Comparative Evaluation of Scientific and Technological Innovation Levels in the Beijing-Tianjin-Hebei Region

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ABSTRACT

Based on principles of systematicity and scientific rigor, this study constructs a three-dimensional evaluation index system encompassing “innovation input - innovation output - innovation environment”. Employing the hierarchical equal-weight ideal solution model, it conducts a comparative assessment of technological innovation levels across the Beijing-Tianjin-Hebei region. Research shows that the overall scientific and technological innovation level index of the Beijing-Tianjin-Hebei region has an average annual growth rate of 7.78% from 2012 to 2022, showing a steady growth trend but experiencing a periodic decline due to fluctuations in Tianjin. The development of the Beijing-Tianjin-Hebei region presents differentiated characteristics, with Beijing steadily growing at a high level and becoming the core driving force of the region; Hebei's low level high-speed growth highlights its potential after 2019; Tianjin has shown strong volatility, with a significant decline from 2016 to 2019 due to reduced investment and loss of research and development institutions. At the sub-dimensional level, innovation investment has gone through three stages: explosive growth, adjustment slowdown, and sustained improvement. Innovation output entered an explosive period after 2020, and the overall innovation environment has improved, but it has declined due to the impact of industry adjustments in Tianjin from 2015 to 2018. Based on this, measures such as establishing a collaborative mechanism among the three regions, implementing precise policies, and improving the factor guarantee system are proposed to provide support for promoting the integrated development of scientific and technological innovation in the Beijing-Tianjin-Hebei region.

Keywords: *Beijing-Tianjin-Hebei region, Level of scientific and technological innovation, Hierarchical equal-weight ideal solution model, Spatiotemporal evolution, Evaluation system.*

1. INTRODUCTION

The 20th National Congress of the Communist Party of China proposed to “comprehensively promote the construction of international and regional science and technology innovation centers, strengthen the construction of scientific and technological basic capabilities, and achieve high-level scientific and technological self-reliance and self-improvement by 2035, entering the forefront of innovative countries”; The Third Plenum of the 20th Central Committee of the Communist Party of China further emphasized the construction of a system and mechanism that supports comprehensive innovation, and the coordinated promotion of the integrated reform of the education, science, technology, and talent system and mechanism to enhance the overall effectiveness of the national innovation system, aiming to clarify the important strategic significance of scientific and technological innovation. Therefore, conducting an evaluation of the level of scientific and technological innovation has irreplaceable key value for multiple entities such as the country, enterprises, and research institutions. It can accurately identify strengths and weaknesses, promote targeted improvement of innovation entities, and enhance core competitiveness.

Based on different academic knowledge backgrounds, scholars in China and foreign countries construct different indicator systems and evaluation methods to evaluate the level of scientific and technological innovation. In terms of evaluation system, based on a single perspective, Zou Yimin and others mainly used single indicators such as the number of patent applications authorized[1-2] or R&D intensity[3] to evaluate the level of scientific and technological innovation. Based on an integrated perspective, Ye Wenxian[4] constructed a two-dimensional evaluation system of "technology input technology output" to assess the scientific and technological innovation capability of Xi'an city; Zheng Qiang[5] constructed a two-dimensional evaluation system of "new knowledge achievement generation - economic value conversion" to evaluate the comprehensive index of scientific and technological innovation in 30 provinces in China. Based on a comprehensive perspective, Cheng Hao et al. constructed a three-dimensional evaluation system of "input - output - environment" and "technology input agglomeration - technology output agglomeration - high-tech industry agglomeration" respectively from the perspectives of input-output[6-8] and regional technology agglomeration[9]. In terms of evaluation methods, TOPSIS method[4], entropy method[5], factor analysis method[7] and other methods are mainly used to evaluate the level of scientific and technological innovation.

According to literature review, the indicators of scientific and technological innovation level are often reflected in a single dimension such as scientific and technological innovation investment or technological innovation environment, which leads to a lack of systematic and comprehensive indicator design. From the perspective of research areas, few scholars have measured the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region, resulting in a lack of consensus on the evaluation of the level of scientific and technological innovation in the region. Therefore, it is urgent to improve the indicator design of scientific and technological innovation level, construct a more spatiotemporal comparable evaluation model for scientific and technological innovation level, and deeply analyze the spatiotemporal evolution of scientific and technological innovation level in the Beijing-Tianjin-Hebei region. The contribution of this article is mainly reflected in: based on theoretical foundations, literature achievements, and research practices, the authors of this article systematically designed a three-dimensional evaluation system for the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region, consisting of "innovation input - innovation output - innovation environment". They constructed a hierarchical equal-weight ideal solution comprehensive evaluation model to evaluate the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region and proposed countermeasures and suggestions for promoting the improvement of scientific and technological innovation in the region. Compared with existing models, the hierarchical equal-weight ideal solution model comprehensively reflects the changes and constraints in the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region during different periods.

2. RESEARCH DESIGN

2.1 Evaluation System Construction

According to the references [6-7,10-12], and following the principles of systematicity, scientificity, dynamism, and operability, the researchers design indicators for the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region from three dimensions: scientific and technological innovation input (I_1), scientific and technological innovation output (I_2), and scientific and technological innovation environment (I_3). First, the I_1 dimension focuses on reflecting the scale and intensity of regional scientific and technological innovation from both human and financial aspects; Second, the I_2 dimension focuses on reflecting the regional ability to transform scientific and technological achievements from two aspects: patent output and market output; Third, the I_3 dimension focuses on reflecting the important support for innovation activities from three aspects: industry, education, and research and development. Finally, by integrating three dimensional indicators, the Beijing-Tianjin-Hebei science and technology innovation level index is measured, represented by I as the explanatory variable value. The selection of indicators for the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region is shown in “Table 1”.

Table 1. The selection of indicators for evaluation level of scientific and technological innovation in the Beijing-Tianjin-Hebei region

Variable	Indicators	First level indicators	Second level indicators
I	Scientific and technological innovation level	Scientific and technological innovation input (I_1)	Proportion of R&D personnel to practitioners Equivalent full-time equivalent per 10,000 high-tech industry R&D personnel Internal expenditure of R&D funds in high-tech industries Internal expenditure of R&D funds for industrial enterprises above designated size
		Scientific and technological innovation output (I_2)	Number of patent applications accepted per 10,000 people Number of patent applications granted per 10,000 people Proportion of technology market transaction volume Export of new products in high-tech industries
		Scientific and technological innovation environment (I_3)	Average number of students enrolled in regular higher education institutions per 100,000 people Number of high-tech enterprises Number of R&D institutions

a Note: The data mainly comes from the “Beijing Statistical Yearbook”, “Tianjin Statistical Yearbook”, “Hebei Statistical Yearbook”, “China High-tech Industry Statistical Yearbook”, and the official website of the National Bureau of Statistics.

2.2 Model Construction

According to “Table 1”, the ideal solution model is used to measure the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region. The ideal solution model constructs the positive and negative ideal values of the scientific and technological innovation level indicators in the Beijing-Tianjin-Hebei region, calculates the distance between each indicator and the positive and negative ideal values, obtains the relative closeness between each indicator and the ideal value, and then measures the index of scientific and technological innovation level in the Beijing-Tianjin-Hebei region.[13] The ideal solution model can be expressed as

$$F_k(t)=\frac{1}{1+\left(\frac{d_{kt}\left(x_{ktj},x_{kj}^{\alpha}\right)}{d_{kt}\left(x_{ktj},x_{kj}^{\beta}\right)}\right)^2}$$

$$\begin{cases} d_{kt}\left(x_{tj},x_{kj}^{\alpha}\right)=\sqrt{\sum_{j=1}^{n} w_j^2 (x_{ktj}-x_{kj}^{\alpha})^2} \\ d_{kt}\left(x_{tj},x_{kj}^{\beta}\right)=\sqrt{\sum_{j=1}^{n} w_j^2 (x_{ktj}-x_{kj}^{\beta})^2} \\ x_{kj}^{\alpha}=\max_{t=1}^{T}\left(x_{ktj}\right) \\ x_{kj}^{\beta}=\min_{t=1}^{T}\left(x_{ktj}\right) \end{cases} \quad (1)$$

In equation (1), $F_k(t)$ represents the scientific and technological innovation level index of the Beijing-Tianjin-Hebei k region in the t year ($k=0,1,2,3$ representing the overall Beijing-Tianjin-Hebei region, Beijing, Tianjin, and Hebei respectively). $d_{kt}\left(x_{ktj},x_{kj}^{\alpha}\right)$, and $d_{kt}\left(x_{ktj},x_{kj}^{\beta}\right)$ represent the distance between the j indicator and the positive and negative ideal values in the Beijing-Tianjin-Hebei k region in the t year respectively. Among them, let $x_{kj}^{\alpha}=(1,1,\cdots,1)$ and $x_{kj}^{\beta}=(0,0,\cdots,0)$ respectively represent the positive and negative ideal values of the j indicator in the Beijing-Tianjin-Hebei k region. x_{ktj} is the standardized indicator values, c_{ktj} is the raw data value of indicators, ① positive indicator standardization: $x_{ktj}=\frac{c_{ktj}}{\max_{t=1}^{T}\left(c_{ktj}\right)}$; ② contrary indicators tandardization: $x_{ktj}=\frac{\min_{t=1}^{T}\left(c_{ktj}\right)}{c_{ktj}}$. w_j is the the weights of the j indicator. To reduce the interference of human factors, the researchers used the hierarchical equal-weight method according to the hierarchical levels in “Table 1”.

3. EVALUATION OF SCIENTIFIC AND TECHNOLOGICAL INNOVATION LEVELS IN THE BEIJING-TIANJIN-HEBEI REGION

Based on the indicator system constructed in Table 1 and combined with Equation (1), a hierarchical equal weight ideal solution model is adopted to measure the science and technology innovation level index (I), science and technology innovation input index (I_1), science and technology innovation output index (I_2), and science and technology innovation environment index (I_3) of the Beijing-Tianjin-Hebei region from 2012 to 2022, as shown in “Figure 1”.

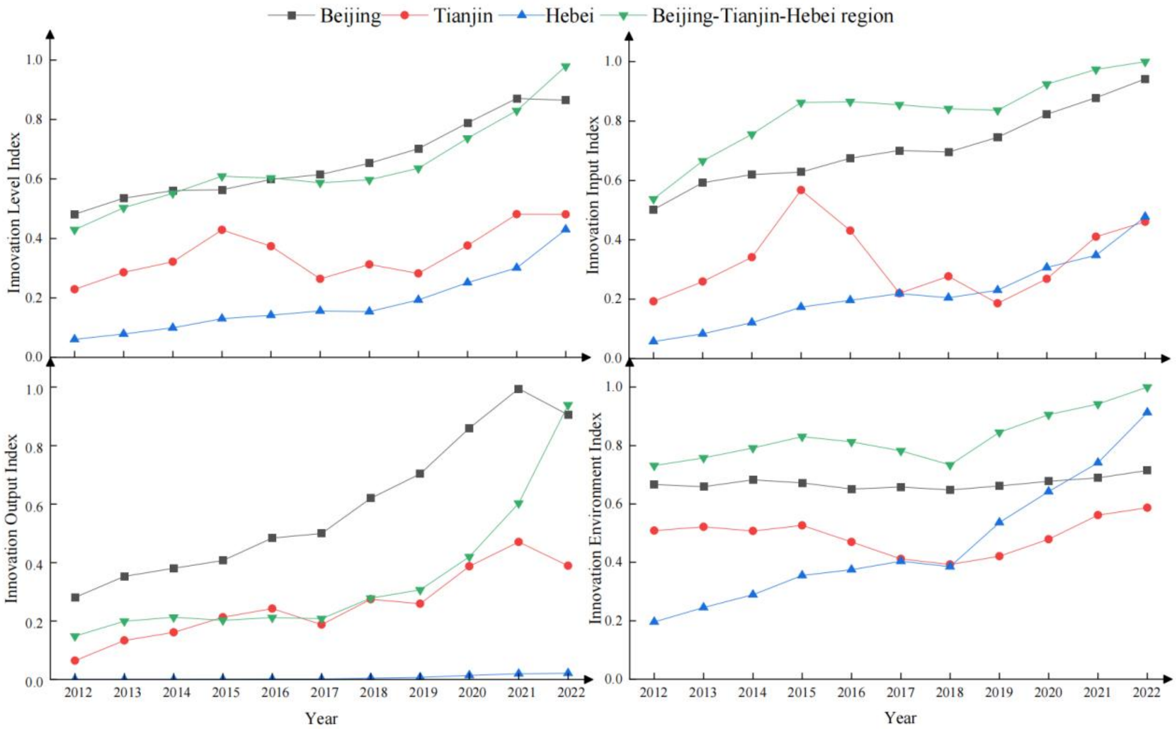

Figure 1 Index of science and technology innovation level in the Beijing-Tianjin-Hebei Region from 2012 to 2022.

According to “Figure 1”, from 2012 to 2022, ①the overall index of scientific and technological innovation level in Beijing and Hebei showed an upward trend, with Beijing steadily growing at a high level and Hebei rapidly growing at a low level, with an average annual growth rate of 5.46% and 19.56%, respectively. In 2022, the Beijing scientific and technological innovation level index showed a slight decline of 0.74%. The reason for this is that the decrease in the export volume of new products in Beijing's high-tech industry has led to a decline in the Science and Technology Innovation Output Index. The Hebei scientific and technological innovation level index achieved rapid growth from 2019 to 2022. The reason for this is that Hebei has continuously increased its investment in science and technology innovation, resulting in a significant increase in the science and technology innovation output index. ②The Tianjin scientific and technological innovation level index shows strong volatility, with a significant decline from 2016 to 2019. The reason for this is that Tianjin's investment in scientific and technological innovation has significantly decreased, and the number of research and development institutions has decreased, resulting in a decline in Tianjin's scientific and technological innovation output. ③The average annual growth rate of the overall scientific and technological innovation level index in the Beijing-Tianjin-Hebei region is 7.78%, and its trend is similar to that of Hebei. Influenced by the fluctuation of the Tianjin scientific and technological innovation level index, there was a certain decline in 2016-2017, but the overall trend shows a steady growth trend.

Overall, Beijing's level of scientific and technological innovation is much higher than that of Tianjin and Hebei, and it is a key driving force for improving the overall level of scientific and technological innovation in the Beijing-Tianjin-Hebei region. Due to the significant fluctuations in its level of technological innovation, Tianjin has become the dominant factor affecting the steady improvement of scientific and technological innovation in the Beijing-Tianjin-Hebei region. Although Hebei still lags behind the Beijing-Tianjin region in terms of technological innovation, it has shown great potential for development and is an important growth point for driving scientific and technological innovation in the Beijing-Tianjin-Hebei region.

Research shows that the gap in scientific and technological innovation level in the Beijing-Tianjin-Hebei region mainly depends on the degree of aggregation of scientific and technological resources and the ability to transform scientific and technological achievements. On the one hand, from the perspective of the degree of aggregation of scientific and technological resources, scientific and technological resources will directly affect the vitality of regional scientific and technological innovation, while the distribution of scientific and technological resources in the Beijing-Tianjin-Hebei region is relatively uneven. Among them, ① as the capital of China, Beijing has a good economic development momentum, absorbing a large amount of technological resources, promoting the deep integration of industry, academia, and research, forming knowledge spillover and network effects, creating a favorable environment for scientific and technological innovation, and enhancing innovation vitality. ②Although Tianjin has developed a number of high-tech industries based on its own port and industrial foundation, the explosion of the science and technology industrial park in Binhai New Area in 2015 dealt a heavy blow to its scientific and technological innovation ecology, causing a large outflow of talent and capital, seriously affecting the efficiency of scientific and technological resource allocation. ③As a province mainly focused on heavy industry and agriculture, Hebei faces significant difficulties in attracting scientific and technological resources due to the siphon effect of surrounding areas, which to some extent restricts the improvement of scientific and technological innovation level. However, after 2019, Hebei Province has adopted policies and measures such as industrial upgrading, increasing investment in scientific and technological talents, and capital, which have led to the accumulation of more scientific and technological resources in Hebei and promoted the improvement of its level of scientific and technological innovation. On the other hand, from the perspective of the ability to transform scientific and technological achievements, the enthusiasm of universities and research institutions as producers of scientific and technological achievements is a prerequisite for improving the ability to transform scientific and technological achievements. As recipients of scientific and technological achievements, the scale and strength of high-tech enterprises are important supports for enhancing their ability to transform scientific and technological achievements. Thanks to its unique technological resource advantages, Beijing has numerous world-class universities and research institutions, which have strong internal driving force and strength in the field of scientific research, promoting the continuous emergence of scientific and technological achievements. And Beijing has gathered a large number of high-tech enterprises with strong capabilities in market development and capital operation, which can quickly transform scientific and technological achievements into actual productivity. However, Tianjin is relatively inferior to Beijing in terms of research foundation and the scale and influence of high-tech enterprises. Meanwhile, due to the relative lack of research competitiveness in the field of science and technology innovation and the lack of support from high-tech industries, Hebei has affected the transformation efficiency of scientific and technological achievements, thereby affecting the level of scientific and technological innovation.

From the three sub dimensions of scientific and technological innovation level, from 2012 to 2015, the overall investment index of scientific and technological innovation in the Beijing-Tianjin-Hebei region showed an explosive growth trend. The growth rate slowed down from 2016 to 2019 and continued to grow from 2020 to 2022. The scientific and technological innovation investment index in Beijing and Hebei shows a continuous growth trend, while the scientific and technological innovation investment index in Tianjin fluctuates greatly, reaching its peak quickly from 2012 to 2015, and then recovering from the previous growth rate and continuing to grow. Research shows that from 2012 to 2025, the explosive growth of overall investment in the Beijing-Tianjin-Hebei region is mainly due to the policy dividends in the early stage of the coordinated development strategy of the region. The national and local levels have concentrated their investment in science and technology resources and launched a large number of cross regional innovation cooperation projects;

The slowdown in growth from 2016 to 2019 is due to the large-scale investment in the early stage entering a period of digestion and adjustment, and innovation investment shifting from "scale expansion" to "quality improvement", with a focus on optimizing the investment structure; The sustained growth from 2020 to 2022 is driven by the demand in emerging fields such as digital economy and biomedicine, as well as the policy orientation of technology empowering industrial recovery after the epidemic, which has steadily increased innovation investment. In addition, as a national center for scientific and technological innovation, Beijing has a dense network of research institutes, universities, and leading enterprises. Its policies continue to focus on basic research and high-end industrial innovation, and its resource supply is stable. Therefore, the investment index in scientific and technological innovation continues to grow at a high level; Hebei relies on the opportunities of industrial transfer in the coordinated development of Beijing-Tianjin-Hebei region, continuously fills the gaps in scientific and technological innovation, increases investment in upgrading traditional industries and cultivating emerging industries, and presents a steady growth trend; The science and technology innovation investment index in Tianjin rapidly peaked from 2012 to 2015, which was related to the short-term investment stimulation of major local science and technology projects and concentrated construction of industrial parks at that time. Subsequently, it shifted towards normalized innovation ecological construction, and the investment pace fluctuated due to the adjustment of regional industrial division of labor. ② From 2012 to 2019, the output index of scientific and technological innovation in the Beijing-Tianjin-Hebei region showed a slow growth trend. From 2020 to 2022, the output of scientific and technological innovation entered an "explosive period". The reason for this is that from 2012 to 2019, the coordinated development strategy of Beijing-Tianjin-Hebei was in the initial stage of promotion, and the investment in scientific and technological resources was mostly concentrated in basic links such as infrastructure construction and scientific research platform construction, making it difficult to achieve the transformation of achievements in the short term. At the same time, Beijing's scientific research advantages, Tianjin's industrial foundation, and Hebei's resource endowment have not formed an efficient linkage, and there are problems such as technological barriers and restrictions on talent mobility, which have constrained the overall output efficiency. From 2020 to 2022, the "14th Five-Year Plan" for scientific and technological innovation and the special policies for the construction of the Beijing-Tianjin-Hebei Collaborative Innovation Community have been successively implemented, focusing on key areas such as key core technology research and cross regional achievement transformation, providing direct policy support for output growth. At the same time, significant breakthroughs have been made in technologies such as digital economy, artificial intelligence, and biomedicine, and the urgent need for technological empowerment in post pandemic industrial recovery has driven the rapid emergence of innovative achievements in related fields. ③ In terms of technological innovation environment, from 2012 to 2022, the overall index of technological innovation environment in the Beijing-Tianjin-Hebei region showed an upward trend, but due to the influence of Tianjin, it showed a significant decline from 2015 to 2018. The scientific and technological innovation environment index in Beijing is at a high level and slowly rising, while Tianjin shows an overall upward trend but a significant decline from 2015 to 2018. Hebei shows an overall upward trend and explosive growth after 2018. As a national center for scientific and technological innovation, Beijing has a dense concentration of research institutes, universities, and leading enterprises. Its policies continue to focus on basic research and high-end industrial innovation, such as artificial intelligence and integrated circuits, with stable resource supply. Although the efficiency of innovation spillover into the development momentum of Tianjin-Hebei region needs to be improved, its own technology trading market, intellectual property services, and innovation ecosystem are highly mature and still maintain a high level of slow growth. From 2015 to 2018, the Tianjin scientific and technological innovation environment index declined due to the impact of environmental protection measures and declining international demand on industries such as petrochemicals, metallurgy, and automobiles that Tianjin relies on. The contraction of production capacity resulted in a decrease in R&D investment by enterprises, and the growth of high-tech enterprises stagnated. At the same time, emerging industries represented by the Internet and electronic information failed to take over in a timely manner, resulting in a slowdown in economic growth, a decrease in fiscal revenue, and a decline in the ability to invest in innovation.

After 2018, the technology innovation environment index in Hebei has experienced explosive growth, thanks to the dual drive of policy dividends and synergy dividends. Hebei has undertaken the transfer of industries from Beijing to Tianjin, and the vitality of industrial innovation has surged. In 2018, more than 1,800 new high-tech enterprises were added, with a total of over 5,000, and more than 10,000 new technology-based small and medium-sized enterprises were added. In addition, R&D resources are accelerating their aggregation, and through the "Beijing-Tianjin R&D, Hebei Transformation" model, key laboratories are jointly established with Beijing and technology projects are jointly applied for.

4. CONCLUSION

Taking into account the impact of input, output, and environment in three dimensions, 11 indicators were selected, including the proportion of R&D personnel in the workforce and the full-time equivalent of R&D personnel per 10,000 high-tech industries. A systematic evaluation system for the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region was designed, and a hierarchical equal weight conceptual model was constructed to comprehensively evaluate the level of scientific and technological innovation in the region from 2012 to 2022. Research shows that from 2012 to 2022, the level of scientific and technological innovation in Beijing and Hebei showed a steady upward trend, while Tianjin exhibited strong volatility; Beijing's level of scientific and technological innovation is ahead of Tianjin and Hebei, becoming the core driving force for promoting the overall development of scientific and technological innovation in the Beijing-Tianjin-Hebei region. The dynamic changes and gaps in the index of scientific and technological innovation level in the Beijing-Tianjin-Hebei region mainly stem from the degree of agglomeration of scientific and technological resources and the ability to transform scientific and technological achievements. From the sub dimension of technological innovation level, the overall investment index of scientific and technological innovation in the Beijing-Tianjin-Hebei region showed an explosive growth trend from 2012 to 2015. The growth rate slowed down from 2016 to 2019 and continued to grow from 2020 to 2022; From 2012 to 2019, the output index of scientific and technological innovation in the Beijing-Tianjin-Hebei region showed a slow growth trend. From 2020 to 2022, the output of scientific and technological innovation entered an "explosive period"; From 2012 to 2022, the overall technology innovation environment index of the Beijing-Tianjin-Hebei region showed an upward trend, but due to the influence of Tianjin, it showed a significant decline from 2015 to 2018. To further enhance the innovation level of the Beijing-Tianjin-Hebei Science and Technology City, the following three measures are proposed.

4.1 Building a "Three in One" Collaborative Mechanism and Breaking Down Barriers to Resource Flow and Transformation

Referring to the practice of the integration of the Yangtze River Delta in Jiashan, it is necessary to break down the identity barriers between universities, research institutes, and enterprises, allow researchers to hold positions in three local units at the same time and be included in the evaluation system of both parties, and promote the "dual employment system" and mutual recognition mechanism of professional titles for talents in the Beijing-Tianjin-Hebei region. It is also necessary to jointly formulate the "Catalogue of Mutual Recognition of Professional Titles for Science and Technology Innovation Talents in the Beijing-Tianjin-Hebei Region", which includes the evaluation results of professional titles in more than 10 key fields such as artificial intelligence and biomedicine in the scope of mutual recognition, achieving "one-time evaluation and universal use in three regions". There is also a must to provide cross regional research subsidies to research teams that adopt the "dual employment system", promote cross regional sharing of scientific and technological talents, and enhance the level of scientific and technological innovation in the Beijing-Tianjin-Hebei region. In addition, the researchers will create a full chain technology trading and achievement transformation platform, jointly build a unified market for technology trading in the Beijing-Tianjin-Hebei region, and develop a digital intelligent matching model to intelligently evaluate the maturity of scientific and technological achievements and industrial adaptability.

4.2 Implementing Precise Policies to Activate the Driving Forces of the Three Regions and Strengthening the Pattern of "Beijing Leading, Tianjin Steadily Advancing, and Hebei Leaping Forward"

Beijing should implement innovative resource allocation and incentive policies, transfer and transform the scientific and technological achievements of Beijing universities to the Tianjin-Hebei region, and provide one-time construction subsidies to research institutions that establish branches in Xiong'an New Area and Tianjin Baodi - Beijing-Tianjin Zhongguancun Science and Technology City. Tianjin should establish an Innovation Ecological Stability Fund and a mechanism for stabilizing innovation investment. For large-scale enterprises with a year-on-year decline in R&D investment, a phased subsidy of 30% of the decline amount should be given, and tax incentives for high-tech enterprises should be increased. In addition, the researchers will focus on promoting the gradient cultivation action of "technology-based small and medium-sized enterprises - high-tech enterprises - technology leading enterprises", providing direct financial rewards to newly recognized specialized, refined, and new small and medium-sized enterprises, and revitalizing idle carrier resources in Binhai New Area to create a transfer station for Beijing's scientific and technological achievements to Tianjin. It is necessary to upgrade the Hebei-Jingnan National Science and Technology Achievement Transfer and Transformation Demonstration Zone, construct exclusive parks for the transformation of Beijing-Tianjin achievements in cities such as Shijiazhuang and Baoding, and build supporting facilities such as concept verification centers and pilot platforms. Through tax exemptions and preferential treatment, attract the transformation of Beijing-Tianjin achievements in Hebei.

4.3 Improving the Element Guarantee System and Strengthening the Support for Innovative Development

On the one hand, there is a must to establish a cross regional innovation investment linkage mechanism, set up the Beijing-Tianjin-Hebei Collaborative Innovation Fund, focus on supporting cross regional joint research and achievement transformation projects, and jointly carry out a technology loan risk compensation mechanism, providing interest subsidies for research and development loans of technology-based enterprises in the Beijing-Tianjin-Hebei region, and jointly issuing Beijing-Tianjin-Hebei technology innovation bonds to support industrial clusters such as integrated circuits and biomedicine. On the other hand, there is also a must to strengthen the evaluation and supervision of innovation performance, establish a collaborative innovation assessment system for the Beijing-Tianjin-Hebei region, incorporate indicators such as the sharing rate of scientific and technological resources and the amount of cross regional achievement transformation into local government performance assessments, and provide financial incentives to cities with outstanding annual collaborative results. At the same time, the Beijing-Tianjin-Hebei Science and Technology Innovation Monitoring Alliance will be established to release core data such as R&D investment, high-tech enterprise growth, and technology transactions in the three regions on a monthly basis, and generate problem warning reports every quarter to provide data support for precise policy implementation.

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