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Research on Comprehensive Evaluation of Innovation Ability of High and New Technology Industry in Shaanxi Province under New Period

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Abstract: ***This paper was based on the analyze of the innovation ability of high and new technology industry, by the way of establishing an index system of Shaanxi new and high technology industry innovation ability evaluation and use the Principal Component Analysis to estimate the technology innovation ability of high and new technology industry. Finally find that the high and new technology industry of Shaanxi province was the eighth of the thirteen chosen provinces. The weakness was low innovation ability, the research and development ability, innovation environment and input-output ability was insufficient——compared with the eastern area. Only by improving the existing problems can we improve the innovation ability faster and accelerate the development of new and high technology industries.***

1. Introduction

In the process of world economic development, the ability to innovate has become more and more important to all countries. Innovation is the guarantee for the survival and development of enterprises, and it is also the inexhaustible driving force for sustained economic development. Nowadays, the continuous development of science and technology not only promotes the innovation of various technologies, but also promotes the development of high-tech industries. The high-tech industry is the driving force for economic growth in the economic era, and it is also in a dominant position in the knowledge economy. Its development has increasingly become an indicator for measuring the economic, political, military, and cultural aspects of a country, and it plays an important role in the development of each country. status. How to better grasp opportunities, meet challenges, and vigorously develop high-tech industries in Shaanxi Province has become an important issue for Shaanxi Province to accelerate economic restructuring, industrial optimization, improve comprehensive competitiveness, and achieve sustainable development. Therefore, it is necessary to comprehensively analyze the innovation capability of high-tech industries in Shaanxi Province, and propose effective solutions to the problems faced by high-tech industries. Based on the analysis of the status quo of high-tech industry innovation capability in Shaanxi Province, this paper will establish an index system to adapt to the evaluation of high-tech industry innovation ability in Shaanxi Province, and use the principal component analysis method to comprehensively evaluate the innovation ability of Shaanxi high-tech industry. Empirical analysis.

2. The indicator system and research methods

2.1 Data source

This paper selects three regions in North China: Beijing, Hebei, and Shanxi; two provinces in Northeast China: Heilongjiang Province, Liaoning Province; one province in East China: Anhui Province; three provinces in Central South China: Hunan Province, Guangdong Province, Guangxi Province; two regions in the southwest: Sichuan Province, Tibet Autonomous Region; two provinces in the northwestern region: 13 provinces of Shaanxi Province and Gansu Province as research objects, selected data of high-tech industries in Shaanxi Province from 2006 to 2015, the main source of data In the "China Science and Technology Statistical Yearbook", "China Torch Statistical Yearbook".

2.2 Comprehensive Evaluation Index System for Innovation Capability of High-tech

Industry in Shaanxi Province Based on the influencing factors of high-tech industry innovation capability, this paper divides Shaanxi high-tech industry innovation capability evaluation index system into four criteria layers: innovation resource allocation capability, research and development capability, innovation environment support capability and innovation production. The output capabilities are shown in Table 1:

Table 1: Index level of innovation capability of high-tech industry in Shaanxi Province

Shaanxi Province High-tech Industry Innovation Capability Index			
Target layer	Criteria layer	Indicator layer	unit
Research on Evaluation of Innovation	Innovative resource allocation capability	R&D expenditure internal expenditure	Billion
		Number of institutions of higher education	One
		Number of high-tech industry incubators	One

Capability of High-tech Industry in Shaanxi Province		Number of scientific and technological personnel	people
		Number of high-tech enterprises	One
	Research and development capabilities	R&D activity manpower	Year of the human
		New product development expenditure	Billion
		High-tech industry patent applications	item
	Environmental support capacity	Internal expenditure on scientific and technological activities	Billion
		High-tech industry investment	Billion
	Innovative output capacity	High-tech new product sales revenue accounted for the proportion of high-tech product sales revenue	%
		Exports of high-tech products	One million dollars

2.3 Model Construction

The purpose of principal component analysis is to classify more variables into a few comprehensive indicators. Its mathematical model is expressed as follows,

$$Y_1 = e_1X = e_{11}X_1 + e_{12}X_2 + \cdots + e_{p1}X_p$$
$$Y_1 = e_2X = e_{12}X_1 + e_{22}X_2 + \cdots + e_{p2}X_p$$
$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$
$$Y_p = e_pX = e_{1p}X_1 + e_{2p}X_2 + \cdots + e_{pp}X_p$$

Among them, $X_1, X_2, \cdots\cdots, X_p$ are P-dimensional random variable; Y_1 is the largest one in $Y_1 = e_1X$ with the largest variance, and Y_2 isthe second largest among all $Y_2 = e_2X$, ..., Y_p is the smallest of all the variances in the $Y_p = e_pX$; $Y_1, Y_2, \ldots, Y_p$ are irrelevant. Therefore, the P principal components of the P variables are the P linear combinations of the P variables.

In this paper, the index is divided into two layers. Because of the large number of indicators in the second layer, we use the principal component analysis method to synthesize the indicators to form the first level of comprehensive indicators. The model is:

$$F_j = (\alpha_1 F_1^{(j)} + \alpha_2 F_2^{(j)} + \cdots + \alpha_k F_k^{(j)}) / (\alpha_1 + \alpha_2 + \cdots + \alpha_k)$$

Here, $F_1^{(j)}$, $F_2^{(j)}$, …, $F_k^{(j)}$ represents the K factor scores of the jth layer; $\alpha_1^{(j)}$, $\alpha_2^{(j)}$, …, $\alpha_k^{(j)}$ represents the variance contribution of the Kth factor of the jth layer; F_j represents the comprehensive score of the Jth layer. That is to say, the scores of each factor are used as variables, and the proportion of the variance contribution rate of each factor to the total variance contribution rate of the factors is weighted and aggregated, and the comprehensive scores of each province and city are obtained. Through the synthesis of different levels of indicators for the innovation capability of high-tech industries in various provinces, this paper finally evaluates the innovation capability of high-tech industries in each province by the value of F_j . The greater the value, the stronger the innovation capability of the high-tech industry.

3. Empirical Analysis

3.1 Analysis of innovative resource allocation capabilities

(1) Standardize the raw data and extract the variance contribution table of the principal component, as shown in Table 2:

From the table, the cumulative variance contribution rate of the first principal component and the second principal component reaches 94.408%, indicating that the two principal components can represent 94.408% of the information of the original five variables, exceeding 85%, to achieve the intended purpose.

(2)Calculate the principal component and load matrix table, as shown in Table 3:

From Table 3, the relationship between the principal component and each variable is as follows:

$$F_{1t} = 0.977X_{1t} + 0.915X_{3t} + 0.986X_{4t} + 0.933X_{5t}$$
$$F_{2t} = 0.743X_{2t}$$

Calculate the principal component score corresponding to 2015 according to the above formula.

(3)Comprehensive score

According to the calculation $F_j = (\alpha_1 F_1^{(j)} + \alpha_2 F_2^{(j)} + \cdots + \alpha_k F_k^{(j)}) / (\alpha_1 + \alpha_2 + \cdots + \alpha_k)$, the comprehensive scores of the innovative resource allocation capabilities of the high-tech industries in 13 provinces in 2015 are calculated, as shown in Table 4:

According to Table 5-3, in 2015, Shaanxi Province's high-tech industry innovation resource allocation capacity ranked ninth among the 13 provinces selected, Guangdong Province first, and Tibet Province ranked 13th. Due to the weak economic foundation of Shaanxi Province, the government's financial resources are limited, and the innovation capability of high-tech industries is insufficient in the allocation of innovative resources

Table 2: Innovative resource allocation capability principal component variance contribution table

Ingredients	Initial eigenvalue			Extract square sum loading		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	4.072	81.444	81.444	4.072	81.444	81.444
2	0.648	12.964	94.408	0.648	12.964	94.408
3	0.228	4.569	98.977			
4	0.05	1	99.977			
5	0.001	0.023	100			
Extraction method: principal component analysis.						

Table 3: Component Load Matrix

	Ingredients	
	1	2
R&D expenditure internal expenditure	0.977	-0.141
Number of institutions of higher education	0.662	0.743
Number of high-tech industry incubators	0.915	0.008
Number of scientific and technological personnel	0.986	-0.146
Number of high-tech enterprises	0.933	-0.233

Table 4: Innovation resource allocation ability score table

Province	Score	Ranking
Guangdong	4.719711	1
Beijing	2.032659	2
Anhui	0.274547	3
Sichuan	0.120323	4
Hunan	0.037649	5
Hebei	-0.11809	6
Liaoning	-0.12275	7
Heilongjiang	-0.54256	8
Shaanxi	-0.54687	9
Guangxi	-1.07152	10
Shanxi	-1.07998	11
Gansu	-1.5183	12
Xizang	-2.18484	13

3.2 Research and development capability analysis

(1)Standardize the raw data and extract the variance contribution table of the principal component, as shown in Table 5:

It can be seen from Table 5 that the variance contribution rate of the first principal component reaches 98.333%, indicating that this principal component can represent 98.333% of the information of the original three variables, exceeding 85%, to achieve the intended purpose.

(2)Calculate the principal component and load matrix table, as shown in Table 6:
From Table 6, it can be seen that the relationship between the principal component and each variable is as follows:

$$F_{1t} = 0.984X_{1t} + 0.995X_{2t} + 0.996X_{3t}$$

Calculate the principal component score corresponding to 2015 according to the above formula.

(3) Comprehensive score
According to the calculation $F_j = (\alpha_1 F_1^{(j)} + \alpha_2 F_2^{(j)} + \cdots + \alpha_k F_k^{(j)}) / (\alpha_1 + \alpha_2 + \cdots + \alpha_k)$, the comprehensive scores of the innovative resource allocation capabilities of the high-tech industries in 13 provinces in 2015 are calculated, as shown in Table 7.

According to Table 7, the research and development capability of high-tech industry in Shaanxi Province ranked sixth in the 13 provinces selected in 2015. In terms of research and development capabilities, Shaanxi Province is in the middle position of the selected 13 provinces. Shaanxi Province can only improve its innovation ability by continuously enhancing its sense of innovation.

Table 5: Innovative resource allocation capability principal component variance contribution table

Ingredients	Initial eigenvalue			Extract square sum loading		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.95	98.333	98.333	2.95	98.333	98.333
2	0.047	1.57	99.903			
3	0.003	0.097	100			

Extraction method: principal component analysis.

Table 6: Component Load Matrix

	Ingredients
	1
R&D activity manpower	0.984
New product development expenditure	0.995
High-tech industry patent applications	0.996

Table 7: Research and Development Capability Score Sheet

Province	Score	Ranking
Guangdong	5.454565	1
Beijing	0.586829	2
Sichuan	-0.10973	3
Anhui	-0.11914	4
Hunan	-0.26935	5
Shaanxi	-0.45148	6
Hebei	-0.48158	7
Liaoning	-0.4892	8

Heilongjiang	-0.70584	9
Shanxi	-0.79945	10
Guangxi	-0.80119	11
Gansu	-0.88922	12
Xizang	-0.92519	13

3.3 Analysis of environmental support capabilities

As with the above process, the original data is standardized, and the variance contribution table of the principal component is extracted, and the principal component and the load matrix are calculated. Finally, according to

$$F_j = (\alpha_1 F_1^{(j)} + \alpha_2 F_2^{(j)} + \cdots + \alpha_k F_k^{(j)}) / (\alpha_1 + \alpha_2 + \cdots + \alpha_k),$$

the comprehensive scores of the environmental support capabilities of the 13 high-tech industries in 2015 are calculated, as shown in Table 8.

3.4 Analysis of innovation output capacity

As with the above process, the original data is standardized, and the variance contribution table of the principal component is extracted, and the principal component and the load matrix are calculated. Finally, according to

$$F_j = (\alpha_1 F_1^{(j)} + \alpha_2 F_2^{(j)} + \cdots + \alpha_k F_k^{(j)}) / (\alpha_1 + \alpha_2 + \cdots + \alpha_k)$$, the comprehensive scores of the environmental support capabilities of the high-tech industries in 13 provinces are calculated in 2015, as shown in Table 9.

According to Table 9, the innovative output capacity of high-tech industries in Shaanxi Province ranked sixth in the 13 provinces selected in 2015. In terms of innovative output capacity, Shaanxi Province is in the middle position of the selected 13 provinces. Shaanxi Province is located in the hinterland, but it is still insufficient compared to the eastern provinces.

Table 8: Environmental Support Ability Score Sheet

Province	Score	Ranking
Guangdong	2.040422	1
Beijing	0.743755	2
Hunan	0.600566	3
Hebei	0.433904	4
Sichuan	0.28693	5
Shaanxi	0.250335	6
Beijing	-0.14966	7
Liaoning	-0.1605	8
Guangxi	-0.46277	9
Shanxi	-0.72714	10
Heilongjiang	-0.83071	11
Gansu	-0.91494	12
Xizang	-1.10989	13

Table 9: Innovative Output Capacity Score Sheet

Province	Score	Ranking
Guangdong	1.481135	1
Sichuan	0.660054	2
Beijing	0.337303	3
Hunan	0.175654	4
Anhui	0.057202	5
Shaanxi	0.034476	6
Liaoning	-0.07333	7
Gansu	-0.13684	8
Hebei	-0.28323	9
Heilongjiang	-0.43209	10
Shanxi	-0.53153	11
Guangxi	-0.55855	12
Xizang	-0.73024	13

4. Comprehensive analysis of high-tech industry innovation ability

As with the above process, all the indicator data are selected, the original data is standardized, the variance contribution table of the principal component is extracted, the principal component and the load matrix are calculated, and finally, according to

$$F_j = (\alpha_1 F_1^{(j)} + \alpha_2 F_2^{(j)} + \cdots + \alpha_k F_k^{(j)}) / (\alpha_1 + \alpha_2 + \cdots + \alpha_k),$$

the environmental support capacity of the high-tech industries in 13 provinces is calculated in 2015. Score, as shown in Table 10.

According to Table 10, in 2015, Shaanxi Province's high-tech industry innovation ability ranked eighth among the 13 provinces selected, Guangdong Province first, Beijing second, Sichuan province third, Anhui province fourth, Hunan province fifth. It is the sixth in Hebei Province, the seventh in Liaoning Province, the ninth in Heilongjiang Province, the tenth in Guangxi Province, the eleventh in Shanxi Province, the twelfth in Gansu Province, and the thirteenth in Tibet Province. On the whole, Shaanxi's high-tech industry innovation capability is in the middle and lower position of the selected 13 provinces, and there are still many shortcomings in terms of innovation capability.

Table 10: High-tech industry innovation ability score sheet

Province	Score	Ranking
Guangdong	8.366978	1
Beijing	1.872193	2
Sichuan	0.31369	3
Anhui	0.297938	4
Hunan	0.06075	5
Hebei	-0.41434	6
Liaoning	-0.54886	7
Shaanxi	-0.56629	8
Heilongjiang	-1.33511	9
Guangxi	-1.62663	10
Shanxi	-1.72704	11
Guangxi	-1.97597	12
Xizang	-2.72364	13

5. Conclusions and Policy Recommendations

According to the above analysis, in 2015, the innovation capability of high-tech industries in Shaanxi Province was ranked eighth in the 13 provinces selected, among which the innovative resource allocation capacity ranked ninth, and the research and development capabilities, environmental support capabilities and innovation output capabilities ranked first. The location of the six, the ability to allocate innovative resources is relatively weak.

5.1 Problems in the development of innovation capability of high-tech industries in Shaanxi Province

5.1.1 Innovative resource allocation ability is weak

The innovation capability base of high-tech industries in Shaanxi Province is relatively weak, and it has become the main factor affecting the innovation capability of high-tech industries in Shaanxi Province. The data shows that the government's financial allocations have shown a downward trend after peaking, which also affects the improvement of the innovation capability of high-tech industries.

5.1.2 Weak technology resources

Shaanxi Province's high-tech industry research and development capacity ranked sixth, but in specific terms, R&D activity manpower and patent applications are lower than other provinces. Although the high-tech industry in Shaanxi Province has shown steady growth in the development of the past five years, overall, the investment in science and technology resources is still weaker than that in the eastern region, which restricts the development of high-tech industries in Shaanxi Province.

5.1.3 Insufficient investment in innovation funds

Although Shaanxi Province's high-tech industrial environmental support capacity ranks sixth, but in terms of specific, the internal expenditure of scientific and technological activities is significantly lower than other provinces. The government's financial allocations have shown a downward trend after peaking, which will also affect the improvement of the innovation capability of high-tech industries.

5.2 Suggestions

5.2.1 The government raises funds for science and technology funds and encourages independent innovation

Capital is an important factor in improving the innovation capability of enterprises. Although the technical innovation funds in Shaanxi Province have shown an increasing trend in the past five years, there is still a big gap compared to other countries in the country. At the same time of introducing technology, we must also drive the development of enterprises through some major projects. The government should also develop relevant support policies to encourage innovation.

5.2.2 Broaden the financing channels of enterprises and realize the effective operation of corporate funds

It is necessary to actively strengthen the support of various financial institutions for high-tech industries, promote the credit guarantee system, promote the development of venture capital, provide more funds for the development of enterprises, and better encourage enterprises to conduct effective technology research and development and promote the entire industry. The ability to innovate to achieve strong support for the operation of high-tech industry funds.

5.2.3 Strengthen the investment of scientific and technological talents and improve the status of R&D of enterprises

Shaanxi Province is a large province of science and education. There are many colleges and universities, but there is no good mechanism for attracting talents. Enterprises should start from their own, establish a learning organization, and cultivate the innovative awareness of R & D personnel. At the same time, the government can play the role of the media, encourage enterprises to cooperate with universities and research institutes to achieve efficient allocation of innovative resources and breakthroughs in innovation.

5.2.4 Strengthen the management of intellectual property rights and promote enterprises to carry out innovative research and development

Strengthening the management of intellectual property rights can protect the legitimate rights and interests of various patents and avoid the occurrence of infringements; on the other hand, it must crack down on the infringement of intellectual property rights, and at the same time increase the incentives for technological innovation patents to promote enterprises. Innovative research and development.

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