

Analysis of Promoting High Quality Industrial Development through Technological Innovation in the New Development Stage of Sichuan Province

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Abstract: High quality industrial development is the foundation of high-quality economic development. The high-quality development of industries must be driven by technological innovation. This article examines the status of technological innovation in the new development stage of Sichuan Province for high-quality industrial development, and puts forward relevant suggestions. The article takes the new development stage as the background, analyzes and compares the characteristics of scientific and technological innovation and high-quality industrial development between China and Sichuan, and then analyzes the theoretical mechanism of promoting high-quality industrial development through scientific and technological innovation from four aspects: industrial structure, talent, green development, and innovation platform. Subsequently, the industrial systems of Sichuan Province's "5+1" modern industrial system, "10+3" modern agricultural system, and "4+6" modern service industry system were analyzed, and the problems existing in the high-quality development of Sichuan's industries in terms of research and development investment, enterprise innovation, and innovation platforms were proposed. Finally, relevant suggestions were put forward to address the issues raised.

Keywords: New development stage, Technological innovation, High quality development of industries, Industrial structure.

1. Introduction

The new development stage is the stage of striving towards the second centenary goal after achieving the goal of building a moderately prosperous society in all respects. The "14th Five Year Plan and 2035 Long Range Objectives Outline of Sichuan Province" proposes to build a nationally influential economic center, construct the Chengdu Chongqing Economic Dual City Economic Circle, and create an important growth pole to drive high-quality development of the country, while accelerating the construction of modern industries. The Outline of the Plan for the Construction of the Chengdu Chongqing Economic Circle proposes that Sichuan and Chongqing should work together to build an economic and technological innovation center with national influence, providing technological support for the construction of a modern industrial system. The Decision of the Sichuan Provincial Committee of the Communist Party of China on Deepening the Promotion of Innovation Driven Leading High Quality Development points out that it is also necessary to promote the deep integration of the innovation chain and the industrial chain. The modernization of Sichuan is a vivid epitome of the process of Chinese path to modernization, which has experienced the same long-term struggle process as the whole country. At present, the modernization construction in Sichuan mainly presents the following characteristics: first, industrialization is in the transition and promotion period from the middle to the later stage; second, urbanization is accelerating; third, agricultural modernization is improving quality and efficiency; fourth, informatization is releasing momentum; fifth, urban and rural development is in a deep integration period; sixth, regional development is in a coordinated optimization period. These characteristics determine that the path of modernization construction in Sichuan is a collaborative process of multiple tasks, multiple goals, and multiple paths. It must be systematically planned

and promoted from a strategic perspective to better adapt to the new stage, new tasks, and new requirements. Sichuan Province also needs to start from its own characteristics in the new development stage, use technological innovation as a new driving force to drive industrial transformation and upgrading, and promote high-quality industrial development.

At present, there have been many studies on methods for high-quality industrial development in China, mainly focusing on the following aspects. One is the connotation of high-quality industrial development. For example, Yang Huta0 (2020) believes that high-quality economic activities are the key to achieving high-quality development, and the connotation and mechanism of high-quality economic activities also develop and change with the development and changes of trade, finance, international division of labor and other systems [1]. Sun Qixiang and Zhou Xinfu (2020) summarized and extracted the core connotation of high-quality economic development from the concept of high-quality development and its micro, meso, and macro levels, based on multiple dimensions such as economy, society, and ecology [2]. As for the research on high-quality development of industries, most scholars will select specific industries and conduct research and analysis on their high-quality development. Zheng Qiongjie and Cheng Yixian (2022) selected the cultural industry and conducted in-depth research on its digital ecology and high-quality development path [3]. Wang Huanran (2022) studied the sports industry in Henan Province and found that technological innovation is an important factor for the high-quality development of the sports industry [4]. Efforts should be made to strengthen key technology research and development, promote platform carrier construction, deepen industrial integration, cultivate leading enterprises, and improve the quality of sports products and services through technological innovation, driving the high-quality development of the sports industry in Henan Province. Many scholars have studied the impact of

technological innovation on industries such as coal, green, grain, and cultural industries. However, there is still relatively little research analyzing the impact of technological innovation on the high-quality development of the entire industry.

The second is the mechanism of the role of technological innovation in the high-quality development of industries. Yang Hutaο (2020) conducted a profound study on the mechanism of high-quality economic activities, and he agrees with the positive feedback mechanism that collaborative growth is a virtuous cycle between high efficiency, high profits, and high wages [1]. Jia Hongwen et al. (2021) believe that high-quality development relies on technological innovation and industrial structure upgrading [5]. Their research found that technological innovation not only promotes high-quality economic development but also promotes industrial structure upgrading. However, industrial structure upgrading has a restraining effect on high-quality economic development. Fortunately, technological innovation can correct the negative effects of industrial structure upgrading on high-quality economic development, thereby indirectly promoting high-quality economic development. Tang Qingquan and Li Haiwei (2011) studied the internal mechanism of China's industrial structure transformation and upgrading using industrial data from Guangdong as a sample, and finally concluded that R&D innovation is an important factor affecting industrial structure and promoting industrial transformation and upgrading [6].

The third is the measurement method of the impact of technological innovation on the high-quality development of industries. Jia Hongwen et al. (2021) empirically examined the impact of technological innovation and industrial structure upgrading on high-quality economic development using simultaneous equation models and SBM models [5]. Zhao Xicang and Yuan Ru (2021) studied the impact of R&D investment and technological innovation on industrial structure upgrading based on panel data from 30 provinces in China from 2005 to 2018, using generalized least squares estimation (GLS) and Bootstrap mediation test methods. Yang Yiwen and Mao Chunmei (2022) used factor analysis and TOPSIS comprehensive evaluation method to measure and evaluate the development level of high-tech industry ecosystems in various provinces [7].

2. Theoretical Mechanism of Promoting High-Quality Development of Industries Through Technological Innovation

2.1. Technological Innovation Drives Industrial Restructuring and Subsequently Affects High-Quality Industrial Development

Technological innovation is changing traditional enterprises. Firstly, technological innovation can make traditional enterprises feel crisis, be prepared for danger in times of peace, lay out early, and consolidate their market position as soon as possible. Secondly, technological innovation can improve the production processes of traditional enterprises and even fundamentally change their production methods. Traditional enterprises improve their production efficiency through changes in production methods. Finally, technological innovation also promotes the improvement of traditional enterprise management

mechanisms, resulting in increased management efficiency. Therefore, the role of technological innovation in traditional enterprises is manifested in multiple aspects, and timely recognition of the importance of technological innovation by traditional enterprises can promote their development.

Technological innovation creates new industries and sectors. The emergence of new industries and industrial sectors is due to the refinement of the division of labor in the original industries, which has given rise to new industries and industrial sectors. Secondly, new technologies have created new industrial fields, giving rise to new industrial sectors in these fields. For example, before computer technology matured, there was no IT industry. After computer technology matured, the IT industry became a very important industry in the market economy. The emergence of new industries and sectors has increased the proportion of high-tech and emerging industries in the industrial structure. The emergence of new industries often has a promoting effect on economic development.

Technological innovation changes the demand structure and consumption structure. The emergence of new technologies can eliminate or reduce the constraints of technology on demand. According to the demand creation supply theorem, new industries and sectors can be created in the process of meeting consumers' new demands, which promote the upgrading of industrial structure.

Technological innovation changes the relationship between related industries. Technological innovation can change the relationship between upstream and downstream industries. The input-output linkage between industries creates a relationship of product innovation and process innovation between upstream and downstream products and upstream and downstream industries. In this way, technological innovation in an industry is transmitted and diffused to its forward or backward linked industries, promoting the emergence of new technological innovations and leading to the expansion or contraction of the industry.

Technological innovation driving the optimization and upgrading of industrial structure is an objective requirement for the sustainable development of modern economy, and also the optimal choice for social and economic development. Technological innovation is also an objective requirement for high-quality industrial development and a driving force for high-quality industrial development.

2.2. Innovative Talents Drives the High-Quality Development of Industries

Population is the foundation of all economic and social activities, and talent is the primary resource. As the demographic dividend fades and the value of talent becomes increasingly prominent. Regional technological innovation has a strong attraction for innovative talents, and the influx of technological innovation talents will promote regional technological innovation. Taking Chengdu as an example, the net inflow of talents in Chengdu from 2017 to 2021 showed a trend from negative to positive, mainly due to the active economic development, developed innovative industries, and the attraction of talents through "building nests and attracting phoenixes". It can be seen that technological innovation will promote the adjustment of industrial structure and create many new industries, which are also highly attractive to talents. The mutual promotion relationship between technological innovation and talent will also promote the high-quality development of Sichuan's industries.

2.3. Technological Innovation Promotes Green Development and High-Quality Industrial Development

Technological innovation is the fundamental driving force for green development, and green development is the ultimate goal of technological innovation. At the industrial level, technological innovation also plays a fundamental role in promoting the green development of industries. Technological innovation and green development are interdependent and mutually reinforcing, creating a new path for China's technological innovation.

Technological innovation promotes the development of green production technology. The advancement of technology has provided more possibilities for the production of enterprises. For example, the water-saving irrigation technology for wheat in northern North China not only ensures national food security but also promotes green agricultural development. Technological innovation can cut off and reduce factors that pollute and damage the environment from the source of production. This demonstrates that technological innovation is the driving force behind green development, and that technological innovation plays a promoting role in green development.

Technological innovation enhances the ability to handle pollution. Technological innovation can enhance the ability for precise pollution control. Common sewage treatment, air pollution control, and garbage and waste disposal all require relevant technologies for targeted treatment. Technological development and green development are not contradictory. For example, sewage treatment technology not only improves the utilization rate of water resources and achieves green development, but also further enhances technology through repeated technological improvements.

2.4. Innovation Platforms Affects the High-Quality Development of Industries

Technological innovation promotes the development of technological innovation platforms, and excellent technological innovation platforms accelerate technological innovation. Technological innovation plays an important role in building excellent technological innovation platforms, and the technological progress brought about by technological innovation can better construct technological innovation platforms. In addition, the technological innovation mentioned earlier can attract more outstanding talents, and the construction of the platform can rely on these outstanding talents. The role of technology innovation platforms in technological innovation cannot be ignored. A good platform can play a role in resource integration, empowerment, and acceleration in the process of technological achievement transformation. Take talent as an example, a good technology innovation platform can retain people and play the role of different talents. The technology innovation platform can better solve the last mile problem on the scientific research road. There is a strong demand for high-tech products on the demand side, and there are also many excellent research results that have not yet been transformed on the supply side. Although the demand side is urgent, innovation is advancing rapidly, and innovative results are not standardized products. Innovation itself also carries risks. In this situation, it is even more necessary for technology innovation platforms to play a role in the transformation of achievements.

3. The Current Situation of Sichuan's Industrial System and Technological Innovation

3.1. "5+1" Modern Industrial System

The "5+1" in the modern industrial system refers to the five major industries of electronic information, equipment manufacturing, food and beverage, advanced materials, and energy and chemical engineering. '1' refers to the digital economy. In 2019, the "Opinions on Promoting the Construction of the '5+1' Industrial Financial System" proposed that by 2022, the added value of large-scale industries led by the '5+1' industry should grow at an average annual rate of about 8%; the scale of industrial financing in the province should be increased from 1 trillion yuan to 1.5 trillion yuan, and the proportion of direct industrial financing to industrial financing should strive to reach 15%. The proportion of industrial enterprise credit financing to the entire industry should be consistent with the economic development structure, driving the total investment in social technological transformation to reach 3 trillion yuan, the total industrial investment to exceed 4 trillion yuan, the total scale of the 5 trillion industry to exceed 6.2 trillion yuan, the scale of the digital economy to exceed 2 trillion yuan, and the modern industrial system driven by the '5+1' industry to be basically formed.

In recent years, Sichuan has focused on the construction of the "5+1" modern industrial system, effectively enhancing the stability and competitiveness of the industrial and supply chains by vigorously focusing on industries, building projects, cultivating enterprises, strengthening platforms, and optimizing layouts. The industrial foundation continues to solidify, with the operating income of the five pillar industries of electronic information, equipment manufacturing, food and beverage, advanced materials, and energy and chemical industry reaching 4.3 trillion yuan. The main indicators of industrial enterprises above designated size in various industries in 2020 are shown in Table 1. As shown in the table below, the scale of energy supply industries such as electricity and heat are much higher than other industries, with computer, communication, and other electronic equipment manufacturing industries ranking second. The revenue generated by the food industry and chemical manufacturing industry is also considerable. The agricultural and sideline food processing industry, food manufacturing industry, wine, beverage, and refined tea manufacturing industry achieved a total revenue of 718.856 billion yuan in 2020, while the chemical raw material and chemical product manufacturing industry achieved a revenue of 2467.85 billion yuan in 2020.

3.2. The "10+3" Modern Agricultural System

The "10+3" modern agricultural system refers to the ten advantageous characteristic industries of Sichuan grain and oil, Sichuan pig, Sichuan cuisine, Sichuan tea, Sichuan wine, Sichuan fruit, Sichuan bamboo, Sichuan medicine, Sichuan cattle and sheep, and Sichuan fish, as well as the three leading industries of modern agricultural seed industry, modern agricultural equipment, and modern agricultural drying and cold chain logistics. The "10+3" system is a distinctive, structurally sound, and complete agricultural industry system. The Opinion on Accelerating the Construction of a Modern Agriculture "10+3" Industrial System and Promoting the Leap from a Major Agricultural Province to a Strong

Agricultural Province proposes that by 2022, the added value of the primary industry in the province will reach 510 billion yuan. At the same time, the static storage capacity of cold chain logistics facilities has reached over 8 million tons, and the contribution rate of agricultural scientific and technological progress in the province has reached 62%. In recent years, the modern agricultural industry system in Sichuan has been continuously improved, and the construction of agricultural science and technology innovation parks has shown initial results. The brand system of "Sichuan Brand" is growing stronger and stronger, with 978 national geographical indication products (296 geographical indication protection products approved and recognized, ranking first in the country; 194 geographical indication products for agricultural products, ranking second in the country and first in the western region), and 28 geographical indication products included in the "275+275" mutual recognition and protection list between China and Europe. The agricultural output value has been increasing year by year, and in 2020, Sichuan's agricultural production remained stable and improved, with the added value of the primary industry reaching 222.66 billion yuan. However, Sichuan's agriculture is currently undergoing a difficult transition from traditional agriculture to modern agriculture. The overall innovation capability of agricultural technology is not strong, and modern biotechnology and traditional breeding techniques have not been organically combined. The total output value of agriculture, forestry, animal husbandry, and fish from 2000 to 2020 is as follows. Overall, the total output value will increase with the increase of years. Agriculture and animal husbandry have always had a relatively large proportion in the four industries, and their output values are not evenly divided. It was not until 2009 that the output value of agriculture steadily exceeded that of animal husbandry. Although forestry and fisheries account for a relatively small proportion, high-quality development of the industry cannot be achieved without forestry and fisheries.

3.3. The "4+6" Modern Service Industry System

The "4+6" modern service industry system refers to the four pillar service industries and six growth oriented service industry systems. The four pillar service industries refer to commercial trade, modern logistics, financial services, and sports tourism. The six major growth service industries refer to technology information services, trade and exhibition services, human resources services, Sichuan cuisine services, medical services, and home community services. The Opinion on Accelerating the Construction of a "4+6" Modern Service Industry System to Promote High Quality Development of the Service Industry points out that by 2022, the structure of the service industry will continue to adjust, the format structure will be continuously improved, the efficiency of service supply will be significantly enhanced, the overall competitiveness will be significantly improved, and new progress will be made in high-quality development. China will initially form a large-scale modern service industry. The gross domestic product of China's service industry will exceed 3 trillion yuan, accounting for about 55% of the regional gross domestic product. The added value of the "4+6" key industries will account for more than 65% of the province's service industry added value, and the added value of productive service industries will account for about 40% of the province's service industry added value. The per capita

service industry added value will reach about 38000 yuan. The modern service industry covers numerous and complex industries. After the outbreak of the epidemic, the service industry has also been greatly impacted by the economic downturn, with the catering, hotel, and tourism industries being the most affected. According to the Sichuan Statistical Yearbook, many companies had negative total profits in 2020. The tourism industry has also been affected by the epidemic. Compared with previous years, star rated hotels, inbound tourists, and domestic tourism revenue have all decreased to varying degrees in 2020.

3.4. Current Situation of Scientific and Technological Innovation in Sichuan Province

There are various indicators for measuring technological innovation, which have been discussed by many scholars and can be roughly divided into innovation input, innovation output, and innovation environment. The composition of R&D funding and the number of personnel in scientific research and technology service institutions in each city (state) are used to measure innovation investment. Research productivity is measured by the number of patents and the conversion rate of achievements. The innovation environment is mainly evaluated based on the number of higher education institutions and the number of enrolled students. In 2020, the internal expenditure of R&D funds in Sichuan Province was 105528.461 million yuan, of which the daily expenditure was 9,328,685.8 yuan, accounting for 88.4% of the internal expenditure of R&D funds. In 2020, there were a total of 231 institutions, 62951 R&D researchers, and 75043 research projects in Sichuan Province, which contributed to the investment and environment for scientific and educational innovation. In 2020, Sichuan Province awarded a total of 265 projects, including 50 scientific research institutions, 94 colleges and universities, 102 enterprises, and 19 others. It can be seen that various entities are making efforts in technological innovation, and enterprises are still the mainstay of technological innovation. Their role in the transformation of scientific and technological achievements cannot be ignored.

4. There are Problems with the High-Quality Development of Sichuan's Industries

4.1. Insufficient Investment in Scientific Research Funds and Lack of Vitality in Enterprises

Insufficient investment in research and development funds. In 2020, the average level of R&D investment intensity in China reached 24%, with Beijing at 644%, Shanghai at 471%, Tianjin at 344%, Guangdong at 314%, Zhejiang at 288%, Shaanxi at 242%, Anhui at 228%, and Sichuan at only 217%. This is also the first time that Sichuan has exceeded 2%. Lack of R&D vitality in enterprises. The development and operation of enterprises lack intrinsic motivation for research and development. In 2019, the R&D investment intensity of industrial enterprises above designated size in Sichuan was 0.88%, which was lower than the national average level. In 2019, the expenditure on new product development in Sichuan's high-tech industry was 165.11 billion yuan, far lower than Guangdong (21652.5 billion yuan), Jiangsu

(747.14 billion yuan), and Zhejiang (359.15 billion yuan). Insufficient R&D funding and low enterprise vitality cannot support the high-quality development of Sichuan's industries.

4.2. Insufficient Transformation of Scientific Research Achievements

The major landmark technological achievements in Sichuan are rare, and the innovation driving force for the high-end development of industries is insufficient. Few have fully independent intellectual property rights like 'Hualong One'. There are not many scientific and technological achievements in Sichuan in terms of research results, but truly high-quality achievements are not common. In the 2020 statistics on the application of scientific and technological achievements, it was found that the number of registered works was about ten times that of award-winning works. Unable to fully transform these scientific research achievements, it is impossible to truly achieve high-quality industrial development.

4.3. The Ecosystem of Technological Innovation is Still Not Excellent

The technology innovation ecosystem includes multiple indicators such as the number of institutions, the number of universities, and the number of students enrolled. The system of technology intermediary service institutions and innovation policy system are not sound enough. All technological innovations at home and abroad are basically economic and financial centers, which support the ecosystem of technological innovation. However, the development level of Sichuan's financial industry is still relatively low, and technological finance is not developed enough. The financing environment for technology transfer and transformation is poor. Compared to Beijing, Shanghai, Guangdong and other places, the scale and activity of Sichuan's capital market are still relatively low, and we need to learn from the development experience of other regions. Finally, Sichuan's attraction to high-quality talents is not prominent. Even with the Chengdu Tianfu New Area, there is a high demand for sales and customer service positions in terms of employment opportunities, indicating that there is not enough demand for high-end technical talents, and there are not yet so many positions to meet the needs of job seekers who want to come to Sichuan. In terms of salary, there is still a considerable gap compared to Beijing, Shanghai, Guangzhou, and Shenzhen, but the consumption areas have not decreased either.

5. Suggestions on Countermeasures for Supporting Industrial Development through Technological Innovation

5.1. Increase R&D Investment

During the 14th Five Year Plan period, the planned target for the overall R&D investment intensity in Sichuan Province is 2.4%, which is five years behind the national target. Therefore, the planned target for the overall R&D investment intensity in Sichuan Province can be appropriately increased. In the later stage of the 14th Five Year Plan, we should strive to exceed the national average level, and at the same time, we should increase the proportion of basic research. The composition of R&D funding should also be considered from multiple perspectives. Enterprises, universities, and research institutions are all important entities in technological

innovation. Reasonable investment in R&D funding can fully unleash the potential for technological innovation of each entity. According to the 2021 provincial final accounts report of Sichuan Province, the province's fiscal expenditure on science and technology in 2021 was 27.31 billion yuan, an increase of 9.14 billion yuan or 50.3% from the previous year. The fiscal expenditure on science and technology showed a trend of recovery growth, with a significant increase from negative to positive growth; In 2021, fiscal technology expenditure accounted for 2.43% of general public budget expenditure, an increase of 0.81 percentage points from the previous year. However, the phenomenon of imbalanced funding investment still exists. Taking R&D investment as an example, in terms of total amount, the investment in Chengdu Plain Economic Zone, South Sichuan Economic Zone, Northeast Sichuan Economic Zone, Panxi Economic Zone, and Northwest Sichuan Ecological Demonstration Zone were 102.71 billion yuan, 10.17 billion yuan, 5.89 billion yuan, 2.48 billion yuan, and 210 million yuan, respectively, with an increase of 14.4%, 21.2%, 17.1%, 17.5%, and 16.7%. The investment in the Chengdu Plain is much higher than in other regions, and in terms of growth rate, the South Sichuan Economic Zone has the highest growth rate. Therefore, the funding investment should also be balanced.

5.2. Enhance the Technological Innovation Capability of Enterprises

The important subject of enterprise technological innovation, in the 2020 statistics of technological innovation achievements, 102 enterprise projects won awards, accounting for 38.5% of the total number of awards. The high-quality development of industries must attach importance to the dominant position of enterprises in technological innovation and expand their discourse power in innovation decision-making. In terms of government policy-making, policies can be formulated to incentivize enterprise innovation, support the innovative development of enterprises, support the establishment of innovation consortia, support enterprises in establishing research and development institutions overseas, and achieve global innovation networks. In terms of researchers, it can promote the flow of R&D personnel to enterprises, injecting new vitality into technological innovation in enterprises. Vigorously encourage and cultivate leading enterprises, and use them to drive industry development. Driven by leading enterprises, cultivate and build high-end modern industrial clusters with regional radiation and driving force around strategic technology fields. Drive the development of industrial chains and clusters with innovative leading enterprises. In government procurement (such as new infrastructure construction), it is necessary to clearly increase the proportion of localized product procurement in Sichuan, effectively supporting the development and growth of enterprises.

5.3. Creating an Innovative Ecosystem

We should take the construction of a national science and technology innovation center as the strategic goal, accelerate the construction and improvement of the regional science and technology innovation ecosystem. Technological innovation cannot be separated from university institutions and enterprises. To establish a good ecosystem, it is necessary to strengthen cooperation between university institutions and enterprises, vigorously improve the system design and compatibility of innovation subject development policies,

business environment supervision policies, and technological innovation incentive policies related to technological innovation, cultivate an excellent ecosystem for innovation and entrepreneurship creation, and fully stimulate the vitality of innovation and entrepreneurship creation in the whole society. Ecology cannot be separated from the system. We need to establish a gradient cultivation system for high-tech enterprises, provide targeted services, and promote technological innovation in enterprises. In addition, attention should be paid to basic research and key core technology breakthroughs, mixed ownership reform of job-related scientific and technological achievements, and cultivation of innovative leading enterprises. Provide special funding support and post subsidy support for R&D investment to corresponding enterprises. The related expenses incurred by state-owned enterprises in implementing national and provincial science and technology plan projects, introducing innovative leading talents, and establishing domestic and foreign research and development centers can be regarded as assessed profits. Support the central government to carry out pilot projects for non asset management before the transformation of job-related scientific and technological achievements in research institutions such as universities and colleges in Sichuan and other provinces. Pilot units will not be included in state-owned asset management before the transformation of job-related scientific and technological achievements.

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