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Research on the Pathways and Countermeasures for Accelerating the Transformation and Upgrading of the Sci-Tech Economy in Xiaogan City

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Abstract: In recent years, Xiaogan City has vigorously implemented an innovation-driven development strategy. However, there is still considerable room for improvement in its scientific and technological innovation level and comprehensive capabilities. Against this backdrop, based on thorough research, this paper analyzes the characteristics of industrial structure changes and the current situation of sci-tech economic development in Xiaogan City. It summarizes the shortcomings and bottlenecks in promoting sci-tech economic development and industrial transformation and upgrading. The paper proposes targeted policy suggestions regarding financial support for scientific and technological innovation, the positioning of industrial chains and innovation chains, coordinated regional development of the sci-tech economy, the cultivation of "Specialized, Refined, Characteristic, and Innovative" enterprises, and the building of R&D and innovation talent teams.

Keywords: Sci-tech economy; Industrial upgrading; Pathways; Countermeasures

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1. Introduction

In the era of the digital economy, technological development holds even greater uniqueness and importance for national economic growth [1]. Facing a complex and ever-changing domestic and international environment and the accelerated evolution of the global economic and trade landscape, it is imperative to accelerate the transformation of China's economic growth drivers through scientific and technological innovation, comprehensively promote high-quality and efficient economic development, and accelerate the construction of a world-leading science and technology power [2]. Against this backdrop, various provinces and cities, under the overall planning and guidance of the national scientific and technological innovation strategy, are actively exploring pathways for "scientific and technological innovation driving the economy." Among them, Hubei Province has systematically planned and focused on building and optimizing the layout, system, and framework for scientific and technological innovation,

enhancing its comprehensive strength, and vigorously promoting the construction of a strong provincial sci-tech system [3]. Within this context, it is both necessary and significant for Xiaogan City to drive its industrial upgrading through scientific and technological innovation.

2. Characteristics of industrial structure change and current situation of sci-tech economic development in Xiaogan City

2.1. Characteristics of industrial structure change in Xiaogan City

Significant upgrading of industrial structure, yet differences remain with economically strong cities in Hubei influenced by multiple factors such as technological progress, deepening division of labor, and upgrading demand, the global economy has transitioned from an agricultural to an industrial economy and then to a post-industrial society, with regular changes occurring in the industrial economic structures of various countries [4]. Since China's reform and opening-up, its industrial structure has been continuously optimized during adjustment, showing a trend of shifting from a "secondary-tertiary-primary" pattern to a "tertiary-secondary-primary" pattern [5]. The same holds true for Xiaogan City. Since 2019, the proportion of the tertiary industry in Xiaogan's GDP has surpassed that of the secondary industry, becoming the leading industry driving the city's economic development. These changes and adjustments indicate a significant enhancement in the comprehensiveness, coordination, and sustainability of Xiaogan's economic development. However, compared with other economically strong cities in Hubei Province, the proportion of the primary industry in Xiaogan's GDP remains relatively high, suggesting continued room for adjustment and optimization of its industrial structure in the future.

As the leading industries grow and strengthen, they gradually concentrate advantageous resources and form spatial agglomerations, generating significant spillover effects [6]. **Table 1** lists the distribution of dominant industries in Xiaogan City. The regional distribution shows a significant agglomeration effect. For instance, the high-tech Zone, Hanchuan City, and Anlu City possess very obvious advantages in their dominant industries. Strategic emerging industries in Xiaogan, such as automobiles and components, optoelectronic information, high-end equipment manufacturing, bio-medicine, and new energy, show positive development trends. These emerging industries are driving the transformation and upgrading of traditional sectors like textiles, garments, food processing, paper products, and salt-phosphorus chemicals. These industries are interconnected in blocks and clustered along chains, moving towards high-end and intelligent development. To date, Xiaogan's high-end equipment manufacturing innovative cluster has been recognized as a national innovative industrial cluster, while Yingcheng's rural innovative cluster, green paper-based materials, and modern textile and apparel have attained provincial-level innovative cluster status.

Table 1. Distribution of leading industries in Xiaogan City

Industry	Xiaonan District	Xiaochang County	Dawu County	Yunmeng County	Yingcheng city	Anlu County	Hanchuan city	High-tech zone
Automobile & parts								√
Optoelectronic information		√						√
High-end equipment Mfg.								√
Textiles & apparel						√	√	√
Bio-medicine		√				√	√	√

Table 1 (Continued)

Industry	Xiaonan District	Xiaochang County	Dawu County	Yunmeng County	Yingcheng city	Anlu County	Hanchuan city	High-tech zone
Food processing				√		√	√	√
Paper products	√							
Metal products	√					√	√	
New energy			√		√	√	√	
Salt-phosphorus chemicals				√	√			

Note: *Data sourced from the Xiaogan Municipal People's Government website.*

2.2. Current situation of sci-tech economic development in Xiaogan City

Science and technology and the economy are mutually supportive, with a favorable economic foundation being a prerequisite for scientific and technological innovation [7]. In 2024, Xiaogan's GDP ranked fifth in the province, above the average level. Against this backdrop, this paper examines the current state of Xiaogan's sci-tech economy through three indicators: the environment and system construction for sci-tech innovation, R&D investment, and the construction of sci-tech innovation talent teams.

2.2.1. Environment and system construction for sci-tech innovation

The sci-tech innovation environment is a crucial factor supporting high-quality economic development [8]. In recent years, Xiaogan City has deeply implemented the innovation-driven development strategy, continuously optimized its sci-tech innovation environment, and gradually improved the corresponding system. It has consecutively maintained the title of "Advanced City" in the provincial comprehensive assessment of sci-tech innovation for four years. In existing sci-tech innovation zones such as Xiaogan Lianggang Economic Zone, Hanchuan Economic Development Zone, Yingcheng Economic Development Zone, Yunmeng Economic Development Zone, and Xiaonan Economic Development Zone, the city has implemented open and targeted policies supporting talent entrepreneurship, financial subsidies, park infrastructure construction, and the provision of sci-tech intellectual resources.

2.2.2. R&D investment

Technological innovation capability is a key variable enabling specialized, innovative, and high-tech enterprises to occupy important positions in the core technologies of industrial chains [9]. R&D investment is a critical behavior for advancing these capabilities [10]. It is a vital indicator reflecting a country or region's innovation capacity, typically measured by the ratio of R&D expenditure to GDP. A higher ratio indicates greater innovation investment and capability. In 2024, China's R&D intensity (R&D expenditure / GDP) reached 2.68%, a record high approaching the OECD average [11]. The R&D intensity of Hubei Province in 2024 was 2.35%, and Xiaogan City's R&D investment intensity is similar to the provincial level.

2.2.3. Construction of the sci-tech talent team

Sci-tech talents are key strategic resources for promoting self-reliance and self-improvement in science and technology [12]. Recognizing the leading and supporting role of talents in its regional development layout ("Main City Rise, Two Belts Collaborate, Xiaogan-Hankou Integration, Diversified Support"), Xiaogan City attaches great importance to talent development, especially sci-tech talent. In terms of policy supply, Xiaogan has successively

introduced the "Huayin Talent Plan," "Golden 15 Policies," and "Huanchuan Innovation and Entrepreneurship Talent Plan," focusing on key industries and fields, strengthening flexible recruitment, and introducing industrial entrepreneurship talents, enterprise innovation talents, and institutional innovation talents. For talent incentives, practices include implementing "case-by-case discussion" for top talent teams, establishing a special fund of 8 million Chinese Yuan for scientific research and technology transfer, and piloting a "package system" for R&D project funds. Furthermore, the city has established "industry-university-research" cooperation relationships with multiple universities and research institutes, built enterprise-university joint development platforms, and increased the cultivation of sci-tech talents.

3. Shortcomings and bottlenecks in sci-tech economic development and industrial transformation in Xiaogan City

3.1. Insufficient support from fiscal sci-tech expenditures for industrial transformation

Local fiscal sci-tech expenditures play a crucial role in supporting technological innovation. Governments can effectively promote regional sci-tech development and industrial upgrading by improving innovation infrastructure, establishing platforms, and guiding industrial agglomeration. Since 2017, the proportion of local fiscal sci-tech funds in the total local fiscal budget expenditure in Xiaogan has shown a yearly declining trend, 2.77% in 2018, 2.75% in 2019, and 2.33% in 2020, with its provincial ranking dropping from 4th in 2018 to 5th in 2019 and 2020. Although this proportion has shown an upward trend since 2021, it remains far below the proportion of sci-tech expenditures in the provincial budget (3.74% in 2023). This indicates not only insufficient government investment in supporting sci-tech innovation but also a relatively limited ability to mobilize resources for promoting industrial structure transformation and upgrading.

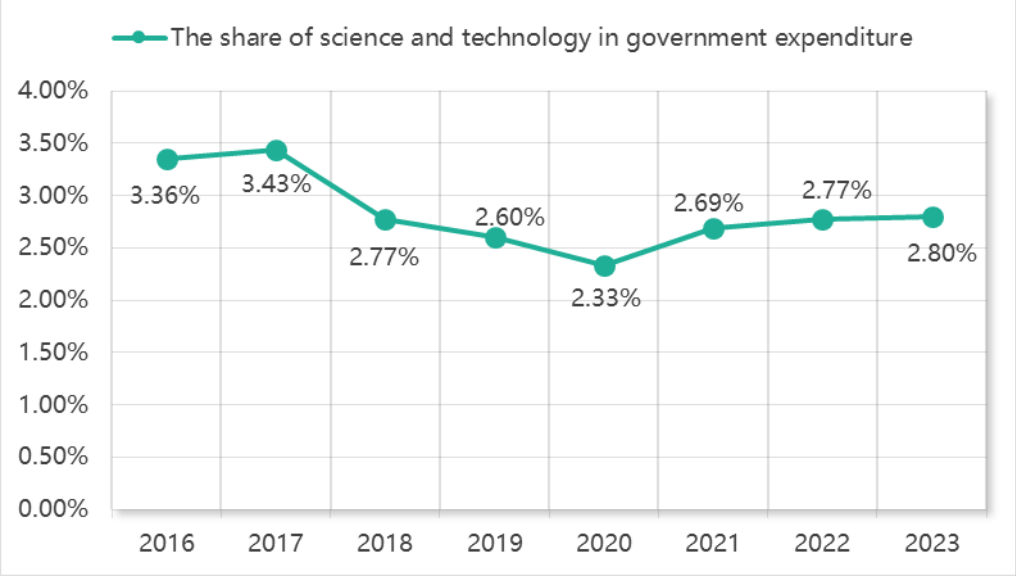

Figure 1. Changes in the share of science and technology in government expenditure

3.2. Weak leading and radiating capacity of sci-tech innovation in the central urban area

Research by Xu and Guo indicates that regional sci-tech innovation activities exhibit significant spatial correlation. Areas with higher levels of innovation within a region can spread influence to surrounding areas, allowing them to access resources beneficial for their own sci-tech development, ultimately achieving coordinated regional

innovation [13]. As previously analyzed, there is a significant imbalance in sci-tech innovation among different regions within Xiaogan. Xianan District, the only municipal district, serves as the political, economic, and cultural center of Xiaogan. However, the innovation vitality, capability, and potential of Xianan District have not fully exerted their leading role as a central area. Its radiating capacity, demonstration effects, and driving effects remain relatively weak.

3.3. Overall insufficient level and regional imbalance of sci-tech investment

China's sci-tech investment has grown rapidly in recent years. In 2023, Xiaogan's R&D intensity reached 2.35%, which still represents a significant gap compared to Wuhan (3.82%) and Xiangyang (2.81%). Internally, sci-tech investment across Xiaogan's regions is severely unbalanced. R&D intensity is relatively high in Xianan, Anlu, and Hanchuan, while the R&D expenditure as a percentage of GDP in Yunmeng County, Xiaochang County, and Dawu County is less than 1%. Regarding the composition of R&D expenditure, Xiaogan has almost no basic research expenditure. The majority is applied research expenditure, with experimental development expenditure accounting for a very small proportion.

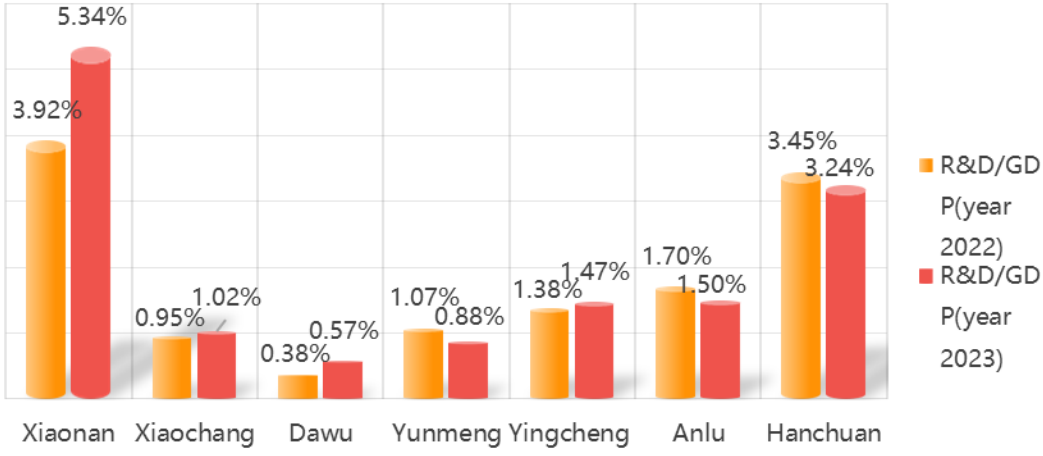

Figure 2. Changes in the share of science and technology in government expenditure

3.4. Sci-tech innovation achievements and independent innovation capability need enhancement

Developing high-tech industries has become an inevitable requirement for all countries to enhance their competitive advantages and overall national strength. Technological innovation is the direct driving force behind the development of high-tech industries [14]. Overall, in recent years, the cultivation of high-tech enterprises in Xiaogan has significantly accelerated, and the transaction volume of technology contracts, the number of patents, and other sci-tech achievements have increased considerably. However, there remains a significant gap between Xiaogan and other cities in Hubei Province, such as Xiangyang, Yichang, and Jingzhou, in terms of upgrading innovative industrial clusters, the cumulative number of high-tech enterprises, the number of national-level technology-based small and medium-sized enterprises, and the transaction volume of technology contracts. The gap in sci-tech achievements between Xiaogan and the top-ranked cities in Hubei is widening, indicating that the city's independent innovation capability still requires substantial improvement.

3.5. Underutilized exploration and application of university sci-tech resources

Jiang, Li, and Shen pointed out that the application of university sci-tech resources and technological innovation are mutually reinforcing [15]. Xiaogan City has relatively scarce higher education resources, with only one public undergraduate university and one private undergraduate university. Although the Xiaogan municipal government and enterprises have signed cooperation framework agreements with some universities and carried out multi-level cooperation in scientific research, technology transfer, and talent cultivation, from a provincial perspective, Xiaogan has not fully utilized university sci-tech resources. Taking the existing public undergraduate university as an example, it faces a decline in both the quantity and quality of sci-tech talents, coupled with a serious "brain drain" phenomenon. The difficulty in attracting and retaining high-end talents is a major challenge for sci-tech innovation development in Xiaogan.

4. Policy suggestions for accelerating the transformation and upgrading of Xiaogan's sci-tech economy

4.1. Strengthen financial support for sci-tech innovation to promote sci-tech-economy integration

Appropriately increase the proportion of sci-tech development funds in Xiaogan's GDP, align technological development priorities with economic sectors, and promote the integration of science and technology with the economy. Specific measures include as follows:

(1) Establish a regional sci-tech advisory institution and improve the sci-tech decision-making system and the tripartite partnership mechanism involving academia, government, and enterprises;

(2) Increase funding for key sci-tech fields, provide financial support for R&D activities of SMEs with innovation potential within its jurisdiction, and shorten the technology innovation transformation cycle;

(3) Promote industrialization by scaling up support from pilot key projects. Fourth, stimulate demand in sci-tech economic industries and cultivate the market for "innovative products."

4.2. Precisely position industrial and innovation chains for targeted strengthening, extending, and supplementing

Currently, Xiaogan City and its districts/counties have a clear industrial layout: leading industries (automobiles and parts, high-end equipment manufacturing, optoelectronic information), traditional industries (food, textiles), and high-tech industries (bio-medicine, new technologies and new materials, etc.). Based on this layout, the following precise pathways are proposed:

(1) Strengthening the chain requires consolidating the existing industrial base. Leading enterprises in various industries need to increase basic research and human knowledge reserves, demanding technological breakthroughs;

(2) Extending the chain requires guiding investment towards promoting the industrial and innovation chains, directing funds towards "hard technology" and "Specialized, Refined, Characteristic, and Innovative" directions;

(3) Supplementing the chain requires achieving supply chain autonomy and controllability. Relevant departments need to guide enterprises within the industrial layout to increase R&D investment in key raw materials, improve self-sufficiency rates, and expand product application scenarios.

4.3. Foster characteristic regional development of the sci-tech economy and promote inter-regional coordination

Aligning with national industrial development orientation, Xiaogan and its districts/counties, based on the new development stage and their own foundations, are striving to build a regional sci-tech innovation ecosystem. However, a comprehensive comparison reveals that while the original characteristics of each region are distinct, the development directions of emerging industries across regions are relatively similar (e.g., high-end equipment manufacturing, new energy, automobiles and parts, optoelectronic information, health industry, new materials). Similar industrial development directions within the region will inevitably lead to internal competition, even low-level and redundant competition, which could hinder the overall industrial system of Xiaogan. Therefore, the municipal government needs to make rational plans based on the industrial foundation and characteristic advantages of each region. With a focus on coordinated regional sci-tech economic development and a global perspective, it should guide the landing of high-end innovative resources and major projects, explore potential sci-tech economic growth poles in different regions, and promote synergistic resonance among these poles.

4.4. Cultivate "specialized, refined, characteristic, and innovative" enterprises to enhance the sci-tech innovation level

To narrow the gap in sci-tech innovation levels with cities like Xiangyang, Yichang, and Jingzhou, it is necessary to follow the development path of sci-tech innovation enterprises and formulate targeted cultivation measures. The steps are as outlined:

(1) Step 1: Combine enterprise self-assessment (setting innovation indicators in advance according to entry standards) with research and survey visits for high-tech enterprise cultivation (focusing on industry, scale, affiliation, and industrial chain) to establish a gradient high-tech enterprise reserve database;

(2) Step 2: Provide precise support and facilitate upgrading (precise matching of technology finance, professional guidance, R&D support);

(3) Step 3: Leverage the leading and assisting role of industrial chain leaders. During this process, the government can provide R&D support to increase the industry knowledge stock and supply innovative thinking for growing innovative enterprises. Utilize industrial and sci-tech support policies to encourage innovative enterprises to establish innovative industrial clusters and build R&D and innovation technology alliances. Implement competition policies to reduce direct allocation of government funds, land, and other factors, ensuring innovative enterprises have the right to fairly obtain production factor resources.

4.5. Rationally utilize university sci-tech resources and build a talent highland for R&D and innovation

On one hand, the government should actively guide high-tech industries to rationally utilize university sci-tech resources. For example, establish a regular communication and exchange mechanism between university talents and government/enterprises, such as effectively motivating universities to strengthen cooperation by sending faculty for secondments and internships in government and enterprises. They should improve the talent guarantee mechanism, support supplementary pension insurance to retain existing talents and enhance industry-science integration, effectively translate knowledge from universities and research institutes, and absorb university sci-tech talents to jointly tackle technical problems with enterprises.

On the other hand, Xiaogan City (districts, counties) should adopt open policies to attract and appropriately utilize talents, forming a characteristic talent policy system. Consider adopting approaches like "special policies,"

"special mechanisms," and "special handling for special cases." Based on regional development goals, current industrial structure, and the existing talent system, formulate precise, locally-suited talent strategies. After introducing talents, focus on their cultivation and incentives, and conduct dynamic monitoring and adjustment of the talent system.

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