

Analysis of the role of government in the construction of cross-regional innovation system

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Abstract: The cross-regional innovation system is an innovation system formed on the basis of the integration of administrative regions and economic regions. Taking the collaborative innovation of Beijing-Tianjin-Hebei region as an example, the role that the government should play in the construction of cross-regional innovation system is analyzed, and draws the following conclusions: There is a link between the “visible hand” (government intervention) and the “invisible hand” (market regulation). The contribution of the government is the precondition for the market to play its role, and the market mechanism further promotes the promotion of government functions, thus forming a virtuous circle in which local governments and market competition are embedded. To be specific, governments play different roles in different development stages of the cross-regional innovation system. In the initial stage of the construction of the system, the government played a leading role as a planner; In its mature stage, the government will cooperate with other various innovation entities in the region as a participant to jointly promote the effective implementation of innovation policies.

1 Introduction

With the refinement of the division of labor, the geographical boundaries between administrative regions have gradually weakened, regional innovation has gradually evolved towards cross-regional cooperation and integrated development, and a cross-regional innovation system has gradually formed. However, most of the existing researches on regional innovation system focus on a single administrative region. Therefore, it is necessary to further strengthen the research on cross-administrative innovation system.

In the past, local governments mostly adopted the independent traditional governance model, but it is not applicable to the cross-regional innovation system, which would lead to many problems, such as local governments only pursue their own interests, cooperative policies are difficult to implement, and the flow of innovation elements across administrative regions are blocked, etc. Therefore, how to transform the role of the government is very important for building a cross-regional innovation system. Taking this as the research topic, this paper explores the relationship between “visible hand” (government intervention) and “invisible hand” (market regulation), and takes the collaborative innovation of the Beijing-Tianjin-Hebei region as an example to analyze the role that the government should play in the construction of cross-regional innovation system.

2 Related concepts of cross-regional innovation system

2.1 Difference and connection between administrative region and economic region

“Region” mainly includes “administrative region” and “economic region” (Table 1). Administrative region is a regional management system formed by dividing the country into different scales for the needs of administrative management. It has relatively stable and clear boundaries. With the continuous development of social division of labor, socio-economic ties have gradually broken the boundaries of certain administrative regions, thereby deriving economic regions.

Economic region is a regional economic complex, which is characterized by strong aggregation and high operation, and its boundary is often fuzzy and dynamic. Wang^[1] believes that an economic region is an area with high homogeneity of economic development, and puts forward that “the region should be a homogeneous field based on geographical boundaries, which can exceed the statutory administrative divisions and include a local government cooperation system based on multiple administrative divisions”. It can be seen that the economic region is formed on the basis of the administrative region, and it is an aggregate formed by

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the combination of several administrative regions. Therefore, the development of the economic region cannot be separated from the management and coordination of the governments of the administrative regions to which it belongs.

Table 1 The difference between administrative region and economic region

Item compared	Administrative region	Economic region
Boundary	Stable and definite	Fuzzy and dynamic
Management concept	Departmentalist orientation	New regionalism
Development trend	Derivative administrative barrier	Break through administrative barriers
Governance mode	District administration	Regional public administration

2.2 The relationship between innovation and regional economic development

The discussion about the relationship between innovation and economic development has been going on for a long time. Since the 1950s, two economic growth theories have emerged in the West, which are neoclassical growth theory and Neo-Schumpeterian growth theory.

Robert Solow proposed the neoclassical economic growth model, which believed that economic growth was mainly influenced by two factors: labor force growth and technological progress [2]. On the basis of this model, neoclassical scholars represented by Romer put forward neoclassical endogenous growth theory. According to this theory, technological innovation is the source of economic growth, and the main factors influencing the level of technological innovation are the degree of division of labor and the accumulation level of human capital[3]. The core idea of Neo-Schumpeter's growth theory is that R&D innovation, knowledge accumulation and the behavior of economic participants can effectively promote economic growth. This theory holds that factors of production have two characteristics of heterogeneity and dynamics, which affect the change of industrial structure to a certain extent. Focusing on the relationship between these two characteristics, extensive and in-depth research has been carried out on the aggregation and diffusion of innovation factors, technological progress and innovation[4,5].

To sum up, the research on cross-regional innovation system is to combine regional economic theory with innovation theory, and study how to cooperate and coordinate among administrative regions to achieve collaborative innovation, so as to achieve balanced and rapid economic development within the whole region through innovation. In other words, the cross-regional innovation system is an innovation system formed on the basis of the integration of administrative regions and economic regions.

2.3 The main characteristics of the cross-regional innovation system

First, the diversification of innovation subjects. The innovation subjects in the cross-regional innovation system include the governments, universities, enterprises and scientific research institutions in different regions, which are interrelated with each other, forming a staggered and complex relationship structure, and jointly forming a trans-regional and multi-level cooperative innovation network. The innovation network covers two aspects: one is the interconnection and cooperation between different types of innovation subjects within each administrative region; Second, innovation subjects from different administrative regions carry out cross-regional cooperation.

Secondly, the aggregation of innovation elements. The innovation elements in cross-regional innovation system mainly include technical knowledge, talents, capital and so on. Among them, technical knowledge and talent factors are the knowledge source in the cross-regional innovation system, which have an important impact on the innovation level of a region. However, one of the important factors affecting the spatial flow of capital is the profit difference. Capital elements always flow from the areas with low profit rate to the areas with high profit rate. Therefore, in the cross-regional innovation system, innovation elements tend to flow from the administrative regions with low innovation level to the administrative regions with high innovation level, leading to the spatial agglomeration of innovation elements.

Finally, the diffusion of innovation results. With the gradual development of the cross-regional innovation system, the aggregation of innovation elements leads to an increasingly obvious gap in the development level of various administrative regions. Administrative regions with a better development level have a certain radiation effect on administrative regions with a slower development level, thus driving their development of advanced industries. In the cross-regional innovation system, the developed regions realize their innovation value through the diffusion of achievements, while the less developed regions realize innovation and development through the application of achievements. The rational division of labor between the two promotes the coordinated development of various regions.

3 The relationship between the government and the market

3.1 Invisible hand and visible hand

Smith put forward the concept of “invisible hand” in *The Wealth of Nations*. He pointed out that all economic subjects are engaged in economic activities with self-interest, and “economic man” inadvertently promotes the realization of social interests in the process of pursuing self-interest. The “invisible hand” reveals the essence of the market mechanism, that is, there is a causal relationship between all economic subjects, and

the linkage between them can effectively promote the rational allocation of resources and the coordination of interests of all parties. However, it cannot be completely left unchecked, which will lead to “market failure”. Therefore, some scholars have proposed another economic theory against the disadvantages of the “invisible hand”—“visible hand”, which refers to the government's leading role in regulating the economic system, that is, government intervention. Through the “visible hand” of the government, the “market failure” can be corrected in time and the stability of the market order can be maintained.

At present, it is generally believed in the academic circle that government and market complement each other, and the debate on “invisible hand” and “visible hand” mainly focuses on the degree of government intervention in the economy. The “invisible hand” realizes the reasonable allocation of resources by adjusting the balance of supply and demand in the market, while the “visible hand” is a series of macro-control measures taken by the government to make up for the deficiency of the market mechanism. Therefore, the externality of the market and the internality of the government make the market and the government that regulate economic activities show an interactive situation.

3.2 Both planning and the market are means of economic regulation

Government intervention and market regulation are both economic means to realize the optimal allocation of resources, and they form a mutually promoting relationship through reasonable division of labor. Only when the market is in a state of complete competition, the “invisible hand” can fully play its role, but this does not exist in reality, the phenomenon of “market failure” will inevitably appear. At this time, it is necessary for the government to play its macro-control role to ensure the stable operation of the economic system. However, it should be noted that there should be a certain degree of government intervention, excessive intervention will also cause obvious negative effects. Therefore, in order to create a good innovation economic environment, it is necessary to combine planning and market organically.

The complementary relationship between the government and the market is mainly reflected in the following two aspects: First, the effective performance of government functions is the basis for the full play of the role of the market mechanism, and a good innovation environment can mobilize the enthusiasm of market subjects; Secondly, the market is the subject of innovative economic activities, which makes the market mechanism play a complementary role to government functions. Under the joint action of the government and the market, both of them can get higher returns than in the independent state. For example, when the market mechanism plays a supplementary role to government functions, and the benefits of the two combined action are higher than the government intervention alone, the enthusiasm of market subjects should be further aroused;

if the benefits are lower than the benefits obtained by the government function alone, government intervention should be strengthened. In the same way, government functions play a complementary role to the market mechanism.

3.3 The interaction between local government and market

In order to pursue the maximization of their respective interests, the local government and the market often adopt interdependent cooperative behavior. To maintain a good interaction between the local government and the market, we must first ensure that the government is “promising”. Local governments have their own development indicators, and actual economic performance has also become the evaluation standard for their assessment. The goal of political promotion urges local governments and government personnel to try their best to achieve the corresponding economic indicators. At the same time, in order to avoid the innovation resources flowing into other administrative areas, local governments must take effective governance measures. In addition, when “market failure” occurs, local governments should respond in time to create a sound innovation environment for market subjects.

there is a “two-way embedding” relationship between local government and market, that is to say, the division of labor between local government and market constitutes the relationship between government and enterprises within the administrative region, and the relationship between government and enterprises is subject to the government's internal incentives and external market competition environment centered on economic performance. There is competition among local governments, and the evaluation standard of competition depends on the economic performance of market innovation subjects in each administrative region. Local governments actively interact with the market to help the market in their respective regions to make profits, and then win in the competition. At the same time, this result-oriented incentive makes local governments have to do something. In a word, the local government and the market penetrate each other, and the government competition is embedded in the market competition, and the market competition in turn affects the government competition^[6].

4 Analysis on the challenges and roles of the government in the cross-regional innovation system

4.1 Challenges faced by governments in cross-regional innovation system

The regional governments blindly pursue their own local interests. Local governments are still accustomed to adopting traditional independent governance models, and the cross-regional flow and optimal combination of innovative elements have been severely hindered. Local

governments blindly pursue the maximization of local fiscal revenue, lack the sense of cooperation and the overall concept, blindly compete for various innovative elements, but ignore the overall cross-regional allocation efficiency of innovation resources. Each local government tries to establish its own complete industrial system, which will inevitably lead to similar industrial structures in different regions, making it difficult to form a coordinated industrial chain. This series of conflicts makes it impossible for each administrative region to form a community of interests, violates the inherent win-win principle of coordinated development in the cross-regional innovation system, and makes it difficult to resolve the conflicts between various regions.

Cooperative policies among regional governments are difficult to implement. In the cross-regional innovation system, most regional governments promote cooperation by signing various agreements, but many cooperative policies are only written and not well implemented. Although the provisions in the cooperation agreement reflect the consensus formed through consultation among regional governments, and each regional government has a certain autonomy, and they may be affected by various factors in the actual implementation process, and fail to fully implement the agreement. For example, agreements are likely to be better implemented when cooperative policies are in line with development plans in the region. However, when it does not conform to the development plan of the region or violates local interests, the agreement may be in vain, and ultimately greatly weaken the overall regional cooperation efficiency^[7].

4.2 The role of the government in the cross-regional innovation system

The government is the planner of cross-regional innovation system (Figure 1). At the initial stage of the construction of the cross-regional innovation system, the system is not perfect, so it is necessary to make a overall strategic plan for the cross-regional innovation activities in the system. At this time, the government should give full play to its macro-control role. According to their own actual development situation, local governments have formulated corresponding schemes to promote innovation in different regions, and ensured the compatibility of different policies in different regions. Each administrative governments is committed to creating a good cross-regional innovation environment, maintaining an orderly economic order, stimulating the innovation vitality of the whole region, and taking into account the interests of all innovation subjects according to the needs of their own regional industrial development, so as to promote the overall level of cross-regional innovation.

The governments is the coordinator of cross-regional innovation systems (Figure 1). With the continuous development of cross-regional innovation system, the development level of each administrative region is uneven, and the innovation policies of each region are prone to be uncoordinated. Therefore, in order to

maintain the steady development of cross-regional innovation system, each administrative region government must constantly adjust the policy according to its actual performance, and pay attention to the compatibility between different regional policies. In addition, a perfect innovation network system is also crucial to the development of cross-regional innovation system, which can effectively promote the generation, transformation and diffusion of innovation achievements^[8]. Therefore, the government should also fully mobilize the enthusiasm of various innovation subjects, guide them to cooperate and coordinate with each other, and establish various forms of community of interests, so as to maintain the sustainable development of cross-regional innovation system.

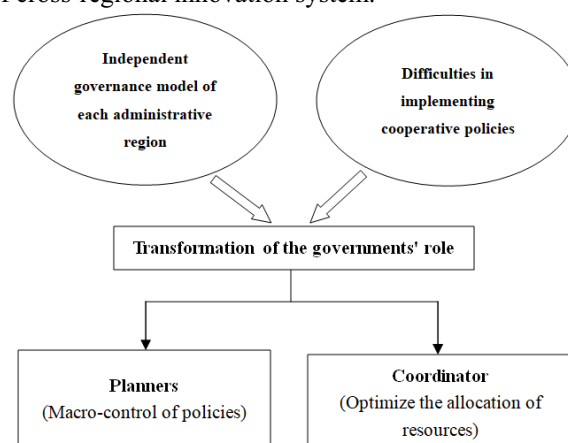


Figure 1 The role of government in the construction of cross-regional innovation system

5 Take Beijing-Tianjin-Hebei cross-regional collaborative innovation as an example

5.1 Overview of Beijing-Tianjin-Hebei cross-regional collaborative innovation

Beijing-Tianjin-Hebei is the region where universities, research institutes and scientific talents are most concentrated in China, and it is also one of the regions with the densest urban distribution and the strongest comprehensive strength. It occupies an equally important position with the Yangtze River Delta and the Pearl River Delta, and plays the core driving role of the third pole of China's economic development. The coordinated development of Beijing-Tianjin-Hebei region is in an extremely important position in China's regional coordinated development strategy. Therefore, the central government and three local governments have been exploring and experimenting on the coordinated development model of Beijing-Tianjin-Hebei region for a long time.

5.2 The main measures taken by the government to promote cross-regional collaborative innovation in Beijing-Tianjin-Hebei

5.2.1 Establish a network of industry-university-research cooperation

The industry-university-research cooperation network is formed under the support of the government, with enterprises as the main body, universities and scientific research institutes as the support, and it plays an important role in the process of promoting the coordinated development of innovation in Beijing-Tianjin-Hebei. By 2018, there were 270 universities in Beijing-Tianjin-Hebei region, accounting for 10.14% of the whole country, and the total number of research institutions run by industrial enterprises above designated size reached 2176, which laid foundation for the collaborative innovation of industry, university and research in Beijing-Tianjin-Hebei region.

In recent years, a number of industry-university-research cooperation and innovation organizations have emerged. With the promotion of the government and the concerted efforts of various innovation subjects, the industry-university-research cooperation in the Beijing-Tianjin-Hebei region has made progress. For example, Tsinghua University has cooperated with Langfang, Qinhuangdao, Tangshan and other cities in Hebei Province to build research institutes and science parks, established four applied research centers such as intelligent transportation, and cooperated with Tianjin University and other universities outside Beijing to jointly build “Tsinghua University Tianjin Advanced Equipment Research Institute”. Peking University signed a strategic cooperation agreement with Hebei, jointly established the New Generation Information Technology Research Institute with Binhai New Area, and cooperated with Tianjin and Hebei on more than 330 projects.

5.2.2 The model of developing headquarters economy

Some enterprises in Beijing moved their headquarters and manufacturing industries to Tianjin and Hebei in the early trial stage, but the effect was not good. After that, Beijing-Tianjin-Hebei learned the lessons of failure and adopted the headquarters economy model to adjust the overall industrial structure. In 2013, Beijing put forward the development idea of “highlighting the advantages of advanced industries, developing supporting industries and increasing the depth of industries”, that is, actively developing supporting industries for Tianjin and Hebei, rationally integrating and distributing innovation resources in the region, and trying to promote the development of Beijing-Tianjin-Hebei cross-regional innovation system by expanding the depth of industries.

Beijing, Tianjin and Hebei have their own unique advantages in innovative resources. The advantages of Beijing are mainly manifested in knowledge and talents, Tianjin has the geographical advantages of coastal areas

and ports and manufacturing advantages, while Hebei has abundant land resources, labor and energy. Under the mode of headquarters economy, the three regions have different orientations depending on their respective advantages, forming a relatively complete industrial cluster and industrial chain in Beijing-Tianjin-Hebei region. Beijing makes use of its resource advantages to attract advanced innovative industries, promoting the migration of innovative resources to Tianjin and Hebei, and developing its own manufacturing industry selectively. However, Tianjin and Hebei are committed to building high-tech industries and modern manufacturing bases.

5.2.3 Jointly build cross-regional science and innovation parks

Beijing, Tianjin and Hebei effectively gather innovative resources such as talents and capital by building cross-regional science and technology parks, so as to realize the efficient connection among the upstream, middle and downstream industries, build an innovation chain of resource sharing and mutual benefit, promote the orderly transfer of the whole industry, and further promote the construction of Beijing-Tianjin-Hebei collaborative innovation community.

Z-Park (Zhong Guan Cun Science Park) is one of the representative important cooperation carriers leading the collaborative innovation of Beijing, Tianjin and Hebei. It follows the principle of government guidance and market operation in parallel, and cooperates with the key regions of Tianjin-Hebei to build characteristic industrial parks through park trustees, share-holding cooperation and enclave economy, etc. With the joint efforts of all parties, some cross-regional co-construction parks have begun to take shape, forming a number of landmark platforms for cross-regional collaborative innovation.

5.2.4 Adjust the fiscal policies of the three regions

One of the important factors restricting the development of the cross-regional innovation system is the failure to coordinate the interests of various regional governments. Therefore, it is very necessary to continuously adjust the fiscal policies of various regions. Although the market plays a role in the allocation of resources to some extent, there are still limitations in the distribution of production factors, and the government can make up for the deficiency of market regulation by reforming fiscal policies. In order to realize the coordinated development of innovation in Beijing-Tianjin-Hebei region, it is necessary to ensure the free flow of innovative elements such as talents, technical knowledge and capital in the three regions and optimize their allocation. Fiscal policy plays an important role in this process. The adjustment of fiscal policy by the government will have a certain impact on the distribution of innovation resources and the structural changes of innovative industry.

The economic level of Hebei Province is obviously lagging behind Beijing and Tianjin, which makes it difficult to provide sufficient financial support for

industrial docking with Beijing and Tianjin, thus affecting the implementation effect of industrial docking among the three regions. Therefore, in order to promote the cross-regional flow of scientific and technological achievements, Beijing, Tianjin and Hebei have formulated corresponding fiscal policies and measures around the guiding funds for the transformation of scientific and technological achievements, loan interest subsidies, subsidy funds, equity investment and venture capital^[9].

5.3 The problems and countermeasures of the government' promotion of Beijing-Tianjin-Hebei cross-regional collaborative innovation

5.3.1 Problems in the governments' promotion of cross-regional collaborative innovation in Beijing-Tianjin-Hebei region

At present, the promotion of collaborative innovation strategy in the Beijing-Tianjin-Hebei region has made some achievements, but there are still many problems to be solved.

First of all, the ability of Hebei Province to undertake the transfer of industry and technology in Beijing and Tianjin is still insufficient, and Beijing and Tianjin, as a relatively developed city, have not fully played their leading roles, thus causing the problem of industrial chain fracture. Secondly, the problem of industrial homogenization is serious. Both Tianjin and Hebei want to undertake more industries, which leads to redundant construction and waste of resources. Finally, there is a lack of coordination mechanism, and the cooperation enthusiasm of innovation subjects is not strong. With the deepening of the collaborative innovation strategy, the rigid means dominated by the administrative power is not conducive to the formation of a benign interaction between the government and the market. When implementing cooperative policies, market subjects are affected by various factors and fail to implement them well. Therefore, how to maintain the balance between government dominance and market dominance is a problem for Beijing-Tianjin-Hebei collaborative innovation^[10].

5.3.2 Countermeasures and suggestions for the government to promote the construction of cross-regional innovation system in Beijing, Tianjin and Hebei

Promote the optimization and upgrading of the industrial structure and the orderly transfer of industries. Hebei Province should pay attention to the construction of supporting facilities for undertaking industrial transfer, dissolve its own surplus production capacity, optimize and transform the traditional middle and low-level

industries, and narrow the economic development gap with Tianjin-Hebei Region .

Rationally plan the cross-regional layout of industries. The governments of Beijing, Tianjin and Hebei should optimize the overall layout of the whole innovation area, clarify their respective functional positioning, avoid the trend of industrial homogenization, realize dislocation development, and form a complete innovation industry chain.

Construct innovative network system with multi-subject participation. First of all, the governments should follow the market rules and improve the common rules of the three markets. Secondly, a good innovation operation mechanism should be constructed on this basis. For example, support enterprises to carry out cross-regional cooperation with universities and research institutions to enhance their scientific research strength; Build a system of undertaking scientific and technological achievements led by enterprises and promote the transformation of scientific and technological achievements, etc.

6 Conclusion and enlightenment

Through the above analysis, it can be concluded that in the process of building a cross-regional innovation system, the “visible hand” and the “invisible hand” are interrelated. Effective measures taken by the government are the basic prerequisites, and the market mechanism gives full play to its role in a good innovation environment, which in turn promotes the further improvement of government functions. Local governments and market competition form a virtuous circle embedded in each other to achieve complementary functions, thereby maintaining the coordinated and steady development of the administrative regions in the overall innovation system. In other words, the role of government is not static. First of all, in the initial stage of the system construction, the government should play its leading role by formulating innovation strategies and cultivating innovative subjects, so as to create a good market environment for all innovative subjects to carry out cross-regional innovation activities. Secondly, with the gradual formation of the cross-regional innovation system, it is far from enough for the government to play its own role. It also needs the active cooperation of all kinds of innovation subjects in various regions, so as to jointly form the joint force of “government+market”. In this case, the government is not only a planner in the system, but also a participant in innovation activities. In the process of building a cross-regional innovation system, government intervention and market regulation form an “visible hand” and an “invisible hand”, which complement each other, and jointly promote the effective implementation of various innovation policies (Figure 2).

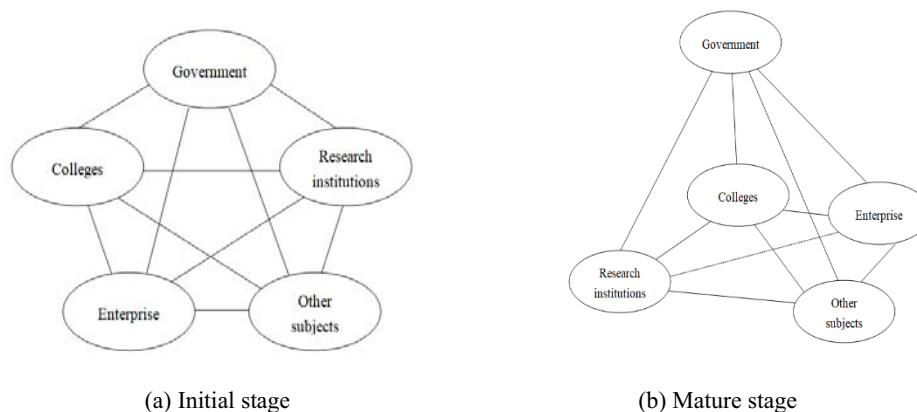


Figure 2 The relationship between the innovation subjects in the cross-regional innovation system

Only by accurately defining the functional orientation of the government in the cross-regional innovation system can we find effective ways for the government to play its role, as follows:

First, promote innovation sharing and establish an innovation platform for regional integration. The key to the formation of cross-regional innovation system is innovation sharing. Due to the diversified types of innovation subjects and their subordination to different administrative regions, regional governments are likely to blindly pursue their own interests when facing the public issues of the overall region, thus fall into a governance dilemma^[11]. Therefore, local governments should break the restriction of fragmentation management on cross-regional integration development, take into account the interests of all parties, pay attention to the compatibility of policies in various administrative regions, and reach a consensus among them, thus forming a series of integrated innovation policies. In addition, it is necessary to give full play to the key role of the market in resource allocation, and promote the development of innovation activities and the diffusion of innovation achievements by establishing a sharing mechanism of innovation benefits. The government mainly supports the market by providing relevant policy guidance and financial support, cooperates with various innovation entities in the market to create a good technological innovation environment and improve the mechanism of achievement transformation, thus promoting the deep integration of innovation chain and industrial chain and promoting the sharing of innovation among administrative regions.

Second, optimize the industrial layout and promote industrial docking among different regions. The core of the cross-regional innovation system is to realize the integrated development of various regions, but it should be noted that integrated development is not equal to homogeneous development. In the cross-regional innovation system, there are differences in geographical location, industrial characteristics and development level among administrative regions. Therefore, the government should make efforts to promote the rational distribution of industries, accelerate the industrial docking and cooperation, straighten out the industrial development chain among different regions. Affected by industrial agglomeration, the distribution of innovation

resources in various administrative regions is quite different. To solve this problem, the regions with relatively rapid development of innovative industries should give full play to the leading role of demonstration, vigorously develop their advantageous industries, and form a cluster layout, then continuously expand their industries to the surrounding regions with relatively backward development level of innovative industries. Each administrative region relies on its own unique regional advantages to form a complete industrial chain, so as to realize scale effect and construct a high-quality integrated cross-regional innovative industrial system.

Third, break down administrative barriers and support the construction of cross-regional cooperation alliances. The government should break down the administrative boundary, abandon the single administrative regional management mode, and change to the systematic management mode of the whole region. Under the guidance of the government, the innovation subjects focus on advanced science and technology innovation industries, unite to form regional collaborative innovation communities, build cross-regional science and technology innovation zones, and form an attractive and radiant innovation space^[12]. In other words, the governments need to establish cross-regional cooperation alliances to promote mutual cooperation between innovation subjects in different regions and achieve common development. Cross-regional cooperation alliance is formed on the basis of reaching consensus among administrative regions. This kind of partnership requires the coordination among each local government to formulate common information feedback and decision-making mechanism, as well as common laws and policy support. Therefore, in order to promote cross-regional economic cooperation and industrial linkage development, the administrative regional governments should actively explore the mechanism of economic accounting and benefit sharing, support the construction of cross-regional cooperation alliances, and build a community of regional innovation interests.

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