainly includes seven secondary indexes such as entrepreneur’s working time, knowledge level, successful beliefs and persevering spirit, active competition and strong sense of crisis, excellent psychological quality, health and energetic energy and team cooperation ability.
- Financing ability. It mainly includes five secondary indexes such as total financing, credit of enterprise, solvency, net assets and return on equity.
- Marketing ability. It mainly includes four secondary indexes such as products market share, new product promotion abilities, after-sales service ability and advertising sales ability.
- Profitability ability. It mainly includes four secondary indexes such as sales profit margins, assets profit margins, assets value increment rate and cost profit margins.
- Growth ability. It mainly includes three secondary indexes such as profit growth, operating income growth rate and total assets growth.

3.2. Establishment of fuzzy comprehensive evaluation model
Establishment of evaluation factor set

The one class index factors form a set, namely \( U=\{u_1,u_2,\ldots,u_n\} \), \( n=6 \), \( u_1=(u_{11},u_{12},u_{13},u_{14},u_{15},u_{16}) \); \( u_2=(u_{21},u_{22},u_{23},u_{24},u_{25},u_{26},u_{27}) \); \( u_3=(u_{31},u_{32},u_{33},u_{34},u_{35}) \); \( u_4=(u_{41},u_{42},u_{43},u_{44}) \); \( u_5=(u_{51},u_{52},u_{53},u_{54}) \); \( u_6=(u_{61},u_{62},u_{63}) \).

Weights of evaluation factors

Weight set of one class index namely \( A=\{a_1,a_2,\ldots,a_6\} \), and meet \( \sum a_i = 1 \) \( (i=1,2,\ldots,6) \). The weights of secondary indexes marks aim, and the weight set \( A_i=\{a_{i1},a_{i2},\ldots,a_{im}\} \), \( (i=1,2,\ldots,6) \). This paper adopts expert grading method to determine the various index weight, shown in Table 1.

<table>
<thead>
<tr>
<th>Target layer</th>
<th>One class index layer</th>
<th>weight</th>
<th>Secondary index layer</th>
<th>weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-tech entrepreneurial enterprise competitive-ness valuation</td>
<td>R&amp;D ability ( u_1 )</td>
<td>0.3</td>
<td>The number of patented technologies ( u_{11} )</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The success ratio of new product development ( u_{12} )</td>
<td>0.15</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Proportion of advanced technology product ( u_{13} )</td>
<td>0.2</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Rate of R&amp;D funds ( u_{14} )</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Proportion of R&amp;D staff ( u_{15} )</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Advanced equipment level ( u_{16} )</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Entrepreneurial ability ( u_2 )</td>
<td>0.2</td>
<td>Working time of entrepreneur ( u_{21} )</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Knowledge level of entrepreneur ( u_{22} )</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Successful beliefs and persevering spirit of entrepreneur ( u_{23} )</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Active competition and strong sense of crisis of entrepreneur ( u_{24} )</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excellent psychological quality of entrepreneur ( u_{25} )</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Health and energetic energy of entrepreneur ( u_{26} )</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Team cooperation ability of entrepreneur ( u_{27} )</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>Financing ability ( u_3 )</td>
<td>0.15</td>
<td>Total financing ( u_{31} )</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Credit of enterprise ( u_{32} )</td>
<td>0.25</td>
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<td></td>
<td></td>
<td></td>
<td>Solvency ( u_{33} )</td>
<td>0.2</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Net assets ( u_{34} )</td>
<td>0.1</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Return on equity ( u_{35} )</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>Marketing ability ( u_4 )</td>
<td>0.1</td>
<td>Product market share ( u_{41} )</td>
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<td></td>
<td></td>
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<td>New product promotion ability ( u_{42} )</td>
<td>0.3</td>
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<td></td>
<td></td>
<td></td>
<td>After-sales service ability ( u_{43} )</td>
<td>0.3</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Advertising ability ( u_{44} )</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Profitability ability ( u_5 )</td>
<td>0.1</td>
<td>Sales profit margins ( u_{51} )</td>
<td>0.3</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Assets profit margins ( u_{52} )</td>
<td>0.3</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Assets value increment rate ( u_{53} )</td>
<td>0.2</td>
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<td></td>
<td></td>
<td></td>
<td>Cost profit margins ( u_{54} )</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Growth ability ( u_6 )</td>
<td>0.15</td>
<td>Profit growth ( u_{61} )</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operating income growth rate ( u_{62} )</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total assets growth ( u_{63} )</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Determination of evaluation set
Evaluation set is made on various fuzzy evaluation result about the indexes of analysis object, namely \( V=(v_1,v_2,v_3,v_4) = (\text{outstanding, good, general, poor}) \). For determining the quantity index, all evaluation result will be represented by hundred mark system, then \( V=(v_1,v_2,v_3,v_4) = (100,80,60,40) \), \( j=1,2,3,4 \).

- Construction of fuzzy evaluation matrix

The fuzzy evaluation matrix \( Q_i \) is a fuzzy mapping from evaluation factors set to the evaluation set, assume \( q_{imj} \) is the membership that son index \( u_{im} \) of factor set \( u_i \) was awarded to the \( v_j \), \( i=1,2,…,6 \), \( j=1,2,3,4 \).

The fuzzy evaluation matrix

\[
Q = \begin{bmatrix}
q_{i11} & q_{i12} & q_{i13} & q_{i14} \\
q_{i21} & q_{i22} & q_{i23} & q_{i24} \\
\vdots & \vdots & \vdots & \vdots \\
q_{im1} & q_{im2} & q_{im3} & q_{im4}
\end{bmatrix}
\]

Make \( B_i=A_iQ_i \), put the fuzzy evaluation matrix of index and the weight matrix of its son indexes multiplicated according to fuzzy matrix multiplication, then get the fuzzy vector \( B_i \) of index, namely

\[
B_i = (a_{1i}, a_{2i},..., a_{ni}) = (b_{i1}, b_{i2}, b_{i3}, b_{i4}).
\]

Lastly, construct the fuzzy comprehensive evaluation matrix \( Q \) integrating fuzzy vectors of various indexes, namely

\[
Q = \begin{bmatrix}
b_{11} & b_{12} & b_{13} & b_{14} \\
b_{21} & b_{22} & b_{23} & b_{24} \\
\vdots & \vdots & \vdots & \vdots \\
b_{ni} & b_{ni2} & b_{ni3} & b_{ni4}
\end{bmatrix}
\]

3.3 The fuzzy comprehensive evaluation

According to the synthetic computation of fuzzy matrix, make

\[
B = AQ = (a_{1i}, a_{2i},..., a_{ni}) = (b_1, b_2, b_3, b_4).
\]

Put \( B \) normalized, calculate \( N = B^* V^T \) and then the final score of fuzzy comprehensive evaluation of high-tech entrepreneurial enterprise competitiveness can be calculated.

4. Empirical Analysis

Based on the above evaluation model, this paper takes a listed company in a domestic high-tech development zone for example and gives the fuzzy comprehensive evaluation of its competitiveness, and the evaluation set for \( V_j \) = (very strong competitiveness, stronger competitiveness, general competitiveness, less competitiveness), and its corresponding values for \( V_j = (100,80,60,40) \). According to relevant material of the enterprise and information relevant personnel provide, combined with the analysis of expert groups the enterprise, determine the membership of secondary indexes for evaluation set \( V \) and the fuzzy evaluation matrix \( Q_i \), shown in table 2.

Table 2 Fuzzy evaluation sub-matrix of secondary indexes

<table>
<thead>
<tr>
<th>One class index</th>
<th>Secondary index</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
</tr>
</thead>
</table>

From table 2 available:

\[
Q_1 = \begin{bmatrix}
0.4 & 0.5 & 0.1 & 0 \\
0.6 & 0.2 & 0.2 & 0 \\
0.4 & 0.3 & 0.3 & 0 \\
0.5 & 0.4 & 0.1 & 0 \\
0.4 & 0.3 & 0.2 & 0.1 \\
0.25 & 0.5 & 0.15 & 0.1
\end{bmatrix}, \quad \text{then}
\]

\[
B_1 = A_1 Q_1 = (0.25, 0.15, 0.2, 0.2, 0.15, 0.05) = (0.25, 0.2, 0.2, 0.1).
\]

Similarly, \( B_2, B_3, B_4, B_5, B_6 \) can be obtained and comprehensive evaluation matrix
Put \( B \) normalized, \( B=(0.33,0.27,0.27,0.13) \), so \( N= B^*V^T=(0.33,0.27,0.27,0.13)(100,80,60,40)^T=76 \)
The evaluation results indicate that the evaluation mark belongs to the higher level, so the enterprise has stronger competitiveness by the evaluation set.

5. Conclusion

The paper, combined with the qualitative and quantitative analysis, uses the fuzzy comprehensive evaluation method to do competitiveness evaluation for high-tech entrepreneurial enterprise, and deals well with problems which are fuzzy and difficult to quantify, which can help enterprise analyze the current situation of competitiveness and improve their competitive strategy technologically to improve their competitiveness. But using the expert grading method to determine the weight of each index cannot avoid completely the existence of subjective factors and other methods also don’t solve this problem fundamentally, so we still need to explore further.

References