

RESEARCH ARTICLE



Research on the Evaluation of Henan Province's Construction of National Innovation Highland Level

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Abstract: As an important province in central China, Henan Province's level evaluation research on building a national innovation highland is particularly important. This article aims to deeply analyze the current situation, advantages, and shortcomings of Henan Province in terms of innovation capability, and propose targeted suggestions to promote further improvement of its innovation capability. Currently, Henan Province has achieved certain results in the field of scientific and technological innovation, such as the rapid development of high-tech industries and the continuous growth of research institutions and talent teams. However, compared with developed areas along the eastern coast, there are still some shortcomings, such as uneven distribution of innovation resources, weak innovation capabilities of enterprises, and low efficiency in the transformation of scientific and technological achievements. In order to enhance the innovation capability of Henan Province, this article suggests increasing investment in scientific and technological innovation, optimizing the allocation of innovation resources, strengthening industry university research cooperation, and improving the efficiency of scientific and technological achievements transformation. At the same time, attention should also be paid to cultivating and introducing high-end innovative talents, improving innovation incentive mechanisms, and creating a good innovation ecological environment. This article analyzes in depth the current situation, advantages, and disadvantages of building a national innovation highland in Henan Province, and combines targeted suggestions to promote the continuous improvement of Henan Province's innovation capabilities and contribute more to the national innovation driven development strategy.

Keywords: Henan Province, national innovation highland, level evaluation

1. Introduction

1.1. Research background

- 1) The key role of innovation in promoting economic and social development

In the current era of globalization and informatization, innovation has become the core driving force for promoting economic and social development. From a historical perspective, every major technological advancement and economic change relies on the power of innovation [1]. For example, the rise of the Industrial Revolution greatly liberated productivity, and human society entered a new stage of development. The arrival of the information technology revolution has profoundly changed people's way of life and social structure.

Innovation not only brings new technologies and products but also promotes the optimization and upgrading of industrial structure, improves resource utilization efficiency, and promotes sustainable economic development [2]. At the same time, innovation can also stimulate social vitality, cultivate people's innovative spirit and practical ability, and provide a continuous source of power for social progress.

Specifically, the role of innovation in promoting economic and social development is mainly reflected in the following aspects: first,

technological innovation can improve production efficiency, reduce production costs, and enhance the competitiveness of enterprises [3]; second, product innovation can meet the increasingly diverse needs of consumers and explore new market spaces; third, management innovation can optimize resource allocation and improve organizational operational efficiency; and fourth, institutional innovation can create a favorable development environment and stimulate the innovation vitality of the whole society.

- 2) The country attaches great importance to building a regional innovation highland

With the deepening development of economic globalization, international competition is becoming increasingly fierce [4]. In this situation, countries are increasing their investment in scientific and technological innovation, striving to enhance their own innovation capabilities and competitiveness [5]. China is no exception. In recent years, the country has attached great importance to scientific and technological innovation work and has made building an innovative country the strategic core of national development [6].

In order to achieve this goal, the country has proposed a strategic concept of building a regional innovation highland. Regional innovation highland refers to the formation of a region with strong innovation capabilities and competitive advantages through the aggregation of innovation resources, optimization of innovation environment, and strengthening of innovation

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cooperation within a certain area [7]. These regions play an important role in promoting national scientific and technological innovation, cultivating emerging industries, and driving regional economic development.

The country's emphasis on building regional innovation highlands is reflected in multiple aspects. First, at the policy level, the country has introduced a series of policy measures to support regional innovation and development, such as establishing high-tech industrial development zones, science and technology parks, etc., providing a favorable policy environment for regional innovation [8]. Second, in terms of capital investment, the government has increased its financial support for regional innovation, providing sufficient financial guarantees for regional innovation through the establishment of special funds and guidance of social capital investment [9]. In addition, in terms of talent cultivation, the country has also taken a series of measures, such as implementing talent introduction plans and strengthening the construction of talent cultivation systems, providing strong talent support for regional innovation [10].

Henan Province, an important province in central China, has rich historical and cultural resources and an industrial foundation. In recent years, Henan Province has actively responded to the national call, vigorously promoted the innovation-driven development strategy, continuously strengthened the construction of the scientific and technological innovation system, and strived to build a national innovation highland [11]. However, compared with developed regions, there is still a certain gap in innovation capability and level in Henan Province. Therefore, evaluating and researching the level of building a national innovation highland in Henan Province has important practical significance [12].

1.2. Research significance

1) Enriching and enhancing regional innovation theory

By conducting an in-depth study of Henan's progress in building a national innovation hub, this research reveals the intrinsic patterns and characteristics of regional innovation development, providing new case studies and experiences that contribute to the expansion and refinement of regional innovation theory. This deepens the understanding of regional innovation capacity disparities and promotes further development of regional innovation theories.

2) Providing theoretical basis for innovation policy formulation

This study analyzes the current status, strengths, and weaknesses of Henan's innovation hub construction, offering theoretical support for the formulation of scientific and rational innovation policies. By identifying specific challenges in the innovation process, it provides practical insights for Henan and other regions to develop more targeted and effective innovation policies.

3) Promoting the optimization of innovation resource allocation and social support

The research helps promote the optimization of Henan's science and technology innovation resources, improving innovation efficiency, and stimulating social attention and support for innovation. By highlighting the achievements and challenges Henan faces in building its innovation hub, the study can attract greater involvement from various social sectors in innovation activities, fostering a collaborative environment that drives innovation and supports sustainable development.

1.2.1. Research objectives

The primary objective of this study is to evaluate the level of Henan Province's development as a national innovation hub, analyzing its current innovation capacity, strengths, and weaknesses and proposing targeted policy recommendations to enhance its innovation capabilities. The specific objectives include:

- 1) In-depth analysis of the current situation regarding Henan's innovation resources, investment, output, and innovation environment;
- 2) Identifying and assessing the main problems and challenges faced by Henan in the process of building an innovation hub;
- 3) Proposing specific policy recommendations aimed at improving Henan's innovation capacity, strengthening the transformation of innovation achievements, and optimizing innovation resource allocation.

1.2.2. Research motivation

The motivation for this study stems from several factors:

- 1) The need for innovation development in Henan: As an important province in central China, Henan faces an urgent need to improve its innovation capacity, especially considering the gaps in innovation levels and technological competitiveness when compared to more developed regions.
- 2) The implementation of national innovation strategies: The national strategy has positioned building an innovative country and regional innovation hubs as a core goal. Henan, as an important province, needs to leverage its own characteristics and strengths to promote regional innovation and contribute to the national innovation system [13].
- 3) Promoting sustainable regional economic development: Innovation is a key driver of economic transformation and sustainable development in Henan and central China [14]. Understanding how Henan can build an innovation hub is of great practical significance.

1.2.3. Research methods

This study uses the following main methods:

- 1) Literature review: A comprehensive review of domestic and international theories and practices related to the development of innovation hubs, examining the definitions, characteristics, and successful case studies of innovation hubs.
- 2) Data analysis: The study collects data on Henan's research institutions, universities, R&D investment, innovation output, etc., to quantitatively analyze the current state and gaps in Henan's innovation hub development.
- 3) SWOT analysis: A SWOT analysis is used to systematically assess Henan's strengths, weaknesses, opportunities, and threats in building a national innovation hub.
- 4) Policy analysis: The study analyzes the effectiveness of existing innovation policies in Henan, identifying areas for improvement and proposing adjustments to enhance their impact.

1.2.4. Research contributions

The main contributions of this study are as follows:

- 1) Expanding and enriching regional innovation theory: By analyzing Henan's development of an innovation hub, this study reveals the internal patterns and characteristics of regional innovation, contributing new cases and experiences to the theory of regional innovation.

- 2) Providing theoretical support for policy formulation: The study provides scientific and rational theoretical support for innovation policy development in Henan and other regions, helping governments formulate more targeted and actionable innovation-driven policies [15].
- 3) Promoting the optimization of innovation resource allocation: The study identifies areas where Henan can optimize the allocation of innovation resources, thereby improving efficiency and encouraging broader social support for innovation. This helps stimulate joint efforts from various sectors to foster innovation-driven development.

1.2.5. Research questions

This study focuses on the following core questions:

- 1) What is the current state of Henan's innovation hub development? This includes the quantity and quality of research institutions and universities, the structure of the innovation talent pool, the level of innovation investment, and the effectiveness of innovation policy.
- 2) What are the main problems and challenges Henan faces in building an innovation hub? Key issues include uneven distribution of innovation resources, weak enterprise innovation capacity, and low efficiency in transforming scientific achievements into practical applications.
- 3) What are the advantages and disadvantages of Henan's innovation hub development? Advantages include geographical location, rich cultural heritage, and a strong industrial base. Disadvantages include a shortage of high-end innovation talent, weak corporate innovation awareness, and an underdeveloped mechanism for converting innovation results.
- 4) How can Henan improve its innovation hub development and contribute to the implementation of the national innovation-driven development strategy? The study proposes specific recommendations, such as increasing innovation investment, optimizing resource allocation, enhancing the role of enterprises as innovation leaders, and improving the transformation mechanisms for innovation achievements [16].

Through these research questions, this study aims to provide a comprehensive evaluation framework for Henan's development as a national innovation hub, offering theoretical support for future policy-making and practical implementation.

2. Literature Review

2.1. The connotation and characteristics of innovation highland

Innovation highland refers to the formation of a region with strong innovation capabilities and competitive advantages through the aggregation of innovation resources, optimization of innovation environment, and strengthening of innovation cooperation within a certain area [17]. Its connotation is mainly reflected in the following aspects: first, it has abundant innovation resources, including scientific research institutions, universities, and scientific and technological talents, etc.; second, it has a favorable innovation environment, including policy support, financial investment, cultural atmosphere, etc.; third, it has strong innovation and achievement transformation capabilities and can continuously introduce new technologies, products, and services; and fourth, it plays an important leading and driving role in regional economic and social development.

The characteristics of the innovation highland mainly include: first, innovation, which means having a high level of technological innovation, product innovation, management innovation, and other aspects; second, agglomeration, which means that innovative factors are highly concentrated within a certain region; third, openness, which means maintaining close connections and cooperation with other regions and international innovation systems; and fourth, dynamism, that is, the development of innovation highlands is a constantly changing and evolving process.

2.2. Summary of experience in building innovation heights at home and abroad

From a foreign perspective, some developed countries have accumulated rich experience in building innovation highlands. For example, Silicon Valley in the United States is a globally renowned innovation hub, and its successful experiences mainly include: first, having world-class universities and research institutions that provide strong intellectual support for innovation; second, the development of venture capital provides sufficient financial support for innovation and entrepreneurship; third, a cultural atmosphere that encourages innovation and tolerates failure has stimulated people's enthusiasm for innovation; and fourth, the government's support and guidance, which has created a favorable policy environment for the construction of the innovation highland [18].

In China, Beijing Zhongguancun and Shanghai Zhangjiang High-Tech Park are also typical innovation hubs. The successful experiences of these regions mainly include: first, the government's high attention and strong support and the introduction of a series of preferential policies and measures. Second, emphasis is placed on industry-university research cooperation, which promotes the transformation and application of scientific and technological achievements. Third, the cultivation and introduction of innovative talents have been strengthened, providing strong talent support for innovative development. The fourth is to continuously improve the innovation service system, which has enhanced innovation efficiency and quality.

2.3. Research status of building a national innovation highland in Henan Province

In recent years, Henan Province has achieved certain results in building a national innovation highland. On the one hand, investment in technological innovation continues to increase, and research conditions are gradually improving. On the other hand, technological innovation achievements continue to emerge and breakthrough progress has been made in some fields [19]. At the same time, Henan Province actively strengthens cooperation and exchanges with domestic and foreign innovation highlands, draws on advanced experience, and enhances its own innovation capabilities. However, compared with developed regions, there are still some gaps in the construction of innovation highlands in Henan Province, such as a shortage of high-end innovative talents, weak innovation capabilities of enterprises, and inadequate mechanisms for transforming innovative achievements.

2.4. The shortcomings of existing research

At present, there are still some shortcomings in the research on building a national innovation highland in Henan Province. First, the understanding of the connotation and characteristics of the

innovation highland is not deep enough, and there is a lack of systematic theoretical research [20]. Second, there is relatively little empirical research on the construction of innovation highlands in Henan Province, and the data sources and analysis methods need to be further improved. In addition, the proposed countermeasures and suggestions for the actual situation in Henan Province are not specific and feasible enough, and further research is needed to strengthen their pertinence and practicality.

3. Research Methodology

This section analyzes the current situation of building a national innovation highland in Henan Province.

3.1. Innovative resources

Henan Province has a certain number of scientific research institutions and universities (see Table 1 for specific details). In terms of scientific research institutions, including some State Key Laboratory and engineering technology research centers, these institutions have made certain achievements in basic research and applied research. In terms of universities, there are several well-known universities in Henan Province, such as Zhengzhou University and Henan University, which play an important role in talent cultivation and scientific research. However, compared with developed regions, there is still a gap in the quantity and quality of research institutions and universities in Henan Province, especially in the construction of high-level research institutions and top disciplines.

Table 1
Number of scientific research institutions and universities in Henan Province in 2023

Category	Number of institutions
Total Universities	156
Undergraduate Institutions	71
Colleges and Vocational Schools	82
Scientific Research Institutions	234

1) Scale and structure of the science and technology talent team

The scale of the scientific and technological talent team in Henan Province is relatively large, but the overall quality and structure need to be optimized (see Table 2 for specific details). On the one hand, there is a relative lack of high-level innovative talents, especially in key core technology fields. On the other hand, the distribution of talents is uneven, and the shortage of talents in some regions and industries is particularly prominent [21]. In addition, the talent incentive mechanism and training system also need to be further improved.

Table 2
Research and development investment in Henan Province in 2023

Item	Amount (billion yuan)
Total R&D Expenditure	105
Basic Research Investment	18
Applied Research Investment	42
Experimental Development	45

3.2. Innovation investment

1) Research and development investment funds

In recent years, Henan Province has continuously increased its investment in scientific and technological innovation, with research and development funding increasing year by year. However, overall, the R&D investment intensity is still relatively low, and there is a significant gap compared to developed regions. At the same time, the structure of R&D investment is not reasonable enough, and the proportion of investment in basic research and applied research is relatively low.

2) Policy support intensity and effectiveness

Henan Province has introduced a series of policies to support technological innovation, such as tax incentives and financial subsidies, which have to some extent promoted the development of technological innovation. However, the implementation effect of policies still needs to be improved, and some policies have deviations and deficiencies in the implementation process.

3.3. Innovation output

1) Patent application volume and authorization volume

The number of patent applications and authorizations in Henan Province has been increasing year by year (see Table 3 for specific details), indicating that scientific and technological innovation activities are becoming increasingly active. However, in terms of patent quality, there are relatively few high-quality and high-value invention patents, and the patent conversion rate also needs to be improved.

Table 3
The number of patent applications and authorizations in Henan Province in 2023

Item	Number of applications/grants
Total Patent Applications	15000
Invention Patents	8000
Utility Models	5000
Design Patents	2000
Total Patent Grants	12000
Invention Grants	6000
Utility Model Grants	4000
Design Grants	2000

2) Development status of high-tech industries

The high-tech industry in Henan Province has developed rapidly, forming a group of competitive high-tech enterprises and industrial clusters. However, overall, there is still room for improvement in the scale and level of high-tech industries, especially in key technological breakthroughs and industrial upgrading.

3.4. Innovation environment

1) Innovation and entrepreneurship atmosphere

With the deepening implementation of the innovation-driven development strategy, the innovation and entrepreneurship atmosphere in Henan Province is gradually becoming stronger.

The government encourages innovation and entrepreneurship, and the attention and support for innovation and entrepreneurship from all sectors of society continue to increase. However, the cultivation of innovation and entrepreneurship culture still needs to be strengthened, and a social atmosphere that encourages innovation and tolerates failure needs to be further created.

2) The degree of improvement of the innovative service system

The innovation service system in Henan Province has gradually improved, including the construction of innovation and entrepreneurship service platforms such as technology enterprise incubators and crowdsourcing spaces, which have achieved certain results. However, the professionalization and marketization level of the service system still needs to be improved, and the service content and methods also need to be further enriched and innovated.

4. Results and Discussion

This study comprehensively analyzed the advantages and disadvantages of Henan Province in building a national innovation highland, summarized the relevant results, and conducted in-depth discussions. The following text will explore the specific advantages and disadvantages of Henan Province in the field of scientific and technological innovation and compare and analyze these results with a literature review to gain a more comprehensive understanding of Henan's strategic position and potential room for improvement in the current innovation context.

4.1. Advantages

1) Geographical location and transportation advantages

Henan Province is located in the central part of China, in a key position of "connecting the east and the west, linking the south and the north." Through convenient railway, highway, aviation, and water transportation networks, Henan has significant advantages in transportation. This geographical and transportation condition not only supports collaborative innovation within the region but also promotes exchanges between Henan Province and other regions across the country in terms of scientific and technological resources, markets, and information. The role of this geographical advantage is consistent with the importance of technological innovation infrastructure in the central region in many studies, but Henan Province's unique transportation advantages provide more possibilities for further enhancing the cross-regional flow of innovative achievements.

2) Rich historical and cultural resources

As one of the birthplaces of Chinese civilization, Henan Province has a profound historical and cultural heritage and abundant cultural resources. These resources not only provide diverse innovative inspiration but also attract a large number of scientific research talents and innovative entrepreneurs, laying the foundation for creating a favorable innovation atmosphere. This study suggests that this cultural resource not only plays a role in gathering talents during the innovation process but also creates a suitable environment for innovation and entrepreneurship. This conclusion is also supported in the literature and supplements the positive role of historical and cultural resources in enhancing regional innovation attractiveness, demonstrating the unique potential of Henan Province's "culture+technology" innovation model.

3) Good industrial foundation

The industrial system in Henan Province is relatively complete, especially in the fields of equipment manufacturing, food processing, and new materials, which have strong capabilities and provide broad application scenarios and market demand for technological innovation. Research has found that this industrial foundation not only accelerates the transformation of technological achievements but also provides possibilities for the improvement of innovation chains and the optimization of industrial chains. Compared with other provinces, Henan's industrial foundation and market size provide practical needs for promoting the application of scientific and technological innovation achievements, which is consistent with the existing literature on the demand for scientific and technological transformation. However, Henan's industry characteristics make it more advantageous in fields such as equipment manufacturing and new materials.

4.2. Disadvantages

1) Shortage of high-end innovative talents

Although Henan Province has a large overall talent pool, there are still significant shortcomings in high-end innovative talents, especially in key core technology areas where there is a lack of leading talents and high-level innovation teams. This study points out that this shortage hinders the breakthrough progress of scientific and technological achievements in high-tech fields and reduces Henan's competitiveness in cutting-edge technological innovation. The importance of high-end talents for regional innovation has been mentioned multiple times in the literature, but there is still a gap between Henan Province and the developed eastern regions in terms of talent level and quality, indicating the need for more policy support to attract and cultivate high-level innovative talents.

2) Weak innovation capability of enterprises

Research has found that some companies have weak innovation awareness and insufficient R&D investment, resulting in low technological innovation capabilities and putting them at a disadvantage in market competition, making it difficult for them to achieve sustainable development. Analysis shows that the fundamental reason for this problem lies in the insufficient innovation resources and weak technological research and development capabilities of enterprises, which is consistent with the existing literature on insufficient innovation of enterprises. However, the situation in Henan is more serious, and this lack of innovation capability is particularly significant in small and medium-sized enterprises.

3) The mechanism for transforming innovative achievements is not sound

In terms of achievement transformation, technological innovation in Henan Province still faces many obstacles. Research shows that there is a disconnect between technological achievements and market demand, and there is a lack of effective transformation platforms and service systems. This finding is consistent with many discussions on the difficulty of transforming innovative achievements in research, but the special feature of Henan Province is its low conversion rate of scientific and technological achievements, indicating that further improvement is needed in the

construction of technology transfer platforms and the market-oriented integration of achievements.

In summary, the results of this study reveal the key advantages and disadvantages of Henan Province in the construction of innovation highlands. Henan has good conditions in terms of location, culture, and industrial foundation, but there are also obvious shortcomings in high-end talent, enterprise innovation capabilities, and achievement transformation mechanisms. To enhance the competitiveness of Henan Province in the construction of innovation highlands, it is suggested to further strengthen the policy of introducing high-end talents, increase support for enterprise research and development, and improve the mechanism for transforming scientific and technological achievements, in order to achieve a complete and efficient innovation chain.

5. Conclusion

This section provides suggestions for building a local government debt risk warning system based on government comprehensive financial reports.

5.1. Intensify the cultivation and introduction of innovative talents

Optimize the talent cultivation system: Strengthen the connection between higher education and vocational education; promote the deep integration of industry, academia, and research; and cultivate more innovative talents that meet market demand. At the same time, emphasis should be placed on cultivating students' innovative thinking and practical abilities and improving their overall quality.

Increase efforts in talent introduction: Develop more proactive talent policies to attract high-level innovative talents from home and abroad to Henan for innovation and entrepreneurship. By providing generous benefits, a good working environment, and development opportunities, Henan's attractiveness to talents can be enhanced.

Improve talent incentive mechanism: Establish and improve talent evaluation and incentive mechanisms, and fully stimulate the innovative vitality and creative potential of talents. Increase the reward for innovative talents who have made outstanding contributions, and create a good atmosphere of respecting knowledge and talents.

5.2. Increase innovation investment and optimize resource allocation

Increase financial investment: The government should continue to increase financial investment in technological innovation to ensure stable growth of research and development funds. At the same time, optimize the direction of the use of fiscal funds, and focus on supporting the research and development of key core technologies and the tackling of major scientific and technological projects.

Guide social capital investment: Encourage diverse entities such as enterprises, social organizations, and individuals to participate in scientific and technological innovation investment through policy guidance and incentive measures. Establish a technology innovation investment and financing system, and broaden the sources of technology innovation funds.

Optimize resource allocation: Reasonably allocate innovative resources to avoid redundant construction and waste. Strengthen the sharing and openness of innovative resources, and improve the efficiency of resource utilization. At the same time, emphasis should be placed on the integration and collaboration of innovative resources to form a collaborative force for innovation.

5.3. Strengthening the position of enterprises as the main body of innovation

Enhance enterprise innovation capability: Encourage enterprises to increase research and development investment, establish research and development institutions, and strengthen technological and product innovation. Support enterprises to carry out industry–university research cooperation and leverage external forces to enhance their innovation capabilities.

Cultivate innovative enterprises: Strengthen support and cultivation for innovative enterprises, and create a group of innovative leading enterprises with core competitiveness. By demonstrating and leading, we can drive more enterprises to embark on the path of innovative development.

Optimize the innovation environment: Improve the innovation policy system, and reduce innovation costs and risks for enterprises. Strengthen intellectual property protection, and safeguard the legitimate rights and interests of enterprises. At the same time, we will strengthen the construction of the innovation service system and provide comprehensive innovation services and support for enterprises.

5.4. Improve the mechanism for transforming innovative achievements

Strengthen the construction of achievement transformation platforms: Establish and improve technology transfer and transformation platforms and mechanisms to promote effective integration between scientific and technological achievements and market demand. Strengthen the construction of technology parks, incubators, and other carriers to provide a favorable environment for the transformation of achievements.

Promote collaborative innovation among industry, academia, research, and application: Strengthen cooperation and communication between industry, academia, research, and application, and create a favorable situation for collaborative innovation. Accelerate the transformation of scientific and technological achievements into real productivity through joint research and development, technology transfer, and other means.

Improve the income distribution mechanism: Establish and improve the income distribution mechanism for the transformation of innovative achievements, and safeguard the legitimate rights and interests of innovation subjects. By reasonable distribution of benefits, stimulate the enthusiasm and creativity of all parties to participate in the transformation of results.

5.5. Create a favorable innovation ecological environment

Strengthen the construction of innovative culture: Promote the spirit of innovation, cultivate an innovative culture, and create a social atmosphere that encourages innovation and tolerates failure. Strengthen science popularization and innovation education, and improve the scientific literacy and innovation ability of the whole nation.

Optimize the innovation policy environment: Improve the innovation policy system, and strengthen policy coordination and targeting. Intensify policy promotion and interpretation efforts to enhance policy awareness and implementation. At the same time, strengthen policy evaluation and adjustment to ensure the effectiveness and adaptability of policies.

Strengthen infrastructure construction: Strengthen the construction and maintenance of scientific and technological

innovation infrastructure to provide strong support for scientific and technological innovation, including the construction and improvement of scientific research facilities, information networks, public service platforms, and other aspects.

5.6. Strengthening regional cooperation and collaborative innovation

Deepen regional cooperation: Strengthen cooperation and exchanges with other innovation hubs at home and abroad, and learn from advanced experience and practices. By jointly building joint laboratories, technology transfer centers, and other means, resource sharing and complementary advantages can be achieved.

Promote collaborative innovation: Strengthen the collaborative cooperation among various innovation entities within the region to form an innovative synergy. Resolve major bottlenecks that hinder innovation and development through joint research and development.

Expand international cooperation space: Actively participate in international scientific and technological cooperation and competition, and expand the fields and space of international cooperation. Strengthen cooperation and exchanges with international organizations, multinational corporations, etc., and enhance Henan's influence and competitiveness in the field of international scientific and technological innovation.

5.7. Conclusion and research contribution

This study provides a detailed analysis of the advantages and disadvantages of building a national innovation highland in Henan Province and proposes corresponding countermeasures and suggestions. However, there are also some limitations in the research, mainly reflected in the locality of the data and insufficient in-depth research in some fields. Future research can combine more specific regional cases to further refine the implementation effects of innovation policies and explore more precise strategies for allocating innovation resources.

For future research directions, this study suggests:

- 1) Development model or framework: In the conclusion section, based on the above analysis, a theoretical framework or model for the construction of regional innovation highlands can be proposed. This framework can comprehensively consider the interactive effects of multidimensional factors such as talent, policies, and resource allocation, providing theoretical support for the construction of innovation highlands in Henan and other provinces.
- 2) Policy impact assessment: Evaluate the effectiveness of different innovation policies through empirical research, especially in terms of the transformation of scientific and technological achievements and the improvement of enterprise innovation capabilities, to provide data support for policy formulation.
- 3) International comparative research: In the future, comparative research can be conducted between Henan Province and other international innovation hubs (such as Silicon Valley, Shenzhen, etc.) to draw on their successful experiences and enhance the international perspective of Henan Province's innovation level.

Through these studies, we can further enhance the innovation capability of Henan Province and provide a reference for the construction of innovation highlands in other central and western regions of China, promoting the high-quality development of the regional economy.

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Ethical Statement

This study does not contain any studies with human or animal subjects performed by the author.

Conflicts of Interest

The author declares that he has no conflicts of interest to this work.

Data Availability Statement

The data that support the findings of this study are openly available in the website of the China National Bureau of Statistics at <https://www.stats.gov.cn/>.

Author Contribution Statement

Kai Zhang: Conceptualization, Methodology, Validation, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition.

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