

Evaluation of the Supply of Regional High-Tech Industry Innovation Factors Based on the PSR Model

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Abstract: The high-quality development of regional high-tech industries requires the effective supply of innovative elements. Based on PSR (Post-State-Response) model, the evaluation index system of high-tech industry innovation factor supply is constructed. The global entropy method is used to evaluate the supply status of innovation factors, and the coordination degree of innovation elements is measured. The system coordination degree evaluates the effective supply of innovation factors in two aspects, and conducts empirical analysis with 30 provinces (municipalities and autonomous regions) as samples. The study finds that the supply of innovative factors presents a large regional difference in China, and improves the supply policy of innovative factors. When the number of innovation elements is increased to a certain extent, there will be a platform period, and the positive impact will gradually appear. The realization of the effective supply of innovative factors is a long process, and most provinces and cities in China have not yet realized the effective supply of innovative elements. Finally, the countermeasures and suggestions for optimizing the effective supply of high-tech industrial innovation elements in the region are put forward.

1. Introduction

The report of the Nineteenth National Congress of the Communist Party of China clearly stated: "Deepening supply-side structural reforms. To build a modern economic system, we must focus on the development of the economy on the real economy, and take the improvement of the quality of the supply system as the main direction of attack." Deepening supply-side structural reforms is the only way to promote high-quality development of the regional economy. At this stage, supply-side structural reforms are no longer simply equivalent to "three eliminations, one reduction and one supplement", but rather improve and improve the quality and efficiency of the supply system during the reform. Its core direction is to promote the formation of effective supply. Effective supply of innovation elements is an important part of China's supply system. It is an important guarantee for building an innovative country and an important strategic resource to enhance China's scientific and technological competitiveness. It will improve the ability to adapt the supply of innovation factors and demand structure, improve the quality of supply, and improve Total factor productivity, realizing two-wheel drive of technological innovation and institutional innovation, and ultimately promote high-quality development of regional economy.

China's high-tech industries have significant characteristics such as knowledge-intensive, advanced technology, high added value of products, and strong industry-related effects, especially under the active guidance of national strategies such as "Innovation-Driven Development Strategy", "Made in China 2025", and "Internet +". Replenishment in time filled the downturn crisis of the traditional industry, brought into play its own advantages and characteristics, and achieved balanced and stable growth. However, at the same time, due to the mismatch in the supply and demand structure of innovation factors, the low-end factor scale input, excessive invalid supply, etc., the technological innovation capability bottleneck or the limitation of scale effects have caused some problems in China's regional high-tech industries, such as industrial continuation Insufficient

development momentum, lack of high-level innovative talents, and insufficient intellectual property utilization capabilities. Therefore, this article introduces a relatively mature PSR model and conducts a full-chain regional high-tech industry innovation factor supply evaluation study from three parts: factor supply reason, supply effect, and supply response. It is very important to optimize the factor supply environment and improve the quality of factor supply. Important practical significance.

2. Literature review

At present, there is no uniform definition standard for the composition of high-tech industry innovation elements. The specific performance is as follows: First, from the perspective of system and environment, Xu Qingrui and others believe that the main elements include universities, scientific research institutions, and enterprises, and the resource elements include knowledge, information, talents, and funds. The environmental elements include internal software and hardware innovation environments and external innovation network environments Et al. [1], Qi Yong and others extended the main elements of innovation to institutions related to generating innovation, including enterprises, research institutions, universities and colleges that directly generate innovation, as well as government, intermediary and financial services institutions that serve innovation [2], Li Peinan et al. Believe that in the innovation system, the elements of innovation are mainly composed of talents, funds, technology and resources [3]. Including technology, human capital, and funds; indirect elements refer to the parts that are closely related to technological innovation in the metropolitan area, including infrastructure, social environment, and macro policies [4]; second, from the perspective of element mobility, Feng Nanping believes that innovation factors Includes liquidity and non-liquidity elements. Liquidity elements include talent, funds, and technology. , Illiquidity factors including environmental, policy, management, system, etc. [5]. The third is based on the structure and function of the element system. Ou Tinggao believes that the innovation elements include the main elements, supporting elements and market elements [6]. Although the perspective on the classification of innovation elements is different, in general, it is believed that the innovation elements mainly include talents, funds, technologies, policies and resources.

Most domestic research on the supply of innovation factors starts with structural reforms on the supply side. On the one hand, it studies the relationship between factor supply and economic development from the overall perspective. Li Peinan, Zhao Lanxiang, Wan Jinbo and other studies have found human capital, internal funds, and external technologies. The impact of the input of innovation elements such as government support and other factors on the performance of different stages of industrial innovation varies [3]. Zhang Yuming and Wang Chunyan pointed out that the internal innovation elements of enterprises promote the upgrade of elements, the improvement of the efficiency of external elements, and the effective supply of the system. Resource interaction promoted the optimization of industrial structure [7]. Hou Xiaodong analyzed the factors affecting economic development from the perspective of the structural imbalance of factor supply. It is necessary to improve the total factor productivity to form a driving mechanism for total factor driving economic development [8]. Proposed that the distortion of the factor market leads to the lag in the development of the productive service industry [9], Hong Yinxing [10], Ren Baoping [11], Gu Shengzhe [12], etc. pointed out that high-quality economic development requires a full flow of innovative factors, eliminating talent, Technology, capital and other factors supply constraints, Gui Huangbao [13], Feng Weiyi, etc. [14], Huang Haixia, etc. [15] used the DEA model to measure the efficiency of provincial innovation and the allocation of scientific and technological resources in China; on the other hand, the impact of certain innovation factors on economic development was studied. Chen Qifei, Zhang Weifu, and Tang Baoqing analyzed local services. The impact of factor supply on the rapid growth of high-tech industry exports [16], Rifat Kamasak research found that the corporate innovation environment has a significant positive impact on innovation performance [17], Li Yuhua and others believe that corporate collaborative innovation, the participation of universities and research institutions, The key resources and operation management of the organizational unit in the industry have a significant impact on the technological innovation of high-tech industries [18].

David Han-Min Wang used quantile regression to study 23 OECD countries and found that R & D expenditure in high-tech industries Economic positive impacts vary with different levels of per capita GDP [19]. Studies by Luca Grilli [20], Ross Brown [21], and Li Miaomiao et al. [22] found that government fiscal policies and management policies have a greater impact on R & D efficiency. Complex effects, such as Zhuo Chengfeng's research found that the inter-provincial flow of R & D personnel and R & D capital will have a significant positive effect on the innovation performance of the inflow region. Impact of government R & D support can effectively promote R & D staff mobility play its innovation effect, but for R & D capital, a positive effect was not significant [23]. Synthesizing relevant research literatures, it is found that most of the research on innovation factor supply focuses on the impact of a certain innovation factor supply on economic development and qualitative analysis. There is not much research on the evaluation of innovation factor supply in high-tech industries in China's provinces. In the process of the indicator system, environmental factors were not taken into account.

The PSR model is the pressure-state-response model. It was proposed by Canadian statistician David Rapport et al. [24]. The International Organization for Economic Cooperation and Development (OECD) has adopted a revised PSR model in environmental reports since the 1970s. It serves as a framework for studying environmental issues. In the late 1980s and early 1990s, the OECD re-evaluated the applicability and effectiveness of the model when conducting environmental index research. Its member states believe that in the process of establishing core environmental indicators, the PSR model is stable and effective. It continues to be used in the organization's environmental assessment work. The PSR model is also widely used in various fields of environmental assessment such as ecosystem health assessment and sustainable use of resources (such as [25-29]), and has become a commonly used model in environmental assessment. Berger et al. Used the pressure-state-response model framework to analyze environmental changes. Compared with traditional analysis methods, they can consider ecological, environmental, and economic development factors more comprehensively [25]. Hughey et al. Started with the status quo of environmental problems in New Zealand and used the PSR model to analyze whether the implementation of environmental policies has reached national satisfaction [26]. Mihyeon et al. Used the PSR model to construct a sustainable development transportation system index system, evaluated the impact of the system on the economy, the environment, and general social welfare, and measured the impact of the system on the natural environment [27]. Chaves et al. Integrated the social, economic, and environmental issues that affect the sustainable development of water resources in the basin through a PSR model into a set of quantitative, dynamic, and comprehensive indicators to build sustainable development of the basin. Index [28]. Wolfslehner et al. Put sustainable forest management indicators into the PSR model framework in the evaluation of sustainable forest management policy research, and evaluated the effects of four forest management strategies through the combination of network analysis (ANP) and PSR model [29]. The PSR model has been widely used in the study of environmental efficiency assessment in China (Gao Shan [30], Feng Yan [31], Zhang Manman [32]), and it has also been gradually introduced into the field of humanities and social sciences. Xie Xiaoqing uses the PSR framework Evaluation of Wuhan's entrepreneurial environment [33], Tang Chaoyong researched Shanxi's leading entrepreneurial talent gathering mechanism [34], Dai Minghui used the PSR model to study the sustainable development of China's foreign trade since reform and opening up [35], Zhang Lei, Hu Huizi, Zhang Min, etc. used the PSR model to construct an index system for the development of military and civilian integration in China's provinces and regions, and evaluated the development level of military and civilian integration in 31 provinces and cities in China [36], Horizontal comparison, and Shanxi Province itself to explore the driving force of the cultivation of new R&D organizations in Shanxi Province, explain the current situation of the cultivation of new R&D organizations in Shanxi Province and propose countermeasures [37], Bu Fangang, and Wang Ying choose the three dimensions of pressure, status, and response, Comprehensive evaluation and quantification of 99 new rural-urbanization levels in Jinan City [38]. Taken together, the "pressure"- "state"- "response" analysis framework of the

current PSR model is suitable for environmental assessment and can also be used for objective comprehensive assessment in other fields.

The supply of regional high-tech industry innovation elements is a complex system on the one hand, including government, financial institutions, innovative talents, intermediary agencies, enterprises and many other innovation entities, involving economic, social, natural, technological and other aspects. Dynamic analysis of innovation factors Supply factors, subject matter, environment, and other factors; on the other hand, the supply of high-tech industry innovation factors has process attributes, that is, different innovation factors play different roles at different stages of the innovation process, although the current evaluation of high-tech industry innovation efficiency There are concerns about the procedural characteristics of the supply of innovation factors, but in the existing research, more attention is given to factor supply as a subsystem of the entire innovation process, and less attention is paid to the state and feedback process of innovation factor supply. The logical framework of the "stress-state-response" model of the PSR model can just make up for the deficiencies in the existing research on the evaluation of the supply of innovation factors, and integrate the causes and effects of the supply of innovation factors in regional high-tech industries and improvement measures into an analytical framework to enable high-tech The supply of industrial innovation elements forms an adaptability L circulation process, promote the sustainable development of high-quality high-tech industry in China.

3. Research design

3.1 PSR Model

The basic idea of the PSR model is that various production and management activities carried out by humans for their own development exert positive or negative pressure on the ecological environment (Pressure), and then change the state of the environment. In the face of this state, the government and social organizations take response measures to cope with the development and changes of the state of the ecological environment (States). The response actions of the government in turn promote or suppress pressure changes, and at the same time affect the state of the ecological environment (States), which constitutes a strict "pressure"- "state"- "response" relationship between humans and the environment Logical framework.

PSR Model includes two loops. First, the outer circle consisting of clockwise arrows. The pressure on the supply of regional innovation factors comes from the demand for economic and social development, technological spillovers from international trade, and environmental sustainable development. These factors produce positive or negative regional supply of innovation factors. The pressure and impact of the need to continuously improve the quantity and quality of innovation factors to meet the needs of economic and social development. After feeling these pressures, the innovation factors show a certain reality. Because the ultimate goal of the supply of innovation factors is to produce and meet demand, and the enterprise is a microeconomic entity, the state of supply of innovation factors includes the input of innovation factors at the enterprise and industrial levels and The state of output, government departments, etc. responded by developing corresponding policies and introducing relevant measures to make the environmental factors related to the supply of innovation factors develop in a good direction, and then affect the quantity and quality of integrated innovation factor supplies. Secondly, the internal cycle consisting of counterclockwise arrows also has the characteristics of a dynamic transmission mechanism. It starts with the state of supply of regional factors, reflecting that the failure to release the pressure of innovation factor supply will inhibit the quantity and quality of innovation factor supply. Which in turn affects the matching of supply and demand of innovation factors, and after feeling the pressure of supply of innovation factors, it feeds back the development of government departments and industries in a required form, thereby forming an organic dynamic cycle.

Based on the above-mentioned logical analysis of the supply of regional high-tech industrial innovation factors, the regional high-tech industrial innovation is regarded as a combination of

innovation factors-high-tech industries-industrial development environment, a system of positive and negative pressure input from the system, changes in the state of the system itself, and The three aspects of the feedback from the main body of the system are to jointly build a research framework for the evaluation of the supply of regional high-tech industrial innovation elements. The PSR model can be integrated with the supply-demand matching of the effective supply of regional high-tech industrial innovation elements. Coordination, and then comprehensively evaluate the innovation factor supply comprehensive index and subsystem coordination degree from the two aspects of the convergence of high-tech industries, whether the industry can be transformed into real productivity and the ability to meet domestic and foreign consumer demand in the industry. Evaluation of effective supply of regional high-tech industry innovation factors. The PSR model has a good applicability to the evaluation of the effective supply of regional high-tech industry innovation factors.

3.2 Evaluation System

This article builds an evaluation index system for the supply of high-tech industrial innovation elements based on the PSR model, which includes three aspects: pressure, status, and response. The selection of the evaluation indicators of the effective supply of high-tech industry innovation factors is shown in Table 1.

Table.1. Evaluation Index System for Effective Supply of Innovation Elements in High-Tech Industry

Factor layer	Child element layer	Indicator layer
Pressure (P)	Economic Pressure	Per capita disposable income of urban residents
		Industrial development level
	Social Pressure	Number of ordinary universities
		Number of R&D institutions
		Investment in fixed assets
International Trade Pressure	Foreign direct investment	
	Environmental Pressure	District electricity consumption
State (S)	Investment Status	Discharge of environmental pollutants
		Expenditure for new product development
	Output Status	R&D Internal funding
		R&D Activity personnel full-time equivalent
		Patent applications
Response (R)	Policy Response	New product development projects
		Number of high-tech companies
	Industry Response	Government R&D Expenditure
		Government education expenditure
		Science and Technology Expenditure
	Internet Broadband Access Households	
	Development level of high-tech industry	
	New product sales revenue	
	Export delivery value	

3.3 Models and Methods

The traditional entropy method can only realize the analysis of two-dimensional data tables of indicators-regions or indicators-time. The global entropy dynamic evaluation model is based on the principle that the sub-tables at each time of the three-dimensional time series data table are arranged from top to bottom in chronological order, and then the indicators are analyzed vertically and horizontally.

The indicator weight is determined according to the idea of the global entropy method. The calculation steps are as follows:

(1) If you evaluate n variables in each area of m in year T , you can get T cross-section data tables $X^T = (x_{ij})_{mn}$, from the obtained data. Introduce a global idea to arrange the T tables in chronological order in a table, a 300×21 matrix is formed, which is written as:

$$\mathbf{X} = (X^1, X^2, \dots, X^T)_{mT \times n} = (x_{ij})_{mT \times n} \quad (1)$$

(2) Because the dimensions of the indicators are different, calculation and analysis cannot be performed directly, and the data must be standardized:

If x_{ij} is Positive indicator, then:

$$x'_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} \times 99 + 1 \quad (1 \leq i \leq mt, 1 \leq j \leq n) \quad (2)$$

If x_{ij} is Reverse indicator, then:

$$x'_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}} \times 99 + 1 \quad (1 \leq i \leq mt, 1 \leq j \leq n) \quad (3)$$

(3) Proportion of the i -th region in the indicator under the j -th indicator:

$$f_{ij} = \frac{x'_{ij}}{\sum_{i=1}^{300} x'_{ij}} \quad (1 \leq i \leq mt, 1 \leq j \leq n) \quad (4)$$

(4) Information entropy of the j -th index:

$$e_j = -k \sum_{i=1}^{300} f_{ij} \ln f_{ij} \quad (1 \leq i \leq mt, 1 \leq j \leq n) \quad (5)$$

(5) Information entropy redundancy of j -th index:

$$g_j = 1 - e_j \quad (6)$$

(6) Weight of each indicator:

$$w_j = \frac{g_j}{\sum_{j=1}^n g_j} \quad (7)$$

(7) Comprehensive evaluation value:

$$F_i = \sum_{j=1}^n w_j x'_{ij} \quad (8)$$

The change in the effectiveness of factor supply is affected by the degree of coordination between pressure, status, and response subsystems. The coordination degree function is introduced here to measure the three subsystems and the coordination status, pressure, state, and response rates of the three subsystems and the comprehensive index of the supply of regional innovation factors should be balanced with each other. The bias of either side will have an impact on the supply of regional high-tech industry innovation factors. The calculation formula is: $C = \frac{X+Y+Z}{\sqrt{(X^2+Y^2+Z^2)}}$. It is not difficult to find from the definition of coordination degree that C is the coordination degree index, which is determined by the value of each subsystem. X , Y , and Z are the pressure, state, and response subsystem indexes. When X , Y , and Z are all positive, when the values are equal, the value of C is the largest, which is 1.732; otherwise, if P , S , and R are negative and equal, the value of C is the smallest. Any other situation lies between the two, and the three subsystems are more coordinated. The closer the C value is to 1.732 [30].

4. Empirical analysis

All data in this article are from the "Statistical Yearbook" of various provinces and cities, as well as "China Statistical Yearbook", "China Industrial Economic Statistical Yearbook", "China High-Tech Industry Statistical Yearbook", "China Science and Technology Statistical Yearbook" and so on. Missing values are filled using interpolation. Using Spss 19.0 software to program and calculate the global entropy method, the comprehensive index and ranking of the supply of high-tech industry innovation factors in 30 provinces, municipalities and autonomous regions in China from 2009 to 2018 are shown in Table 2.

Table.2. China's High-Tech Industry Innovation Factor Supply Comprehensive Index and Ranking 2009-2018

Pro	2009	2011	2013	2015	2017	2018	Mean	Rank
Beijing	12.06	16.89	19.52	26.59	29.67	30.05	21.82	4
Tianjin	7.68	8.33	9.65	11.97	16.66	12.79	10.79	11
Hebei	3.86	5.02	5.73	8.03	10.21	11.33	6.97	18
Guangdong	30.62	39.65	50.59	63.43	72.03	83.58	54.35	1
East	11.23	14.63	18.20	23.08	26.77	28.21	19.68	
Jilin	3.81	4.46	5.06	6.89	6.73	7.28	5.49	20
Henan	4.40	5.90	7.20	11.68	15.68	16.60	9.48	13
Hubei	5.48	7.13	8.72	12.41	15.70	16.64	10.43	12
Jiangxi	5.02	5.71	6.85	8.38	10.47	11.33	7.61	16
Central	4.36	5.37	6.56	9.10	11.19	12.01	7.69	
Sichuan	6.45	8.13	10.42	14.35	16.95	18.37	11.88	7
Yunnan	3.23	3.63	4.22	5.04	5.83	6.37	4.58	24
Shanxi	7.21	7.04	8.90	12.90	16.61	15.64	10.88	9
West	3.76	4.17	4.99	6.45	7.87	8.27	5.68	
Mean	6.45	8.06	9.92	12.88	15.28	16.16	11.35	

From Table 2, it can be seen that the average value of the comprehensive factor supply index for innovation in high-tech industries in 30 provinces, municipalities, and autonomous regions in China is 11.35. Compared with the Guangdong Province Index, the highest domestic province, the composite factor supply value of each province is still relatively large. Room for improvement. The horizontal comparison found that only the 7 provinces and municipalities in Beijing, Shanghai, Jiangsu, Zhejiang, Guangdong, Shandong and Sichuan exceeded the national average. Except Sichuan, all the indexes were concentrated in the eastern region. From the perspective of regional vertical comparison, the average Guangdong Composite Index of Innovation Factor Supply averages 54.35, which is 51 higher than the lowest value in Qinghai Province. The differences in the supply of innovation factors between provinces and cities in China are relatively obvious. Various factors such as the level of development of traditional and high-tech industries, location advantages, policy systems, infrastructure construction, and social and cultural environment ultimately lead to regional differences in the supply of factors.

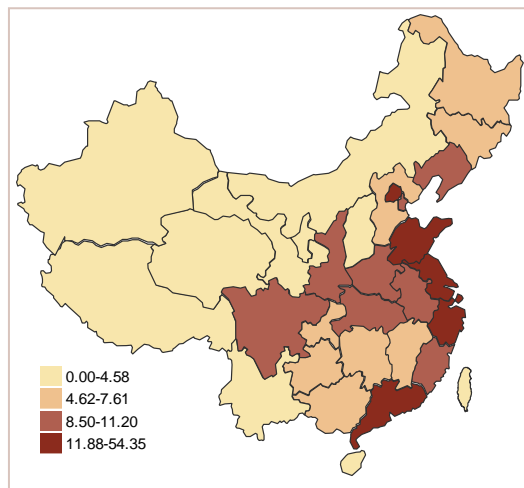


Figure 1. China's high-tech industry innovation factor supply composite index mean spatial distribution map

As shown in Figure 1, based on the average 10-year innovation factor supply comprehensive index for 30 provinces from 2009 to 2018 as a basis for mapping, from the perspective of regional division, the central and western innovation factor supply comprehensive index is significantly lower than the eastern region. The average supply of innovation factors in the eastern, central, and western regions were 19.61, 7.69, and 5.68, respectively, showing a stepwise development state. The difference between the central region and the western region is small, and both are in the stage of low-growth factor supply. From the perspective of time, the gap between the levels of supply of innovation factors between China's provinces in the 10 years from 2009 to 2018 has gradually widened. As shown in Table 2, except for Guangdong and Jiangsu, the average changes in other provinces, cities, and autonomous regions in China are concentrated below 20, and the provincial differences among Gansu, Qinghai, Ningxia, Xinjiang, Hainan, Inner Mongolia, and Hainan are less than 3. Regional independent innovation capabilities, technology introduction digestion and absorption capabilities, factor endowments, institutional policies, and degree of openness have led to an uneven supply of innovation factors in China. The development level of traditional industries in the eastern region is significantly better than that in the central and western regions. It has a high degree of marketization, a strong atmosphere of innovation, and a significant resource agglomeration effect. It has also built a large number of dual-innovation demonstration bases and actively deployed the construction of national industrial innovation centers. The resource agglomeration effect in the industry is not as good as in the eastern region.

Analyze the changes in the pressure (P), state (S), and response (R) indices in the evaluation system for the supply of innovation factors in 30 provinces, municipalities, and autonomous regions in China from 2009 to 2018, with the purpose of further analyzing the affected areas the mechanism of the level of innovation factor supply.

(1) Pressure (P) index. The pressure (P) layer of the innovation factor supply system contains a total of 8 economic indicators, of which 2 are reverse indicators and 6 are positive indicators. After data processing and analysis, the pressure (P) index is a neutral value. The greater the pressure on factor supply.

The pressure (P) index reflects the impact of human economic activities on the supply of innovation factors. On the whole, from 2009 to 2018, the supply pressure (P) index of innovation factors across China's provinces has been increasing year by year. From the perspective of regional division, the differences between the eastern, central, and western regions are obvious. The six provinces with the largest slopes of the pressure (P) index are all distributed in the eastern region, indicating that the impact of pressure indicators on the supply of innovation factors has increased significantly. The index has increased but has remained at a low level below 5 for ten years. Different provinces have different levels of economic development, and there is a large difference in the pressure on the supply of innovation factors. The market economy in the eastern region is more developed and the resource agglomeration effect is stronger. At the same time, the difference in the internal pressure index of the eastern region is greater than that of the central and western regions, and the internal impetus for the innovation of elements is stronger than the willingness to cooperate. In terms of time series, the time and degree of changes in the pressure (P) indicators in different provinces are different, and the pressure indexes of Jiangsu and Guangdong have the fastest changes. From 2012 to 2014, the slope of the change in the pressure (P) index in Jiangsu Province was the largest, which made Jiangsu Province develop from a lower state to a higher pressure level, and the impact on the supply of innovation factors increased significantly. Henan Province, Anhui Province, Sichuan Province, and Shaanxi Province have shown a year-on-year increase in the pressure (P) index. The impact of pressure indicators on the supply of innovation factors continues to increase.

(2) State (S) index. The state of supply of innovation factors in China's 30 provinces, municipalities, and autonomous regions has improved. Except for Guangdong, Jiangsu, Zhejiang, Shandong, Shanghai, and Beijing, the remaining provinces (S) index the rise is not significant. As far as regional division is concerned, the six provinces and cities with the largest changes in the overall slope of the state (S) index from 2009 to 2018 are Guangdong, Jiangsu, Beijing, Zhejiang, Shandong, and Shanghai, all in the eastern region. Prospective industrial policies and geographical advantages

are closely linked. The average value of the state of innovation factor supply state index in the central and western regions is small, 1.99 and 1.29, respectively, and there is still much room for improvement compared with the average of 7.18 in the eastern region. It is worth noting that although the overall level of the central and western regions is relatively low, the state of factor supply (S) in central and western provinces such as Anhui, Hubei, Sichuan, and Shaanxi has been improving year by year. In terms of time series analysis, although some provinces in the eastern region have experienced slow growth in the factor supply state (S) index after 2014 and a plateau period has appeared, they have remained at a high level overall, while most provinces in the central and western regions have maintained innovative factor supply states (S) It is in the process of rising year by year, and provinces such as Gansu have maintained a low rate and low level. After a short "platform period" between 2009 and 2012 in Guangdong Province, the state (S) index increased at a higher rate, which fully demonstrated Guangdong's economic vitality and strong agglomeration effect. It should be pointed out that the supply state (S) of innovation factors will appear in the "platform period" after sufficient creation and concentration. This is due to the continuous optimization of the supply state of innovation factors, and the space for substantial improvement on the original level gradually shrinks.

(3) Response (R) index. The innovation factor supply response (R) indicators of 30 provinces, municipalities, and autonomous regions in China have shown an overall upward trend, reaching a peak in 10 years in 2018, but the provincial index has a large difference, most of them The central and western provinces and cities' response (R) index maintained a low level of low growth. From a regional perspective, Guangdong, Jiangsu, and Shanghai are all located in the eastern regions of the three provinces with the largest overall change slopes in the response (R) index. At the same time, there are also large regional differences. Central and western provinces such as Shaanxi, Sichuan, Henan, and Hubei, relying on their own government policies, have driven the rapid accumulation of high-tech industry innovation factors. As of 2018, the response (R) index has reached the level of some developed provinces in the east. From the time series point of view, from 2011 to 2014, in response to national policies, various regions vigorously developed high-tech industries, especially the introduction of government policies, and the innovation factor response (R) index slope became larger. With the continuous improvement of the state's industrial policy for high-tech industries and the construction of corresponding supporting facilities, starting in 2016, most provinces and cities' response (R) index curves have become steeper than before, and peaked in 2018.

(4) Analysis of coordination. The closer the coordination degree coefficient C is to 1.732, the better the coordination between the supply of innovation elements to the three internal subsystems. Cluster analysis was performed based on the average of the coordination coefficients of the provinces during the 10-year period from 2009 to 2018. Combined with the research of Gao Shan [30] and others, the 30 provincial coordination values were divided into four levels. Category analysis, 10 provinces including Beijing, Tianjin, Jiangsu, Zhejiang, and Anhui with coordinated supply of factors, all concentrated in the central and eastern regions, and basically coordinated are Guangdong, Liaoning, Shanghai, Chongqing, Sichuan, etc. In each province, the supply of innovation factors in Jilin, Shanxi, Guangxi, Yunnan, and Gansu is not very coordinated. Qinghai, Ningxia, Inner Mongolia, and Hainan are in a very uncoordinated state. The degree of coordination of elements in the central and eastern regions is significantly better than that in the western region. The development of traditional industries in the western region is lagging behind, and the role of government policies has not yet fully manifested, including the development of demonstration projects, the construction of a good industrial development environment, and the improvement of the policy system, which has led to the general lack of coordination of the supply of innovative factors in the western region. At the same time, a comparison of the coordination coefficient between 2017 and 2018 found that the regional internal development was unbalanced, and the coordination status between provinces was quite different. Hainan was in a very uncoordinated state, while the remaining provinces in the eastern region had already Coordinate supply of factors. In terms of time series, the coordination coefficient of most provinces in 2018 is lower than that in 2017. This is due

to the rapid growth of the stress (P) subsystem, which cannot be coordinated with the state (S) and response (R) subsystems.

Table.3. Hierarchical classification of supply coordination degree of innovation factors

Coordination level	Coordination factor	Number of provinces	Features
coordination	≥ 1.69	10	Achieve coordination within the system and strongly support the sound development of high-tech industries
Basic coordination	1.56~1.68	9	Basically achieve coordination within the system and have certain ability to support development
Not very coordinated	1.52~1.55	7	Intra-system coordination has not yet been achieved, but there is still development prospects
Extremely uncoordinated	≤ 1.51	4	Failure to achieve intra-system coordination and gaps with standards

On the basis of the degree of coordination, referring to the study by Gu Weinan et al. [39], the provinces with a comprehensive score of innovation factor supply that is not significantly different from the level of coordination degree (theoretical ≤ 4) are referred to as high-level innovation factor effective supply type and coordination. Provinces that rank significantly better than the comprehensive score of factor supply are called coordinated leading, otherwise they are called factor supplied leading. The analysis shows that, in terms of regional division, the coordination degree of innovation factor supply in the eastern region is significantly better than that in the western region, showing a gradient pattern. 1) the first gradient: Beijing, Jiangsu, Zhejiang, Tianjin, Shandong, Fujian, the comprehensive index of innovation factor supply and the degree of coordination coefficient are in a leading position to achieve a high level of effective supply of innovation factors; 2) the second gradient: Guangdong, Shanghai, Liaoning, Sichuan, Shaanxi, the ranking of the comprehensive index of innovation factor supply is significantly higher than the factor coordination degree coefficient, which belongs to the leading factor supply; 3) the third gradient: Jilin, Heilongjiang, Henan, Hubei, Chongqing, innovation factor supply The rankings of the comprehensive index and the degree of coordination coefficient are not much different, but the development speed of the two is relatively slow. They are at a medium level in the country and belong to the effective supply of innovative factors; 4) the fourth gradient: Hebei, Anhui, Hunan, Jiangxi, and Guizhou. The factor coordination factor is significantly better than the comprehensive index of innovation factor supply, which is a leading type of coordination; 5) the fifth gradient: Shanxi, Inner Mongolia, Yunnan, Gansu, Guangxi, Qinghai, Ningxia, Xinjiang, Hainan, which belongs to low-level innovation Factor supply.

5. Conclusion

Based on the PSR (pressure-state-response) model, this paper constructs an evaluation index system for the effective supply of innovation elements in high-tech industries, and selects relevant statistical data from 30 provinces, municipalities, and autonomous regions in China to provide economic and social pressure on the supply of innovation elements, the state of supply of elements, Systematic analysis and evaluation of policies and measures. The research in this article draws the following conclusions:

(1) The status of the supply of innovation factors in China's provinces, municipalities and autonomous regions has the following characteristics: 1) the development level of China's innovation factor supply varies greatly from region to region. The composite index and each subsystem index in the eastern region are better than those in the central and western regions. The original level of economic development, infrastructure construction and the corresponding measures of the

government department on the supply of innovation factors have a certain impact on the concentration and reproduction of high-quality innovation factors; 2) the optimization measures for the supply of innovation factors increase to a certain extent and innovation will occur. The platform stage of the state of supply of factors (S) is due to the continuous improvement of the environment for the production and concentration of innovation factors and the shrinking of the space for progress. To continue to improve the supply of innovation factors and achieve effective supply, it must be based on local development levels. Only by carrying out policy innovation and management innovation can we develop a new space for the production and accumulation of innovation factors at a higher level; 3) Effective supply of innovation factors requires that each subsystem be at a high level and have a good degree of coordination. Among the 30 samples, only a few provinces and cities, such as Beijing, Jiangsu, Zhejiang, Tianjin, Shandong, and Fujian, can achieve a high level of effective supply. The effective supply of innovative elements is a relatively slow accumulation process.

(2) Based on the changes in the comprehensive indexes of most provinces and cities in the country, the cumulative effect of policies and measures to optimize the supply of innovation factors has been gradually released, and government departments are innovating policies and measures. Eventually achieve effective supply.

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