The Study on the Development of Strategic Emerging Industry in Shandong Province Based on Factor Analysis

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***Abstract*—Since the Eleventh Five-year Plan, Shandong Province has issued a series of policies to promote the development of strategic emerging industries. Developing strategic emerging industries is a path to restructure the economy and transform the economic development pattern. This paper uses the factor analysis and makes an empirical analysis on the strategic emerging industries in Shandong Province. Finally, this paper puts forward the relevant countermeasures for the emerging industries.**

Keywords-strategic emerging industry; factor analysis; development problem

I. INTRODUCTION

The term '*strategic emerging industry*' is an innovative vocabulary, which refers to technology-intensive industries that have a leading role in promoting the long-term development of economy and society. Based on major technological breakthrough and development demand, these industries consume less material resources and have a great potential for growth and profitability.

In November 2009, the Premier Wen Jiabao stated that the government builds an innovation-oriented country as a strategic goal, maintains the sustainable development as a strategic direction and obtains the core competitiveness of economy and technology as a strategic priority, which makes strategic emerging industry as the driving force for economic and social development[1].

II. ANALYSIS OF MAJOR INDUSTRY DEVELOPMENT IN SHANDONG PROVINCE

Shandong Province, located in the China's eastern areas, is the crucial coastal manufacturing base. In April 2011, the government issued the *Decision on Accelerating the Development of Strategic Emerging Industries*, specifying 6 emerging industries and 33 main areas of development. The strategic emerging industries consist of new materials, new information technology, energy saving, new medicine and biology, ocean development, high-end equipment manufacturing. The government decides to annually provide the financial supports of no less than 1 billion for the strategic emerging industries. With the effective implementation of various programs and great breakthroughs of innovation, Shandong has made significant progress in some emerging industries.

TABLE I. ECONOMIC INDICATOR OF MAJOR INDUSTRIES IN SHANDONG PROVINCE(2009-2012)

Industry	**Output Value(Unit:100 million yuan)**				**Total Energy Consumption (Unit:10000 ton SCE)**
	2009	***2010***	***2011***	***2012***	***2012***
Overall industry	33896.65	39169.92	45361.85	50013.24	32229
Primary industry	3226.64	3588.28	3973.85	4281.70	343
Secondary industry	18901.83	21238.49	24017.11	25735.73	27615
Tertiary industry	11768.18	14343.14	17370.89	19995.81	4271

From Table 1, we can see that in recent years the primary industry, the secondary industry, and the tertiary industry have been developing rapidly, while the GDP is also growing. The output value of secondary industry accounts for the largest proportion of the overall industry.

In terms of energy consumption, in 2012 the secondary industry has a higher rate of energy consumption with a higher output value. The increase of the output value is based on the highly energy wasting. Under such crude and quantitative mode of economic growth, the government will face a series of issues, e.g. resource depletion, environmental damage and economic recession. The government will work hard to transform the economic development pattern, restructure the economy and set out on a path of the balanced and sustainable development[2].

III. EMPIRICAL RESEARCH ON STRATEGIC EMERGING INDUSTRIES IN SHANDONG PROVINCE

A. *Economic Indicators*

In order to seek the key development areas in Shandong, this paper calculates the related industrial indicators of the emerging dominant industry, makes a deep research using the factor analysis method and points out the relevant strategies. Table 2 shows the definition and description of the economic indicators.

TABLE II. ECONOMIC INDICATORS AND THEIR DESCRIPTION

Indicator	Description	Formula
GOV	Gross industrial output value	(Unit:10000 yuan)
IAR	Investment Absorption rate	Total investment amount in one industry to total investment in the region(%)
TA	Total assets	(Unit:10000 yuan)
ACR	Total assets contribution rate	Sum of total profit, tax and interests to the average total assets(%)
TP	Total profits	(Unit:10000 yuan)
RTA	Return on total assets	Total profit to total assets(%)
IER	Employment rate of investment	The average annual employment to the average net value of fixed assets(%)
CER	Cost and expense ratios	Total profits to total cost(%)

B. *Empirical Analysis*

This paper uses SPSS software and makes the factor analysis of 24 industries in Shandong Province. The calculation results are shown in Table 3.

First, KMO and Bartlett's test is calculated. Kaiser-Meyer-Olkin measure of sampling adequacy is 0.519, indicating that the sample data are suitable for factor analysis; Bartlett's test of sphericity is 257.970 and reaches the significant level of 1% ($p = 0.000 < 0.01$).

Through the principal component analysis, Table 4 shows the total variance explained. The cumulative explained variance of the first three indicators reaches 0.87832, indicating that the three indicators, whose eigenvalues are all greater than 1, can represent the whole information of the eight components.

TABLE III. INDUSTRIES AND RELEVANT INDICATORS

Industry	GOV	IAR	TA	ACR	TP	RTA	IER	CER
Extraction of petroleum and natural gas	13241942	0.0064	16425535	0.8062	3954124	0.2407	0.0324	0.5691
Processing of food from agricultural products	101744055	0.0235	40974560	2.4831	6299562	0.1537	0.0542	0.0659
Manufacture of foods	22144802	0.0091	12983976	1.7055	1591653	0.1226	0.0409	0.0789
Manufacture of textile wearing apparel	19878077	0.0071	8138787	2.4424	1246018	0.1531	0.1138	0.0704
Manufacture of furniture	7196078	0.0044	3177393	2.2648	547109	0.1722	0.0604	0.0834
Printing, reproduction of recording media	4796587	0.0038	2112529	2.2705	354310	0.1677	0.0637	0.0812
Manufacture of articles for culture, arts & crafts, sports and entertainment	14589866	0.0042	5501558	2.6520	971314	0.1766	0.0864	0.0726
Manufacture of chemical raw material chemical products	126492341	0.0699	73234300	1.7272	8940431	0.1221	0.0215	0.0749
Manufacture of medicines	26900133	0.0175	18124995	1.4841	2984274	0.1646	0.0306	0.129
Manufacture of rubber and plastic	46827521	0.0200	23676542	1.9778	3234999	0.1366	0.0330	0.0749
Manufacture of non-metallic mineral products	63103311	0.0333	35823150	1.7615	5273991	0.1472	0.0373	0.0934
Manufacture of metal products	45428526	0.0268	21506533	2.1123	3053067	0.1420	0.0483	0.0746
Manufacture of general purpose machinery	59230183	0.0417	33603465	1.7626	4452601	0.1325	0.0467	0.0835
Manufacture of special purpose machinery	44329274	0.0393	24927233	1.7783	3430927	0.1376	0.1795	0.0851
Manufacture of vehicle	46798355	0.0348	32849771	1.4246	2637789	0.0803	0.1194	0.0593
Manufacture of transport equipment for railway, shipping, aerospace and other uses	14811106	0.0147	13765468	1.0760	914078	0.0664	0.0852	0.0696
Manufacture of electrical machinery & equipment	53679478	0.0312	30448803	1.7630	3494771	0.1148	0.0441	0.0702
Manufacture of computer, communication equipment and other electronic equipment	40026972	0.0151	17556846	2.2798	2115692	0.1205	0.0689	0.0555
Manufacture of measuring instrument	5650269	0.0048	2883990	1.9592	464034	0.1609	0.0726	0.0946
Processing of timbers, manufacture of wood, bamboo, rattrap, palm, and straw products	16539333	0.0068	4636249	3.5674	1202326	0.2593	0.0798	0.0801
Manufacture of chemical fiber	2106016	0.0012	1826273	1.1532	152031	0.0832	0.0277	0.0799
Recycling and disposal of waste resource	656974	0.0015	236926	2.7729	61385	0.2591	0.0551	0.104
Production and supply of gas	1891047	0.0028	2460008	0.7687	191995	0.0780	0.0142	0.0997
Manufacture of paper and paper products	24581087	0.0114	21209592	1.1590	1484771	0.0700	0.0203	0.0638

TABLE IV. TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	*% of variance*	*Cumulative %*	*Total*	*% of variance*	*Cumulative %*
1	3.863	48.286	48.286	3.863	48.286	48.286
2	1.684	21.054	69.341	1.684	21.054	69.341
3	1.479	18.491	87.832	1.479	18.491	87.832

Through the orthogonal rotation, Table 5 shows the rotated component matrix and Table 6 shows the component score coefficient matrix. The total variance of the first three indicators reaches 87.832%. Each main indicator equation is as follows.

$$F1= 0.265*GOV+ 0.245*IAR+ 0.258*TA+ 0.049*ACR+ 0.271*TP+ 0.033*RTA- 0.003*IER+ 0.006*CER \quad (1)$$

$$F2= 0.042*GOV- 0.037*IAR- 0.017*TA+ 0.416*ACR+ 0.122*TP+ 0.594*RTA+ 0.079*IER+ 0.256*CER \quad (2)$$

$$F3= 0.056*GOV+ 0.073*IAR- 0.029*TA+ 0.368*ACR- 0.121*TP- 0.116*RTA+ 0.393*IER- 0.558*CER \quad (3)$$

TABLE V. ROTATED COMPONENT MATRIX

	Component		
	1	*2*	*3*
TA	0.982	-0.146	-0.058
GOV	0.979	-0.040	0.083
TP	0.972	0.071	-0.188
IAR	0.936	-0.162	0.101
RTA	-0.134	0.972	-0.117
ACR	-0.016	0.720	0.624
CER	-0.070	0.367	-0.848
IER	-0.063	0.178	0.627

From the above analysis, we can get the industry comprehensive assessment function.

$$\Sigma W_i F_i = 0.48286*F1 + 0.21054*F2 + 0.18491*F3 \quad (4)$$

The values of each indicator are put into Eq. (4) through standardization. Table 7 shows the comprehensive evaluation results of each industry according to the comprehensive score.

TABLE VI. COMPONENT SCORE COEFFICIENT MATRIX

	Component		
	1	*2*	*3*
GOV	0.265	0.042	0.056
IAR	0.245	-0.037	0.073
TA	0.258	-0.017	-0.029
ACR	0.049	0.416	0.368
TP	0.271	0.122	-0.121
RTA	0.033	0.594	-0.116
IER	-0.003	0.079	0.393
CER	0.006	0.256	-0.558

TABLE VII. RESULTS OF FACTOR ANALYSIS

Ranking	Industry	F1	F2	F3	Comprehensive score
1	Manufacture of chemical raw material chemical products	3.1342	-0.1730	-0.3591	1.4106
2	Processing of food from agricultural products	1.5115	0.6542	0.3428	0.9310
3	Manufacture of special purpose machinery	0.5908	0.0878	1.3367	0.5510
4	Manufacture of non-metallic mineral products	1.0716	0.0370	-0.3349	0.4633
5	Processing of timbers, manufacture of wood, bamboo, rattrap, palm, and straw products	-0.4785	2.2804	1.0292	0.4394

From the score analysis of the first factor, manufacture of chemical raw material chemical products is ranked No.1, followed by processing of food from agricultural products and manufacture of non-metallic mineral products. These pillar industries make great contribution to the economy. However, from the score analysis of the second factor, the scores are relatively low, indicating that the investment cannot promote the application of technological achievements.

From the score analysis of the second factor, the top three industries are processing of timbers, manufacture of wood, bamboo, rattrap, palm, and straw products, recycling and disposal of waste resource and extraction of petroleum and natural gas. The investments of these three industries are lower, while the gross output values are larger. To a certain extent, these industries can alleviate the pressure of employment. However, these industries should improve the production efficiency and introduce the talents.

From the score analysis of the third factor, manufacture of special purpose machinery and manufacture of textile wearing apparel have some advantages, indicating that the government intends to increase the R&D investment and improve the productivity.

In conclusion, based on the above analysis, the government should develop manufacture of chemical raw material chemical products, processing of food from agricultural products and manufacture of special purpose machinery. Thus, the government pays attention to other emerging industries, e.g. biological medicine, biological energy, marine, high-end equipment and new energy vehicles.

IV. POLICY IMPLICATION

A. *Promote the Differentiation of the Leading Industries*

With respect to the planning of strategic emerging industries in Shandong, compared with other provinces, the government generally expands the scope of emerging industries. Contrary to the relevant regulations, some traditional high-tech industries and the leading industries are included in the scope of strategic emerging industries. At the provincial level, the government should allocate resources rationally and improve industrial concentration according to the actual local conditions[3]. For the cities, the local government should promote the development of the industries with new technology and the core competitiveness, based on the long-term sustainable development in the region.

B. *Encourage Innovation of Strategic Emerging Industries*

Enterprises should encourage the basic and applied researches. To provide technical supports, the scientific researches and technological applications are carried out in the specific industries, e.g. marine biotechnology, marine equipment manufacturing, air power technology, high-end ship manufacturing, biomedical technology and high-end computer manufacturing.

Enterprises intend to encourage the continuous innovation. Enterprises make efforts to avoid excessive scale expansion, set up the technological innovation mechanism and enhance the innovation performance. Governments attempt to increase the scientific investments, establish supporting measures to encourage the technology innovation and enhance the capability of corporate independent innovation[4].

C. *Increase the Fiscal and Financial Supports*

1) *Increase financial input*

The government tends to gradually increase the special funds for strategic emerging industries in the financial budgets, set up advanced platforms engaged in the product research and development, encourage technological progress and innovation and provide technical supports for the major transformation projects. Blue Economic Zone in Shandong makes more investments in technology research and development, industrialization and innovation of strategic emerging industries[5].

2) *Enhance the leverage of tax*

Tax policy is an important tool for the government to support strategic emerging industries. Government should conscientiously implement a series of tax policies for new technology and product and provide tax incentives for emerging enterprises.

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