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Research on Promoting the Deep Integration of the "Four Chains" in Shaanxi Province

Yan Ma[1,2,a], Wei Tang[1,2,b,*], Jiajia Lv[1,2,c]

[1]School of Accounting and Finance, Shaanxi Business College, Xi'an, Shaanxi, China
[2]School of Accounting and Finance, The Open University of Shaanxi, Xi'an, Shaanxi, China
[a]3163780550@qq.com, [b]tangwei070504@126.com, [c]anintendo@126.com
[*]Corresponding author

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Abstract: In the new era, China's economy is moving towards high-quality development. Shaanxi, as the "bridgehead" of western development, the core area and advanced manufacturing base of "One Belt and One Road", has a complete industrial system, with the advantages of factors, favorable policies and extroversion model, and the rapid development of industry and innovation. For example, there are a considerable number of scientific and technological smes, high-tech enterprises and listed enterprises on the science and technology innovation board before October 2022. However, compared with Guangdong, Jiangsu and Zhejiang, there is a gap in the "four-chain" integration, and there are core capabilities, collaborative supporting and mutual integration mechanisms, which promote its deep integration into the key to high-quality development of manufacturing industry, so relevant research is urgent. Starting from the current situation and problem analysis of Shaanxi's "four chains", this paper designs the realization path from the construction of high-quality industrial chain and innovation chain, highly enriched capital chain, and high-level talent chain, and establishes four mechanisms: market-led, innovation-driven, platform support, and policy guarantee. Theoretically, explore new models, new formats, new paths and key factors, effects and mechanisms to enrich the theoretical connotation; In practice, it provides support and suggestions for government planning policies, industrial restructuring and cultivation, enterprise technology and product innovation and high-quality development, helps Shaanxi achieve reasonable layout and deep integration of "four chains" under the dual-cycle pattern, enhances industrial competitiveness, leads the new direction of economic development driven by innovation, stands out in regional competition, and contributes to the high-quality development of the national economy. We will create a new situation of coordinated industrial development, promote the transformation and upgrading of the economic development model, achieve optimal allocation of resources and sustainable development, enhance Shaanxi's position and influence in the global industrial chain, build industrial clusters with unique advantages, and foster new driving forces for innovation and development.

1. Introduction

Shifting from high-speed growth to high-quality development is the distinctive feature and inevitable requirement of China's economic development in the new era. In the report, it is proposed to promote the deep integration of the innovation chain industrial chain capital chain talent chain (referred to as the "four chains"). Industry is the carrier of economic development, innovation is the first driving force leading development, capital and talent as two key support, the deep integration of the "four chains" is not only an important measure to build a new development pattern, but also an important support for building a modern system. Therefore, how to deeply integrate the "four chains" has become an important problem to be solved urgently. As the "bridgehead" of the national western development strategy and the core area of the "Belt and Road" Initiative, Shaanxi is also an important national advanced manufacturing base, and has established a relatively complete modern industrial system[1]. In recent years, with its own factor endowment advantages, the "depression" effect of preferential policies, and the outward development mode actively integrated into the "Belt and Road" Initiative, Shaanxi has entered the fast track of industrial development and increasingly active technological innovation[2]. As of October 2022, more than 14,700 technology-based smes in Shaanxi have been evaluated to be in storage; More than 5,900 high-tech enterprises have been evaluated; The number of listed enterprises on the Science and Technology Board (over the meeting)reached 12, ranking at the forefront of the west. However, there is still a significant gap between Shaanxi and Guangdong, Jiangsu, Zhejiang and other regions in the integrated development level of "four chains", showing the typical characteristics of "lack of core capabilities, insufficient coordination and support, and lack of mutual integration mechanism"[3]. How to promote the deep integration of "four chains" has become the key to leading the high-quality development of Shaanxi manufacturing industry. In summary, it is urgent to study the path and mechanism of the "four-chain" deep integration drive.

2. Research Significance

At present, China is in a critical period from a manufacturing power to a manufacturing power and a science and technology power, promoting the synergy of the industrial chain, innovation chain, capital chain and talent chain is the key support for achieving high-quality development and building a modern industrial system[4]. The report of the Party's 20th National Congress also clearly requires "accelerating the implementation of the innovation-driven development strategy" and "promoting the deep integration of the innovation chain industrial chain capital chain talent chain". From the connotation, the process of "four chains" integration mainly includes two stages of development, the first stage is mainly each chain in accordance with its own development law into a separate chain. The second stage is guided by the national strategy, focusing on major areas related to the national economy, people's livelihood and the lifeline of the economy, and carrying out accurate docking and integration construction of the industrial chain, innovation chain, capital chain and talent chain in relevant fields, so as to achieve a virtuous cycle, effective penetration and deep integration[5]. The integration of the "four chains" plays an important role in promoting economic development in building a new development pattern, building a modern industrial system, and improving the national innovation system[6].

(1)Theoretical significance: On the one hand, explore the new mode, new business form and new path of the integrated development of Shaanxi's "four chains"; On the other hand, this paper explores the key factors, effects and driving mechanism of the deep integration of Shaanxi's "four chains", and the research results help to enrich the theoretical implications of the deep integration and development of Shaanxi's "four chains" under the new dual-cycle development pattern, and provide a theoretical basis for the rational layout and deep integration and development of Shaanxi's

"four chains".

(2)Practical significance: At the government level, the study of Shaanxi's "four-chain" deep integration mechanism can provide intellectual support for the government to formulate Shaanxi's "four-chain" deep integration planning and policy adjustment; At the industrial level, it provides a reference mechanism for promoting the deep integration, reconstruction, cultivation and development of Shaanxi's "four chains"; At the enterprise level, it can provide measures and suggestions for R&D entities to achieve technological breakthroughs, product innovation and commercialization, and enterprises to achieve high-quality development[6].

3. The realization path of Shaanxi's "four-chain" deep integration

3.1. Build a high-quality industrial chain, and deploy an innovation chain around the industrial chain

In order to promote industrial innovation and development, China needs to aim at the global frontier, rely on its own industrial scale, supporting and first-mover advantages in some fields, improve the self-sufficiency rate of upstream R & D and design, enhance the "original creativity" of technology and the "transformation" of results, and accelerate the creation of an emerging industrial chain, and promote the deep integration of the Internet, big data, artificial intelligence and various industries[7]. Guide innovation resources to the upstream and downstream enterprises in the industrial chain, and build research and development institutions based on enterprises[8]. In enhancing the dimension of independent research and development, it is necessary to increase investment in basic research and applied basic research, create a good research environment for universities, scientific research institutions and enterprises from the aspects of funds and policies, and support them to carry out frontier and key core technology research, such as Shaanxi scientific research team can in-depth exploration in new materials, new energy, biomedicine and other fields[9]. At the same time, strengthen the construction of intellectual property protection system, improve laws and regulations, crack down on infringement, set up incentive mechanisms and tax incentives, and build trading platforms, so as to enhance the autonomy and independence of technological innovation, and help build high-quality industrial and innovation chains[10]. Deep integration of technology and production, the integration of the Internet, big data and artificial intelligence with various industries is the trend of The Times[11]. The traditional manufacturing industry in Shaanxi can realize intelligent production management through digitalization, the agriculture uses big data for precision planting and breeding, and the service industry uses artificial intelligence for innovation and development, such as finance, medical care, education, tourism and other fields[12]. This integration can promote industrial transformation, upgrading and innovation, enhance core competitiveness, and provide support for the construction of industrial chains and innovation chains[13].

3.2. Build a high-level innovation chain, and lay out the industrial chain around the innovation chain

Under the guidance of the goal of comprehensively improving the ability of independent innovation, the technological innovation and achievement transformation of enterprises should be closely linked to the national strategy and market demand, focusing on the key areas and core technologies of the industry, and actively layout strategic emerging industries and future industries, so as to breed a number of key technologies with originality and leadership, and drive the optimization and development of the industry with the science and technology supply of the innovation chain[14]. In the independent innovation-oriented dimension, it is necessary to have a

keen industry insight and forward-looking thinking, and accurately focus on the key areas that determine the direction of the industry and the core technologies that build core competitiveness, such as precision machining and intelligent control technology in the field of high-end equipment manufacturing in Shaanxi Province, and chip design and manufacturing in the electronic information industry and a new generation of communication technology[15]. At the same time, it should focus on strategic emerging industries and future industries such as new energy, new materials, biomedicine and artificial intelligence[16]. Taking Shaanxi as an example, it can rely on its own scientific research and industrial foundation to build industrial clusters in the field of new energy, promote industrial upgrading in the field of new materials, cultivate core enterprises in the field of biomedicine, and promote integration with traditional industries in the field of artificial intelligence[17]. According to this, we continue to optimize the direction of innovation, inject lasting impetus into the development of the industry, based on the current industrial foundation, and aim at future development opportunities[18]. Focusing on key areas and forming original leading key technologies are the core elements of enhancing industrial competitiveness. This needs to stimulate innovation vitality by increasing research and development investment, attracting high-end talents, strengthening industry-university-research cooperation and other measures, and then create key technologies with independent intellectual property rights[19].

3.3. Build a highly enriched capital chain and promote the deep integration of innovation chain and capital chain

In the process of industrial and innovation development, it is of great significance to rationally distribute the capital chain around all links of the industrial chain and innovation chain. In terms of reasonable allocation of funds, it is necessary to thoroughly analyze the characteristics, needs and opportunities of the industrial chain and innovation chain according to the current economic situation, abandon the traditional extensive model, carefully plan the flow of funds, give precise policies, and focus on supporting key weak links, such as the case of funding support in the field of chip manufacturing and artificial intelligence in Shaanxi high-tech industry. This is the only way for industrial innovation and development and high-quality economic growth[20]. Increasing investment in scientific and technological innovation is also a key move, which is the core driving force to promote scientific and technological progress and industrial upgrading. In terms of increasing R&D investment, it is not only necessary to strengthen government financial investment in industrial basic research and give full play to its basic and leading role. For example, Shaanxi has set up special scientific research funds for advantageous industries such as aerospace and electronic information to fund research on key technologies and enhance core competitiveness. Social capital should also be guided to participate by means of tax incentives, subsidies, procurement and other means. We will improve the system of scientific and technological financial services, build a diversified investment pattern, and make the government and social capital complement each other to jointly promote the development of scientific and technological innovation. It is also indispensable to build a diversified investment and financing system platform that can cover all links of the "four chains"[21]. This platform should be comprehensive and inclusive, integrating financial resources such as bank credit, venture capital, and capital market financing, and breaking down barriers to form synergy.

3.4. Build a high-level talent chain to provide talent support for the industrial chain innovation chain

In the general pattern of industry and talent development, laying out talent chain around the industrial chain, and relying on the talent chain to empower the industrial chain, is the core strategy

to achieve synergistic development of the two. In terms of the concentration of scientific and technological talents, in the current complex and changing economic environment, in-depth insight into the talent needs of all links of the industrial chain and accurate allocation of talent resources are of great importance to industrial competitiveness and sustainable development. It is important to encourage the flow of scientific and technological talents to the industrial front line, which is the key position of scientific and technological innovation and transformation, where talents can directly tackle technical problems and market demand, and display professional capabilities. To this end, it is necessary to introduce preferential policies such as housing subsidies, children's education concessions, tax deductions and other preferential policies, while strengthening the construction of industrial parks and enterprise scientific research environment, providing advanced equipment and good atmosphere, such as Shaanxi for key industries to implement talent introduction plan, attract talents at all levels, inject impetus into industrial technological innovation. Promote the deep integration of the talent chain and the industrial chain, build the ecology of "gathering talent by production, generating production by talent, and integrating talent into production", the cooperation mechanism of production, university and research can promote the exchange of talents, and the personnel of enterprises and university scientific research institutions can learn from each other, and the construction of industrial clusters can also attract talents to gather and form scale effects, like the semiconductor industry cluster, to provide broad space for talents[22].

4. Driving mechanism of the deep integration of "four chains" in Shaanxi

4.1. Market-led mechanism

It is essential to build a market-led competitive neutral mechanism. This requires eliminating ownership discrimination, promoting market-oriented reform of state-owned enterprises, increasing policy support for private enterprises, such as ensuring equal competition opportunities for all types of enterprises in advanced manufacturing, and strengthening intellectual property protection to optimize resource allocation, promote the integration of "four chains", improve Shaanxi's competitiveness in the double cycle, and achieve high-quality development. The birth mechanism of new industries, new business forms and new models is a new engine for economic development. Shaanxi should make efforts in policy, industry-university-research cooperation, and innovation and entrepreneurship ecology, such as supporting technology research and development and application in the field of digital economy, strengthening the construction of industry-university-research cooperation alliances, building platforms such as maker Spaces, attracting capital and talents to gather in emerging fields, forming a new "four-chain", and building a modern industrial system. The Belt and Road Initiative has brought great opportunities to Shaanxi. With its location and cultural advantages, Shaanxi should strengthen cooperation with countries and regions along the routes in infrastructure, trade, industry and humanities, such as building international logistics hubs, expanding exports of featured products, promoting two-way industrial investment, and holding cultural and academic activities, so as to expand market space, accelerate the integration of "four chains" and enhance international influence.

4.2. Innovation-driven mechanism

Shaanxi's innovation-driven mechanism is mainly carried out from the following five aspects: First, the key core technology "horse racing" and "revealing-ranking" mechanism. In the process of promoting the integration of the "four chains", the "horse racing" mechanism stimulates multiple teams or enterprises to compete in the same technical field, prompting them to optimize their schemes, improve efficiency and quality, and expand innovative ideas; The mechanism of

"uncovering the list" collects solutions to key problems from the society to attract top teams to overcome difficulties, such as Shaanxi semiconductor industry to promote advanced process research and development and solve high-end chip packaging and testing problems, not only to break through technical bottlenecks, promote technology diversification, but also to provide support for industrial chain upgrading, enhance the core competitiveness and sustainable development ability of the industry. The system mechanism of "one institute, one institute" is an effective mode of innovation in Shaanxi Province, aiming to integrate the resources of research institutes and enterprises and realize the deep integration of production, university and research. Scientific research institutes rely on academic accumulation and research capabilities to provide technology and ideas for enterprises, and enterprises give play to market perception and industrialization capabilities to transform results into products and benefits. For example, a scientific research institute cooperates with enterprises in the field of new materials, establishes R & D centers and production bases, accelerates the integration of innovation chain and industrial chain, improves industrialization efficiency, and creates conditions for the coordination of capital chain and talent chain, attracts capital and talent, and promotes the sustainable development of innovation. The "two industries" integration mechanism is of great significance to the "four chains" integration of Shaanxi, that is, to promote the deep integration of advanced manufacturing and modern service industries. The advanced manufacturing industry opens up application scenarios for the modern service industry, and the modern service industry provides service support and expands value-added space for the advanced manufacturing industry.

4.3. Platform Support Mechanism

Shaanxi's platform support mechanism is mainly reflected in the following four key aspects: First, the resource pooling mechanism of Qin Chuangyuan innovation-driven platform plays a core role. It deeply integrates the scattered scientific research, industrial, financial and human resources in Shaanxi, breaks the barriers of factors, establishes a scientific allocation system, accurately insights the needs of projects and enterprises, provides a full range of resource support, such as providing venues, equipment, funds and talents for start-ups, and promotes resource sharing and cooperation between universities, scientific research institutions and enterprises to accelerate the transformation of scientific research results. To lay a solid foundation for the integration of the "four chains", inject innovation vitality and development momentum, and promote economic development and industrial upgrading. Second, the government-industry-university-research collaborative innovation mechanism provides an important guarantee. This mechanism will closely connect the government, universities, scientific research institutions, enterprises and users to form a synergy of innovation. Government leads the way, provides funding and optimizes the environment; Universities and research institutions provide theory and technology as the source of scientific research. Enterprises achieve industrialization results, feedback market demands, users participate in innovation, and provide demand information. This article takes the field of new energy vehicles as an example. Government subsidies, university research, enterprise production, and user feedback jointly promote industrial upgrading, build a complete innovation ecosystem, and facilitate the integrated and innovative development of the "four chains" in Shaanxi. Third, the "industrial fund +VC+PE+ credit + guarantee" risk sharing mechanism builds a financial support system. Industrial funds support key industrial projects and guide industrial direction; VC and PE invest in early - and growth-stage companies, providing capital, experience and resources; Credit institutions provide traditional loans to ensure the operation of enterprises; Credit increase of guarantee institutions helps enterprises to raise financing.

4.4. Policy safeguard mechanism

First, the mechanism of attracting talents and recruiting wisdom in "talent enclaves" has become an important means to promote the integration of "four chains". By setting up research and development institutions and other "enclaves" in areas rich in talents, Shaanxi has formulated policies such as capital subsidies, tax incentives and project funding, built a talent service system, guaranteed housing, medical care and children's education, and strengthened cooperation with "enclaves" to build exchange platforms. This mechanism breaks through geographical restrictions, attracts high-end talents, makes up for the shortcomings of local talents, accelerates the integration of innovation chain and industrial chain, supports the coordination of capital chain and talent chain, and injects vitality into industrial development. Second, the transfer and transformation mechanism of scientific and technological achievements in the three institutional reforms is crucial. Reform of the property rights, evaluation and conversion income distribution system of post scientific and technological achievements, clarify the ownership of property rights, build a scientific evaluation system, optimize income distribution, stimulate the enthusiasm of researchers, improve the conversion rate and industrialization level of results, promote the combination of scientific and technological achievements and industrial demand, promote the deep integration of innovation chain and industrial chain, and attract capital and talent participation. Third, the "one enterprise, one policy" mechanism for stabilizing growth and promoting development is highly targeted. Shaanxi formulated policies according to the characteristics and needs of different enterprises, and provided financial subsidies, tax relief and other assistance to key enterprises after investigation and analysis. Support the cultivation of small and medium-sized enterprises and provide entrepreneurship counseling and other services. The mechanism precisely fits the demands of enterprises, improves the effectiveness and pertinency of policies, promotes the innovation and development of enterprises, and promotes the coordination and integration of the "four chains".

5. Conclusions

In the in-depth exploration of the innovation ecosystem, it is not difficult to find that the industrial chain, innovation chain, capital chain and service chain constitute its core elements, and these elements show significant consistency and compatibility in connotation and development path. Further promoting the "four-chain" integration process is undoubtedly a key measure to improve the overall efficiency of the innovation ecosystem. In fact, it is the steady development of each of the "four chains" and the close interaction and function between them that have powerfully driven the expansion of the industrial scale and the jump in the level of the innovation ecosystem. In essence, the core of the "four-chain" integration lies in the continuous deepening of cooperation and the continuous improvement of the level of collaboration between various innovation entities, such as enterprises, universities, research institutes, intermediaries, service institutions, innovation alliances, venture capital institutions and financial institutions. With the construction and analysis of the framework model, we further clarified the characteristics and laws of the integration of "four chains" : First, the industrial chain is like the leader in the "four chains", pointing out the direction for the entire system by virtue of its leadership and dominance; Second, the innovation chain is at the key connecting point of the "four chains", and as the core link within the scientific and technological innovation ecosystem, it is the source power for the vigorous development of the industrial chain. Third, the service chain plays the role of "adhesive", and its construction focuses on cooperation and complementarity, guided by service systemization, and realizes effective connection between various chains through industry and cross-industry service alliances and associations; Fourth, the agglomeration area of innovation carriers such as industrial clusters, innovation clusters, industrial bases and science and technology parks has built an indispensable

spatial foundation for the deep integration of "four chains". Fifth, industry-university-research cooperation organizations, large platforms for industrial R&D transformation (covering industrial research institutes, advanced technology research institutes, industrial research institutes, etc.), innovation alliances and large enterprises, etc., constitute the key nodes for the deep integration of innovation chain and industrial chain; Sixth, as the core subject of technological innovation, the comprehensive ability and number of innovation subjects in the region are directly related to the success or failure of the "four-chain" integration, and become the key factor determining the success of this process.

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