Research Article

Research on Selection and Application of Leading Industry in Zaozhuang based on Factor Analysis

1Bing Zhang and 1,2Junhai Ma
1College of Management Economic, Tianjin University, Tianjin 300072, China
2Tianjin University of Finance and Economics, Tianjin 300222, China

Abstract: Zaozhuang is a city with exhausted natural resources, its economy development must be transformed, but the choosing of the leading industry is the key of the transformation. Based on present development situation of Zaozhuang city, this paper establishes the evaluation indexes, and chooses the leading industries by using factor analysis. Coal mining and dressing, tobacco processing, nonmetal mineral products and chemical raw material and chemical products etc. 29 ordinary machineries are leading industries. The conclusion of the research has great theoretical and practical value.

Keywords: Factor analysis, leading industry, Zaozhuang city

INTRODUCTION

Zaozhuang was listed as the city with exhausted natural resources by the State Council in 2009, it meant that the development of Zaozhuang has risen to national strategy. There will be more opportunities and challenges in Zaozhuang. Zaozhuang is a typical city with exhausted natural resources, coal mining has seriously constrained its development. So choosing new leading industry becomes the key of transformation in Zaozhuang.

Gang and Yu (2002) study the scientific select module of district dominant industry. According to the characteristic of predominant industry, Chen and Huaxue (1996) established a system of six indexes, which can be used as basic theory of the selection and appraisal of predominant industry. In the view of connotations of leading industries and the current policy guidance, the index system of choosing leading industries indicators is built by Ren and Xinyun (2012) about growth potential, industrial correlation, comparative advantages, technological innovation, energy saving and environmental protection. Based on the theory of selecting leading industries, the standard and the rules are established for choosing leading industries and the evaluation system is constructed for selecting Daqing leading industries by Wang and Zhaoge (2009). Wanga et al. (2012) propose and verify an R&D value chain framework to explore the relationship among productivity, R&D, and firm market values, as measured by Tobin's q theory. The conclusion of the research has great theoretical and practical value (Wanga et al., 2012).

THEORETICAL BASIS AND MODEL

Determination principles of index: Leading principle means that we should focus on leading industries in evaluation, simplify unimportant indexes, and set weight for indexes. Scientific principle is the basis of establishing of index system, it should ensure the truth of evaluation, and can reflect competitive force of industry from different sides. Industry competition can’t be described by only one or several indexes; it needs a series of indexes which are associated with each other, so we should pay attention to overall principle. We should consider the difference of city indexes when we design index system. The common index system should be chosen for comparability. Comprehensive principle is also important. City industry construction is a social economy system which includes more subsystems, so we should use much more information to describe the whole system. Every principle is important and indispensable.

Standard of leading industry choosing:

- Industrial connection norm: A industry which is related with the other industry can drive the development of other industries. Industrial connection norm is measured by industry influence and induction degree.
- Technological innovation norm: Science and technology constitute a primary productive force. Technology development level resolves the innovation and sustainable development of the whole industry. Technological innovation norm is measured by specific gravity of R&D, number of R&D staff member and output efficiency of R&D.
• **Potential of industry development:** Potential of industry development mainly depend on elasticity of income demand, the industry which has high elasticity of income demand has wide future development. A industry which has high labor productivity can expand demand quickly, so this industry has potential of industry development. In general, the progress trend of labor productivity is decided by comparative labor productivity. Potential of industry development is also measured by market occupancy and profit tax rate of industry.

• **Regional comparative advantage:** Comparative advantage is unique resources and favorable conditions in the development of economy. Industrial contribution ration and location quotient can reflect regional comparative advantage.

• **Sustainable development:** In the fact of bad consequence which is caused by ecological deterioration and environment pollution, people pay more attention to sustainable development. So the leading industry should has great ability of sustainable development, thus it can develop organically. Sustainable development can be measured by energy consumption, discharge of wastewater, tailpipe emission and carbon dioxide emission of unit added value.

• **Foreign trade:** In the environment of economic globalization, any industry is impossible to be independent in the global market, so foreign trade is a important norm of leading industry. This norm is measured by export scale and export dependence.

**Model:** According with the original date of index system which we establish, we can get original matrix.

\[
A = \begin{pmatrix}
a_{11} & a_{12} & \cdots & a_{1n} \\
a_{21} & a_{22} & \cdots & a_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
a_{m1} & a_{m2} & \cdots & a_{mn}
\end{pmatrix}
\]

where,
- \( m \) = The year, and \( m = 1 \) in base year
- \( n \) = The number of index
- \( a_{ij} \) = The original date of evaluation index

Standardizing the original date, then we get standard matrix. The formula of standardization is:

\[
a_{ij}^* = \frac{a_{ij} - \bar{a}_{j}}{\sqrt{\text{Var}(a_{j})}}
\]

where,
- \( a_{ij} \) = The original date of every index in every year
- \( \bar{a}_{j} \) = The average value of every index
- \( \sqrt{\text{Var}(a_{j})} \) = The standard deviation of every index

So, the model of choosing leading industry is as follow:

\[
Z_i = \sum \omega_j F_{ij}, i = 1,2,3\ldots j = 1,2,\ldots n
\]

where,
- \( Z_i \) = Comprehensive score of industry \( i \)
- \( F_{ij} \) = Score of factor \( j \) in industry \( i \)
- \( \omega_j \) = The weight of factor \( i \)

There are two important points. First, simplify 12 factors to several main factors; second, calculate the weight of every factor. There are 4 steps specifically.

First, we calculate variance contribution of related matrix about 12 factors by using principal component analysis. Because cumulative variance contribution isn’t less 80%, we can determine main factors.

Second, we can get factor loading by using dimensionality reduction, and every factor regression coefficient by using vari-max rotation.

Third, we can calculate score of every industry by using formula:

\[
F_{ij} = \sum_k V_{ik} X_{kj}
\]

where,
- \( F_{ij} \) = The score of main factor \( i \) about industry \( j \)
- \( V_{ik} \) = Related coefficient of index \( j \) about factor \( i \)
- \( X_{kj} \) = The value of factor \( k \) about industry \( j \)

Forth, let variance contribution of every main factor as weight, we can get comprehensive score of every industry. Then, we can get leading industries.

**POSITIVE ANALYSIS**

**Date reduction:** This study choose lots of dates from statistical yearbook of Shandong and each city. We get every index value of leading industry base on circular economy by using principal component analysis.


**Factor analysis of leading industry choosing**: By using factor analysis for standardized date, we get characteristic value, proportion, cumulative and rotating ingredients matrix.

In Table 2, we can see that: according to the principles of characteristic value and cumulative, we extract 3 factors. These 3 factors can present the character of all factors. We continue analyzing these 3 factors, and get principal component factor loading matrix.

In Table 3, the first principal component mainly present industrial contribution ration, value scale, fixed assets, employment and size profit tax; the second principal component mainly present Export scale and
Let contribution ration of principal component as the weight, and combine with model:

$$F = 0.58F_1 + 0.274F_2 + 0.146F_3$$

We can get the score of every principal component, then make comprehensive evaluation for every industry (Table 4).


### Table 3: Rotating ingredients matrix

<table>
<thead>
<tr>
<th>Primordial composition</th>
<th>To scale component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>Zscore:X1</td>
<td>0.733 0.186 -0.044</td>
</tr>
<tr>
<td>Zscore:X2</td>
<td>0.087 0.974 -0.068</td>
</tr>
<tr>
<td>Zscore:X3</td>
<td>-0.015 0.973 -0.013</td>
</tr>
<tr>
<td>Zscore:X4</td>
<td>0.986 0.049 0.043</td>
</tr>
<tr>
<td>Zscore:X5</td>
<td>0.882 -0.133 0.171</td>
</tr>
<tr>
<td>Zscore:X6</td>
<td>0.971 0.073 -0.125</td>
</tr>
<tr>
<td>Zscore:X7</td>
<td>0.951 -0.036 -0.054</td>
</tr>
<tr>
<td>Zscore:X8</td>
<td>-0.008 -0.057 0.995</td>
</tr>
</tbody>
</table>

### Table 4: Score coefficient matrix

<table>
<thead>
<tr>
<th>Composition</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zscore:X1</td>
<td>0.173</td>
<td>0.077</td>
<td>-0.025</td>
</tr>
<tr>
<td>Zscore:X2</td>
<td>0.000</td>
<td>0.498</td>
<td>0.017</td>
</tr>
<tr>
<td>Zscore:X3</td>
<td>-0.024</td>
<td>0.505</td>
<td>0.070</td>
</tr>
<tr>
<td>Zscore:X4</td>
<td>0.238</td>
<td>0.008</td>
<td>0.048</td>
</tr>
<tr>
<td>Zscore:X5</td>
<td>0.217</td>
<td>-0.073</td>
<td>0.157</td>
</tr>
<tr>
<td>Zscore:X6</td>
<td>0.233</td>
<td>0.006</td>
<td>-0.113</td>
</tr>
<tr>
<td>Zscore:X7</td>
<td>0.231</td>
<td>-0.044</td>
<td>-0.053</td>
</tr>
<tr>
<td>Zscore:X8</td>
<td>0.002</td>
<td>0.055</td>
<td>0.960</td>
</tr>
</tbody>
</table>

### Table 5: Industry score and rank in Zaozhuang

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F</th>
<th>Rank</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.753565</td>
<td>-0.83901</td>
<td>-0.51896</td>
<td>2.456892</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1.967903</td>
<td>-0.03201</td>
<td>-0.47759</td>
<td>1.062883</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>0.251941</td>
<td>3.649669</td>
<td>-0.67637</td>
<td>1.047385</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>1.478958</td>
<td>-0.00818</td>
<td>0.90952</td>
<td>0.988344</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>1.501413</td>
<td>0.10314</td>
<td>0.260574</td>
<td>0.937124</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>-0.08318</td>
<td>3.539715</td>
<td>-0.27146</td>
<td>0.882005</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>0.554601</td>
<td>0.579</td>
<td>0.220567</td>
<td>0.512517</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>0.312418</td>
<td>-0.45289</td>
<td>2.940369</td>
<td>0.486405</td>
<td>8</td>
<td>37</td>
</tr>
<tr>
<td>-0.48813</td>
<td>2.3995</td>
<td>0.533285</td>
<td>0.452145</td>
<td>9</td>
<td>35</td>
</tr>
<tr>
<td>0.443211</td>
<td>-0.20657</td>
<td>0.460007</td>
<td>0.267622</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>0.391252</td>
<td>0.402072</td>
<td>-0.86332</td>
<td>0.211049</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>-0.06616</td>
<td>0.437282</td>
<td>0.522632</td>
<td>0.157746</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>-0.29414</td>
<td>0.666827</td>
<td>0.591017</td>
<td>0.098399</td>
<td>13</td>
<td>28</td>
</tr>
<tr>
<td>0.113827</td>
<td>-0.1193</td>
<td>-0.22963</td>
<td>-0.00019</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>-0.00964</td>
<td>-0.34201</td>
<td>-0.07971</td>
<td>-0.11094</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>-0.4262</td>
<td>-0.41222</td>
<td>1.579996</td>
<td>-0.12947</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>-0.63518</td>
<td>-0.28534</td>
<td>2.123683</td>
<td>-0.13653</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>-0.44437</td>
<td>-0.41458</td>
<td>1.561669</td>
<td>-0.14333</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>0.255942</td>
<td>-0.59175</td>
<td>-0.9741</td>
<td>-0.15591</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>-0.30803</td>
<td>-0.37546</td>
<td>0.380786</td>
<td>-0.22594</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>-0.23083</td>
<td>-0.36793</td>
<td>0.023994</td>
<td>-0.23119</td>
<td>21</td>
<td>23</td>
</tr>
<tr>
<td>-0.44519</td>
<td>-0.36203</td>
<td>0.407695</td>
<td>-0.29788</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>-0.59484</td>
<td>-0.35537</td>
<td>0.96659</td>
<td>-0.3014</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>-0.25651</td>
<td>-0.40959</td>
<td>-0.49597</td>
<td>-0.33341</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>-0.36872</td>
<td>-0.40866</td>
<td>-0.08172</td>
<td>-0.33777</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>-0.36873</td>
<td>-0.45882</td>
<td>0.009068</td>
<td>-0.33825</td>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>-0.39458</td>
<td>-0.28462</td>
<td>-0.23642</td>
<td>-0.34136</td>
<td>27</td>
<td>33</td>
</tr>
<tr>
<td>-0.22531</td>
<td>-0.44185</td>
<td>-1.00035</td>
<td>-0.3978</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>-0.41023</td>
<td>-0.40441</td>
<td>-0.43894</td>
<td>-0.41283</td>
<td>29</td>
<td>14</td>
</tr>
<tr>
<td>-0.59162</td>
<td>-0.40937</td>
<td>0.287978</td>
<td>-0.41327</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>-0.48772</td>
<td>-0.39722</td>
<td>-0.19212</td>
<td>-0.41977</td>
<td>31</td>
<td>12</td>
</tr>
<tr>
<td>-0.61212</td>
<td>-0.41069</td>
<td>-0.1394</td>
<td>-0.48791</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>-0.58917</td>
<td>-0.43354</td>
<td>-0.66576</td>
<td>-0.55771</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>-0.591</td>
<td>-0.44632</td>
<td>-0.73572</td>
<td>-0.57249</td>
<td>34</td>
<td>10</td>
</tr>
<tr>
<td>-0.63653</td>
<td>-0.44129</td>
<td>-0.61871</td>
<td>-0.58043</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>-0.66797</td>
<td>0.971</td>
<td>-1.65005</td>
<td>-0.7665</td>
<td>36</td>
<td>21</td>
</tr>
<tr>
<td>-0.63982</td>
<td>-0.52499</td>
<td>-1.99366</td>
<td>-0.80602</td>
<td>37</td>
<td>39</td>
</tr>
<tr>
<td>-0.65247</td>
<td>-0.52252</td>
<td>-1.95831</td>
<td>-0.80751</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>-1.14009</td>
<td>-5074.31</td>
<td>1647.98</td>
<td>-7762.29</td>
<td>39</td>
<td>20</td>
</tr>
</tbody>
</table>
CHOOSING OF LEADING INDUSTRY IN ZAOZHUANG

From the Table 5, we know that new economic growth point should be found with the thought of sustainable development in Zaozhuang city. The rank of leading industry is: coal and natural gas extraction, textile and its products, machine tool industry, cement industry, fine chemical, new building materials industry, electronic information industry, service industry and coking industry. For Zaozhuang city, we not only keep original leading industries, but also add some new leading industries. For example, textile and its products, machine tool industry and cement industry. In the guidance of national chemical industry development strategy and policy, we should build a series of coal chemical industry enterprises which have high competition ability, added value and technical content. Thus, the structure of economy industry in Zaozhaung can get further promotion.

CONCLUSION

Zaozhaung is a city with exhausted natural resources, its economy development must be transformed. By using factor analysis, this paper research the selection and application of leading industry in Zaozhuang. We get that textile and its products, machine tool industry and cement industry have been new leading industries. In the guidance of national chemical industry development strategy and policy, we should build a series of coal chemical industry enterprises which have high competition ability, added value and technical content. Thus, the structure of economy industry in Zaozhaung can get further promotion.

REFERENCES