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Deep integration of innovation chain and industrial chain

Ren Lulu[1,a,*]

[1]*Hebei University of Engineering, Handan, 056004, China*
[a]*17320695879@163.com*
[*]*Corresponding author*

Abstract: *Promoting the deep integration and development of the innovation chain and industrial chain is of great significance to improving high-quality economic development. This article explains the connotations of innovation chain and industrial chain respectively, and then sublimates the connotation of innovation chain and industrial chain integration. It proposes two integration methods: innovation chain promotes the industrial chain and industrial chain pulls the innovation chain. It points out that the key elements in the integration process of the two chains include: Core technologies, innovation platforms and innovation entities discussed some progress made in the integration process of the two chains, including the continuous growth of entities during the integration process and the effective implementation of major national science and technology projects; and pointed out that there is a "two skins" phenomenon in scientific and technological innovation during the integration process. The scientific and technological innovation platform is not perfect, and the mutual coordination pattern of the industrial chain and innovation chain has not been deepened. Based on the above issues, it is proposed that during the integration process, we should increase R&D investment, improve the conversion rate of scientific and technological achievements, promote the coordinated development of multiple chains, strengthen the construction of innovation platforms, and continue to promote the "chain leader system".*

Keywords: *innovation chain; industrial chain; integration of the two chains; innovation subject*

1. Introduction

The 2022 "Science and Technology Innovation China" annual conference pointed out that it is necessary to strengthen "science and technology innovation" to serve "mass entrepreneurship and innovation", promote the integration of the two chains, and use technological innovation to promote high-quality economic development. The integrated development of the innovation chain and industrial chain is of great significance to building a new development pattern [1]. Promote the integration of the innovation chain and the industrial chain. On the one hand, deploy the innovation chain around the industrial chain, based on the weak links of the industry, so that the innovation chain can effectively support the industrial chain and drive the optimization and upgrading of the industrial chain; on the other hand, lay out the industry with the innovation chain as the center Chain, based on technological innovation, solves the key and difficult points in the industrial chain, gives full play to the supporting role of scientific and technological resources, and realizes the upgrading of the industrial chain. In recent years, my country's industries have developed by leaps and bounds, and the industrial structure has been continuously optimized. However, at the same time, there are also some problems, mainly reflected in the fact that most of my country's industries are still located at the middle and low end of the global value chain, and there is a large gap with developed countries; my country's investment in R&D and innovation is insufficient, the conversion rate of scientific and technological achievements is low, and there are a series of problems such as the "two skins" phenomenon of science and technology and innovation [2]. This article aims to analyze the connotation and methods of innovation chain and industrial chain integration, propose existing problems in the integration process and propose corresponding countermeasures and suggestions.

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2. Integration of industrial chain innovation chain

2.1. The connotation of industrial chain innovation chain integration

In order to explore the connotation of the integration of industrial chain and innovation chain, we should first explore the respective connotations of industrial chain and innovation chain. HIRSCHMAN believes that the industrial chain is a related industry with input-output linkage [3]. Regarding the research on the formation mechanism of industrial chain, Wu proposed that the concept of industrial chain includes four dimensions, namely enterprise chain, value chain, supply and demand chain and space chain. Each chain should correspond to each other. The industrial chain is generated from the coordination of four dimensions. It is the internal law and formal model of the industrial chain mechanism [4]. MARSHALL first proposed the concept of innovation chain, believing that the innovation chain is a series of activities in which multiple innovation entities conduct production and research and development [5]. Xu proposed that the innovation chain is a linear innovation model with multiple links such as basic research, technology research and development, and achievement transformation [6]. Regarding relevant research on the integration of innovation chain and industrial chain, most scholars have discussed the connotation, integration process, integration method and significance of the integration of the two chains. Kuang Maohua analyzed the significance of double-chain integration and proposed that the modes of double-chain integration include innovation chain pushing the industrial chain and industrial chain pulling the innovation chain [7]. Zhang Xiaolan made suggestions for the integrated development of my country's innovation chain and industrial chain by referring to the experience of integrated development of innovation chain and industrial chain in developed countries [8]. This article believes that the integration of innovation chain and industrial chain is not a simple superposition of two chains, but a double helix structure that promotes, collaborates with and develops together.

2.2. Industrial chain innovation chain integration model

2.2.1. The innovation chain drives the industrial chain

This model is mainly applicable to developed countries and multinational companies. The theoretical logic originates from technological innovation first, then industry, promoting the formation of industrial chains. In the end, the two promote each other to form a new industrial chain and a new innovation chain. Developed countries and multinational companies are easy to form technological innovation chains because they have resources such as technology, capital, and talents. Developed countries are often located in the middle and high end of the global value chain and are engaged in R&D and design, which is conducive to promoting industrial transformation and upgrading and optimizing and adjusting industrial structures. , and then continuously realize the upgrading of the industrial chain. Developed countries and multinational companies have solved major technical difficulties in the industrial chain through technological innovation, thereby realizing the optimization and upgrading of the industrial chain. They have used independent intellectual property rights and core technologies to further derive independent and controllable industrial chains. The evolutionary path can be summarized as "basic Research-Technological Innovation-Industrial Chain Upgrading" [9].

2.2.2. The industrial chain drives the innovation chain

This model is mainly applicable to developing countries. The theoretical logic is based on the industrial foundation first, and then technological research on the core links in the industrial chain through technological innovation. Finally, the two promote each other. Due to the spillover effect of technological innovation in developed countries, developing countries continue to absorb foreign innovative technologies, build their own industries, digest and absorb learning through the introduction of technology, solve key problems such as core technology "stuck", and continuously promote the improvement of independent innovation capabilities. , forming a new industrial chain, which is an important way for developing countries to upgrade their industrial chains. The most typical example is HiSilicon, a company established by Huawei. By learning advanced foreign technologies and sorting out the technical difficulties existing in the industrial chain, it eventually no longer relied on foreign technologies and produced its own chips.

2.3. Key elements for the integrated development of the two chains

2.3.1. Core technology

Innovation in the industrial chain includes innovative ideas, creating new products, introducing new technologies, and bringing new knowledge. The most critical step is to achieve technological innovation. By innovating on the middle and low-end links of the industrial chain, we can solve the difficulties in the industrial chain and realize the added value of the industrial chain; and by sharing resources with other

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enterprises in the network, we can play the leading role of leading enterprises, build industrial clusters, and drive regional development. Promote the complementarity and mutual promotion of the industrial chain and innovation chain. The industrial chain does not exist alone, but multiple industrial chains are intertwined and develop collaboratively. Therefore, common technologies in the industrial chain are also indispensable. During the integration process of the two chains, we should focus on common technologies and break through the existing technologies in common technologies to solve key and difficult problems, continuously innovate common technologies, and achieve rapid upgrading and optimization of multiple industrial chains.

2.3.2. Innovation platform

The innovation platform is an innovation carrier that promotes the integration of the innovation chain and industrial chain. Its main function is to integrate various resources in the two chains, including knowledge, technology, information and other resources, and promote the deep integration of the innovation chain and industrial chain. My country's science and technology innovation platform is an infrastructure with functions such as research and development, resource sharing, etc. It mainly includes key laboratories and engineering technology innovation centers. It is the basic guarantee in the integration process of the innovation chain and industrial chain. Countries are committed to building innovation platforms. Among them, the United States has created the "Information Highway" plan, covering infrastructure such as universities and governments, creating a series of platforms for the open sharing of scientific and technological resources across the country; the United Kingdom has built a scientific and technological innovation platform and established professional vertical services. The network platform realizes the integration and exchange of information resources with governments, universities and scientific research institutions. One of the typical cases is Silicon Valley in the United States. Capital investment, technology investment and policy promotion have jointly created the construction of Silicon Valley's innovation platform, and built a number of national key experimental centers and innovation parks.

2.3.3. Innovation subject

The integration process of the industrial chain innovation chain involves the participation of multiple entities, including core enterprises, universities, scientific research institutions, collaborative enterprises, users, etc.

The process of industry-university-research cooperation involves joint collaboration between industry, industry, academia, and industry-research. Universities and scientific research institutions provide core enterprises with knowledge resources and technological innovation. Both can collaborate with enterprises to build innovation platforms. , apply new technologies and new concepts to core enterprises, so that enterprises can continuously use technological innovation to solve key and difficult problems in the industrial chain, and achieve upgrading and optimization of the industrial chain. Collaborating enterprises and core enterprises cooperate with each other to exchange knowledge and information and other advantageous resources to achieve innovation in the industrial chain. As consumers of the products supplied by the core enterprise, users' feedback provides a basis for the strategic planning of the core enterprise, making the strategic layout more reasonable and effective. The government and intermediaries do not directly participate in industry-university-research cooperation. The government can promote cooperation between industry, academia and research by formulating relevant policies, such as by formulating relevant talent introduction policies to achieve the gathering of human resources, and by implementing preferential tax policies to achieve the establishment of industrial clusters. Innovative entities need to invest a large amount of funds in early stage research and development, and financial intermediaries assume the role of fund providers, providing effective support for enterprises' innovation activities, ensuring the orderly operation of the capital chain, and enhancing the original innovation power of core enterprises. Therefore, multiple entities such as universities and scientific research institutions, governments, collaborative enterprises, financial intermediaries, and users work together to achieve technological innovation in the industrial chain, thereby promoting the in-depth integration of the two chains.

2.4. The current progress in the integration of my country's industrial chain innovation chain

2.4.1. The main body continues to grow in the process of integration of industrial chain innovation chain

The country has always placed innovation at the center of the overall national development, continuously increased investment in innovation, accelerated the cultivation of innovative subjects, and gradually optimized the innovation ecology. Since the implementation of the "Chain Leader System" in 2019, some leading enterprises have served as chain owners, which has promoted the development of regional economy to a certain extent, solved the difficulties in the development of small and medium-

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sized enterprises, and formed cities such as Wuhan's "Optical Valley" and Hefei's "Sound Valley". "And other science and technology industry cluster areas have driven the innovative development of upstream and downstream enterprises. Secondly, the development of "specialized, specialized and innovative" small and medium-sized enterprises should be accelerated, the cultivation of high-quality small and medium-sized enterprises should be accelerated, the technical difficulties and product production problems in the industrial chain of manufacturing enterprises should be solved, the optimization and upgrading of the industrial chain of small and medium-sized enterprises should be improved, and the deep integration of the innovation chain and industrial chain should be promoted.

2.4.2. Effective implementation of major national science and technology projects

The country has formulated two batches of major national special projects. The first batch is 16 major national special projects from 2006 to 2020, and the second batch is 16 major national special projects from 2016 to 2030. The implementation of the first batch of major special projects has been completed, and the second batch of major national special projects has been completed. A number of major projects are being carried out continuously. From 2017 to 2020, a total of 1,149 topics were implemented and a total of 179,300 projects were funded. The implementation of major national science and technology projects provided good support for innovation activities and promoted the deep integration of the industrial chain innovation chain. In order to treat reflux esophagitis, Luoxin Pharmaceutical developed Taixinzan, the first independently developed competitive acid blocker in China; my country successfully launched a hyperspectral observation satellite using a launch vehicle, opening up new opportunities for remote sensing observation in my country research fields.

3. Existing problems in the integrated development of industrial chain innovation chain

3.1. The phenomenon of "two skins" in scientific and technological innovation is serious

Although there are multiple innovation entities involved in the integration process of the two chains, the goals pursued by each entity are different, and the relevant entities lack the willingness to integrate. As a profit-making unit, enterprises often pay more attention to economic interests. Pilot trials in the innovation chain The work is characterized by high investment and high risks, and companies are often unable to withstand the pressure of funds; universities and scientific research institutions often apply for projects in pursuit of ratings and evaluations, but are shelved after the project is completed, resulting in a waste of R&D resources and a very low conversion rate of scientific and technological achievements. , universities, scientific research institutions and enterprises have not achieved effective connection. All of the above have caused a mismatch between R&D institutions and production institutions, and scientific and technological innovation has "two skins" [10].

3.2. The scientific and technological innovation platform is imperfect.

The country's scientific and technological innovation platforms tend to focus on basic research and applied research. They provide insufficient support for pilot testing and achievement transformation, and lack in-depth cooperation with enterprises. As a result, R&D results are placed in laboratories and the transformation rate of scientific and technological achievements is low. In addition, the innovation resources of some universities are closed to enterprises, and resource sharing is insufficient, making it difficult for enterprises to access the resources and complete the transformation of innovative results. As of the end of 2021, my country has a total of 1,287 national-level technology business incubators and 1,636 national enterprise technology centers, but there is still some gap with the nearly 1,500 technology business incubators in the United States.

3.3. The pattern of mutual collaboration between the industrial chain and innovation chain has not yet been deepened.

The country has mainly formed industrial clusters and innovation demonstration zones centered on the Beijing-Tianjin-Hebei, Shenzhen Economic Development Zone, and the Yangtze River Delta. By the end of 2021, cities such as Beijing and Shanghai have been among the top ten global science and technology clusters, and advantageous resources are mainly concentrated in core cities. , high-tech enterprises also mostly gather in these areas, which is not conducive to the balanced distribution of regional resources, causing differences in the integrated development of the two chains. In the development of regional economy, the resources of the industrial chain innovation chain are mostly focused on leading enterprises and core enterprises. It is still necessary to play the demonstration role of leading enterprises to drive overall development so that more enterprises can participate in the collaborative innovation network and utilize the network. Acquire and exchange innovative resources to

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achieve technological innovation, thereby promoting the upgrading of the enterprise's industrial chain, solving the difficulties encountered in enterprise development, and promoting the in-depth integration of the two chains.

4. Measures and suggestions

4.1. Increase investment in research and development

R&D investment is the basic guarantee for innovation activities, so sufficient funds should be provided during the integration of the innovation chain and industrial chain. Scholars generally divide the innovation chain into stages such as innovative ideas, basic research, applied research, technology development and product production. China is often located at the middle and low end of the global value chain, and there is a big gap with developed countries. Its main business is production and terminal sales, and it is less involved in core technologies such as R&D. Therefore, it should increase investment in R&D and continue to absorb and learn advanced foreign technologies. , continue to tackle key difficulties in the industrial chain, promote industrial transformation and upgrading, and gradually extend my country's industrial chain to the core links.

4.2. Improve the transformation mechanism of scientific and technological achievements

The transformation of scientific and technological achievements refers to the process of applying innovative R&D results to products to achieve continuous improvement of corporate benefits. It is a key step in the integration process of the innovation chain and industrial chain. Universities and scientific research institutions should strengthen the concept of openness and sharing and work together with enterprises. , so that enterprises have channels to obtain scientific and technological innovation resources from universities and scientific research institutions, and ensure effective connection between production institutions and R&D institutions. At the same time, universities should not only focus on "production" and "research", but also put "use" equally on first place. While ensuring economic interests, enterprises should put innovation first. Only through continuous technological innovation can we tackle key and difficult problems in the industrial chain and achieve economic benefits more effectively. Only by collaboration between universities and enterprises can the “last mile” of transformation of scientific and technological achievements be realized.

4.3. Promote the coordinated development of multiple chains

In the process of integrating the innovation chain and industrial chain, it is necessary to combine the capital chain, talent chain, and policy chain for common development, of which the innovation chain and industry chain are the main bodies, and the capital chain, talent chain, and policy chain collaborate to provide effective support for their integrated development. Financial intermediaries should assume the role of capital suppliers. The government, as the "invisible hand", should strengthen the design of top-level systems to achieve a reasonable allocation of innovation resources so that enterprises dare to undertake pilot tests in the innovation chain. At the same time, it should strengthen high-end. We will cultivate talents at all levels and increase efforts to introduce talents to provide basic guarantee for the integrated development of the innovation chain and industrial chain.

4.4. Strengthen the construction of innovation platforms

The innovation platform is an important carrier for the collaborative development of the innovation chain and industrial chain, and its forms are constantly enriched. It mainly achieves the integrated development of the innovation chain and the industrial chain by building innovation resource gathering platforms, national key laboratories, national incubator centers, etc. The integration of the innovation chain and industrial chain is not only susceptible to the influence of internal innovation entities, external carriers also play a crucial role in its development. Therefore, we should strengthen the construction of innovation platforms to provide basic guarantees for the optimization and upgrading of the industrial chain.

4.5. Continue to promote the “chain length system”

The main person in charge of the government agency plays the role of "chain leader", coordinates the allocation of various advantageous resources, makes full use of resources, encourages and accelerates the cultivation of a group of industry leading enterprises and core enterprises, and plays the role of "chain leader", who occupies an important position in the industrial chain. important position, we should give

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full play to the leading role of leading enterprises, eliminate disadvantageous links, reflect the leading advantages of leading enterprises, enable other enterprises to develop and form industrial clusters, thereby driving regional economic development and opening up pain points and blocking points in the industrial chain. , difficulties, to achieve solid, strong and stable chains, enhance the international competitiveness of the industrial chain, so that China's industrial chain is not limited to the production and sales links, promote the gradual expansion of the industrial chain upstream and downstream, and achieve high-end development of the industrial chain, Shorten the gap with developed countries.

5. Conclusion

In recent years, my country's innovation chain and industrial chain integration have made unprecedented progress. After continuous reforms, the country has established many forms of innovation platforms. R&D investment has increased year by year, and investment in basic research and applied research has been continuously strengthened. However, compared with developed countries, there are still Large gap. Our country should strengthen the efficient integration of the innovation chain and industrial chain by improving the resource sharing system of universities, continuing to increase investment in R&D, improving the conversion rate of scientific and technological achievements, implementing the "chain length system", promoting the coordinated development of multiple chains, and building an innovation platform. Continuously carry out technological innovation on key and difficult points in the industrial chain, continuously promote the upgrading of the industrial chain, and promote the adjustment of the industrial structure.

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