

Research Article

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

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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 Huaixue (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 Zhao (2009). Wang *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 (Wang *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.

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix}$$

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:

$$a_{ij}^* = \frac{a_{ij} - \bar{a}_j}{\sqrt{Var(a_j)}}$$

where,

a_{ij} = The original date of every index in every year

\bar{a}_j = The average value of every index

$\sqrt{Var(a_j)}$ = The standard deviation of every index

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

$$Z_i = \sum \omega_j F_{ij} \quad i = 1, 2, 3 \dots j = 1, 2, \dots n$$

where,

Z_i = Comprehensive score of industry i

F_{ij} = Score of factor j in industry i

ω_j = The weight of factor j

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.

In Table 1, NO.1 to 39 respectively mean: 1.Coal Mining and Dressing 2. Ferrous Metals Mining and Dressing 3.Nonmetal Minerals Mining and Dressing 4.Farm and Sideline Products Processing 5.Food Production 6.Beverage Production 7.tobacco 8.textile industry 9.nuclear fuel processing industry 10.fur articles 11.wood working 12.cabinet making 13.Paper Products 14.press industry 15.Cultural Educational and Sports Goods 16.Oil processing 17.coking 18.Chemical raw materials and chemical products manufacturing 19.Produce of Fertilizer 20.Medical and Pharmaceutical Products 21.Chemical Fiber 22.Rubber Products 23.Plastic Products 24.Nonmetal Mineral Products 25.cement making 26.Black metal

Table 1: Industry date in Zaozhuang city

No	Contribution rate	Export scale	Export dependence	Value scale	Fixed assets	Employment scale	Profit and tax	Labor productivity
1	1.88492	-0.41614	-0.39888	4.23610	4.65625	4.73622	5.61422	-0.56089
2	-0.77428	-0.41614	-0.39888	-0.63534	-0.46287	-0.58457	-0.34658	0.33579
3	-0.26804	-0.41614	-0.39888	-0.24294	-0.41778	0.06331	-0.22905	-0.93728
4	1.69932	0.66004	0.20585	0.62722	-0.04597	0.31838	0.22306	0.27326
5	0.17266	0.37684	0.36881	0.04210	-0.28664	-0.15605	0.00120	0.54181
6	-0.39915	-0.41614	-0.39888	-0.37938	-0.38011	-0.36011	-0.22726	-0.03287
7	-0.65662	-0.41614	-0.39888	-0.67691	-0.52298	-0.64069	-0.48389	2.24877
8	0.30376	0.59340	0.23556	0.47961	-0.08838	0.92035	0.15830	-0.81152
9	0.58019	4.19176	3.07659	0.27164	-0.14252	0.73160	0.09954	-0.88667
10	-0.58475	-0.41614	-0.39888	-0.66950	-0.50322	-0.55906	-0.42933	-0.71889
11	-0.13615	-0.41614	-0.39888	-0.28086	-0.38361	-0.18666	-0.20807	-0.44041
12	-0.29489	-0.41614	-0.39888	-0.58381	-0.46143	-0.51825	-0.37296	-0.14829
13	0.47041	-0.14293	-0.14951	0.09119	0.02321	0.08882	-0.07855	-0.21575
14	-0.20486	-0.41614	-0.39888	-0.48596	-0.46143	-0.40092	-0.32199	-0.39132
15	0.19477	3.56871	3.45946	0.04199	-0.36405	0.17554	-0.02039	-0.51617
16	-1.35400	-0.41614	-0.39888	-0.19130	-0.11494	-0.41112	-0.16669	1.61779
17	-1.38243	-0.41614	-0.39888	-0.21629	-0.12214	-0.42133	-0.18108	1.59839
18	1.17648	0.22357	-0.22192	2.06546	1.85118	1.02238	0.59362	0.73738
19	-0.58948	-0.41614	-0.39888	-0.42537	0.32646	-0.39072	-0.66977	-0.08454
20	-65899	-0.28619	-0.02267	-0.49669	-0.42540	-0.50295	-0.31060	0.55034
21	-0.66530	-0.41614	-0.39888	-0.76448	-0.50754	-0.66619	-0.48389	-1.68358
22	-0.18274	-0.41614	-0.39888	-0.34952	-0.24670	-0.39582	-0.25064	0.42574
23	0.06446	-0.41614	-0.39888	-0.25831	-0.34881	-0.28359	-0.20987	0.08812
24	1.80594	0.20025	-0.23477	2.17603	1.41390	2.28243	1.27359	-0.43795
25	-0.96542	-0.41614	-0.39888	0.19778	0.74604	0.80302	0.08395	-1.03612
26	-0.56421	-0.41614	-0.39888	-0.70079	-0.50404	-0.62028	-0.44671	-0.10365
27	-0.63450	-0.41614	-0.39888	-0.64518	-0.48469	-0.61008	-0.41494	1.04256
28	-0.25619	0.46346	0.78185	-0.18356	-0.34243	-0.30399	-0.18768	0.56279
29	3.67062	-0.05963	-0.28445	1.67406	0.13479	0.95096	0.90662	0.44506
30	0.50121	-0.40947	-0.39166	-0.04436	-0.26276	-0.09483	-0.06956	-0.00398
31	-0.27752	-0.41614	-0.39888	-0.48087	-0.45505	-0.48764	-0.35018	0.47564
32	1.50503	-0.36616	-0.36956	0.56851	-0.25123	0.16534	0.23145	0.59670
33	-0.15352	-0.35616	-0.24836	-0.45511	-0.44413	-0.40092	-0.32679	-0.19570
34	-0.47181	-0.41614	-0.39888	-0.69593	-0.50157	-0.59477	-0.44492	-0.64708
35	-0.27831	1.32974	3.36796	-0.40414	-0.47378	-0.42133	-0.27103	0.31181
36	-0.61239	-0.41614	-0.39888	-0.73064	-0.50898	-0.63559	-0.46111	-0.60448
37	-0.39520	-0.41614	-0.39888	0.04984	2.31399	-0.38051	-0.25724	2.64913
38	-0.64872	-0.41614	-0.39888	-0.76337	-0.47913	-0.63559	-0.48509	-2.00541
39	-0.65030	-0.41614	-0.39888	-0.76094	-0.47152	-0.59477	-0.47969	-2.03854

Table 2: The explained total variance

	Initial characteristic value			Extraction sum of squares			Rotary sum of squares		
	Total	VP	CP	Total	VP	CP	Total	VP	CP
1	4.158	51.969	51.969	4.158	51.969	51.969	4.143	51.790	51.790
2	1.977	24.716	76.686	1.977	24.716	76.686	1.961	24.507	76.296
3	1.015	12.683	89.369	1.015	12.683	89.369	1.046	13.072	89.369
4	0.585	7.311	96.680						
5	0.131	1.632	98.312						
6	0.081	1.009	99.322						
7	0.040	0.500	99.821						
8	0.014	0.179	100.000						

smelting and rolling processing industry 27.Non-ferrous metal smelting and rolling processing industry 28.Metal Products 29.Ordinary Machinery 30.Equipment for Special Purpose 31.Transport Equipment 32.Electric Equipment and Machinery 33.communication equipment 34.Instruments and culture 35.Handicrafts and other Manufacturing 36.Resource waste and waste material recycling processing industry 37.Electric heat production and supply industry 38.Production and Supply of Gas 39.Production and Supply of Water.

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

Table 3: Rotating ingredients matrix

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

Table 4: Score coefficient matrix

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

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).

In Table 5, the top 5 industry are: 1.Coal Mining and Dressing, 9.tobacco, 18.Chemical raw materials and chemical products manufacturing, 24.Nonmetal Mineral Products, 29.Ordinary Machinery.

export dependence; the third principal component mainly present labor productivity.

Table 5: Industry score and rank in Zaozhuang

F1	F2	F3	F	Rank	No
4.753565	-0.81901	-0.51896	2.456892	1	1
1.967903	-0.03201	-0.47759	1.062883	2	24
0.251941	3.649669	-0.67637	1.047385	3	9
1.478958	-0.00818	0.909526	0.988344	4	18
1.501413	0.10314	0.260574	0.937124	5	29
-0.08318	3.539715	-0.27146	0.882005	6	15
0.554601	0.579	0.220567	0.512517	7	4
0.312418	-0.45289	2.940369	0.486405	8	37
-0.48813	2.3995	0.532851	0.452145	9	35
0.443211	-0.20657	0.460007	0.267622	10	32
0.391252	0.402072	-0.86332	0.211049	11	8
-0.06616	0.437282	0.522632	0.157746	12	5
-0.29414	0.666827	0.591017	0.098399	13	28
0.113827	-0.1193	-0.22963	-0.00019	14	13
-0.00964	-0.34201	-0.07971	-0.11094	15	30
-0.4262	-0.41222	1.579996	-0.12947	16	16
-0.63518	-0.28534	2.123683	-0.13653	17	7
-0.44437	-0.41458	1.561669	-0.14333	18	17
0.255942	-0.59175	-0.9741	-0.15591	19	25
-0.30803	-0.37546	0.380786	-0.22594	20	22
-0.23083	-0.36793	0.023994	-0.23119	21	23
-0.44519	-0.36203	0.407695	-0.29788	22	31
-0.59484	-0.35537	0.96559	-0.3014	23	27
-0.25651	-0.40959	-0.49597	-0.33341	24	11
-0.36872	-0.40866	-0.08172	-0.33777	25	6
-0.36873	-0.45882	0.009068	-0.33825	26	19
-0.39458	-0.28462	-0.23642	-0.34136	27	33
-0.22531	-0.44185	-1.00035	-0.3978	28	3
-0.41023	-0.40441	-0.43894	-0.41283	29	14
-0.59162	-0.40937	0.287978	-0.41327	30	2
-0.48772	-0.39722	-0.19212	-0.41977	31	12
-0.61212	-0.41069	-0.1394	-0.48791	32	26
-0.58917	-0.43354	-0.66576	-0.55771	33	34
-0.591	-0.44632	-0.73572	-0.57249	34	10
-0.63653	-0.44129	-0.61871	-0.58043	35	36
-0.66797	-0.50427	-1.65005	-0.7665	36	21
-0.63982	-0.52499	-1.99366	-0.80602	37	39
-0.65247	-0.52252	-1.95831	-0.80751	38	38
-11400.9	-5074.31	1647.98	-7762.29	39	20

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 Zaozhuang can get further promotion.

CONCLUSION

Zaozhuang 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 Zaozhuang can get further promotion.

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