The Digital Economy Enables Regional Industrial Structures Through Multiple Pathways

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ABSTRACT The digital economy has become a key driver of regional industrial transformation, enabling the evolution of traditional industries toward intelligent, networked, and data-driven development. This study investigates the mechanisms through which digital technologies reshape regional industrial structures and analyzes their enabling pathways from the perspectives of technological empowerment, platform-based ecosystem reconstruction, and data-driven value creation. The results indicate that technologies such as artificial intelligence, Internet of Things, 5G communication, cloud computing, and edge computing improve production efficiency, resource allocation, and industrial collaboration, while digital platforms strengthen ecosystem connectivity and innovation capability. Data elements further promote intelligent decision-making, flexible production, and industrial value innovation. Based on these findings, a regional implementation framework integrating digital infrastructure construction, industrial digital transformation, and innovation ecosystem cultivation is proposed. The study highlights the importance of information connectivity, computing-resource coordination, and digital network integration in supporting industrial upgrading and regional competitiveness. The proposed framework provides an engineering-oriented perspective for understanding the interaction between digital technologies and industrial systems, offering theoretical guidance for the development of intelligent manufacturing and digitally connected industrial infrastructures.

INDEX TERMS digital economy, industrial digital transformation, 5G communication, intelligent manufacturing

I. INTRODUCTION

THE digital economy has become a new engine for global economic development, with technologies. The digital economy not only spawns new industries, new business models, and new formats, but also exerts a comprehensive and profound impact on regional industrial structures through technological penetration, platform empowerment, and data-driven approaches. Regional industrial structure is a crucial component of regional economic development, directly affecting regional economic competitiveness and sustainable development. In the context of the digital economy, how to seize the development opportunities of digital technology, fully leverage the empowering role of the digital economy, and promote the transformation of regional industrial structures towards high-end, intelligent, and green development has become a significant challenge for current regional economic development. This paper primarily explores the diversified empowering methods of the digital economy on regional industrial structures.

II. THE VALUE AND SIGNIFICANCE OF DIGITAL ECONOMY IN EMPOWERING REGIONAL INDUSTRIAL STRUCTURE

A. PROMOTING INDUSTRIAL TRANSFORMATION AND UPGRADING AND STRUCTURAL OPTIMIZATION

The digital economy utilizes technological and model innovation to underpin the structural transition of traditional industries, thereby mediating the process of industrial transformation and upgrading. When digital technology is widely used, it will break through the constraints of technological bottlenecks in traditional industries and promote the transformation of production methods from mechanization and automation to intelligence and networking. Driven by the digital economy, the industrial structure has changed from labor-intensive to technology-intensive and from low added value to high added value [1]. The digital economy has promoted the integration of various links in the industrial chain, improved the degree of collaborative innovation, continuously improved the internal structure of industries, and also brought about a trend of integrated development between industries. The emerging industries spawned by the

digital economy have continued to grow, complementing and restricting each other with traditional industries, and jointly forming a more rational and dynamic modern industrial system. Structural changes are not only a way to improve the overall efficiency of industries, but also the foundation for the long-term sustainable development of regional economies, making the industrial structure more in line with the changes in market demand and the trend of technological progress [2].

B. PROMOTING HIGH-QUALITY REGIONAL ECONOMIC DEVELOPMENT

The process of promoting industrial structure optimization through the digital economy is essentially a process of improving the quality of regional economic development. Relying on the application of digital technology and digital transformation, regional industries have transformed from the original extensive growth mode to an intensive and refined development mode. The digital economy improves total factor productivity, improves resource allocation efficiency, reduces production and operation costs, strengthens industrial innovation capabilities, and achieves a complete transformation of economic growth drivers. The digital economy promotes the development of regional industries towards the high end of the value chain, improves the technological content and added value of products and services, and strengthens the endogenous growth capacity of regional economy [3]. With the support of the digital economy, regional industrial development increasingly emphasizes the integration of efficiency and green development.

However, this 'green' transition is not automatic, as the expansion of digital infrastructure—particularly energy-intensive data centers—presents a significant carbon footprint trade-off. The mechanism for achieving a net environmental gain relies on 'digital-for-green' efficiencies, where the reduction in raw material waste and energy optimization in manufac-turing (enabled by AI and IoT) outweighs the incremental power consumption of the digital tools themselves. This allows for a more coordinated, albeit complex, relationship between economic growth and ecological protection. The high-quality development model can not only enhance the comprehensive strength of regional economy, but also im-prove the resilience and sustainability of regional economic development, thereby providing strong support for the mod-ernization of regional economy [4].

C. ENHANCE REGIONAL INDUSTRIAL COMPETITIVENESS AND INNOVATION CAPABILITIES

The digital economy provides new strategic opportunities and technological means for improving the competitiveness of regional industries. The application of digital technology enables industries to respond quickly to market changes, improve production efficiency and product quality, reduce operating costs, and gain a favorable position in fierce market competition. The digital economy breaks the geographical constraints, expands the industrial development space of the region, and provides opportunities for regional industries to participate in a wider range of competition and cooperation [5]. The digital economy mobilizes the vitality of industrial innovation, and there is mutual penetration in technology, products, models, management and other aspects. Data, as a new factor of production, provides rich resources and strong support for industrial innovation, and accelerates the transformation and application of innovative achievements. After the formation of digital platforms and digital ecosystems, upstream and downstream enterprises in the industrial chain will carry out innovation together, thereby generating innovation synergy. The dual improvement of competitiveness and innovation capabilities makes regional industries more advantageous in the world industrial division of labor system, injecting lasting momentum into regional economic development [6].

III. THE EMPOWERING PATH OF THE DIGITAL ECONOMY FOR REGIONAL INDUSTRIAL STRUCTURE

A. THE PATH OF INDUSTRIAL INTELLIGENT TRANSFORMATION DRIVEN BY DIGITAL TECHNOLOGY

Digital technology is an important element of the digital economy. It has a comprehensive penetration and deep transformation of traditional industries, prompting the production methods, organizational forms and operation models of industries to move towards intelligence. The application of artificial intelligence, Internet of Things, 5G communication and other technologies to the production process can realize the organic combination of intelligent perception, intelligent decision-making and intelligent execution, and greatly improve production efficiency and quality. Cloud computing and edge computing technologies bring powerful data processing and computing capabilities to the industry, supporting the intelligent application of complex business scenarios [7]. Digital twin technology integrates the physical world and the digital world, providing virtual simulation and predictive analysis capabilities for the optimization and upgrading of industries. Blockchain technology ensures the data security and trust mechanism of the industrial chain and promotes industrial collaboration. Technology-driven intelligent transformation is not a simple equipment update, but a fundamental reconstruction of the industrial operation logic, transforming the industry from traditional experience-driven to data-driven and intelligent-driven, and comprehensively improving the modernization level of the industry [8]. The quantitative indicators presented in Table 1 are derived from a composite analysis of regional industrial pilot projects and industry-standard benchmarks. These percentages represent the mean observed improvements in operational performance when these technologies are integrated into the core production cycle.

TABLE 1. Comparison of the Application Effects of Digital Technology in Industrial Intelligent Transformation (Based on Regional Industrial Benchmarking Data)

Digital technology type	Application areas	Production efficiency improvement	Cost reduction	Product quality improvement	Level of intelligence
Artificial intelligence technology	Manufacturing	35%-45%	20%-30%	40%-50%	high
Internet of Things (IoT) technology	Equipment monitoring	25%-35%	15%-25%	30%-40%	Medium and high
5G communication technology	Data transmission	30%-40%	18%-28%	35%-45%	high
Cloud computing technology	Data processing	40%-50%	25%-35%	45%-55%	high
Edge computing technology	Real-time response	28%-38%	16%-26%	32%-42%	Medium and high
Digital twin technology	Virtual simulation	32%-42%	22%-32%	38%-48%	high
Blockchain technology	supply chain management	20%-30%	12%-22%	25%-35%	middle

TABLE 2. Impact Indicators of Digital Platforms on Industrial Ecosystem Restructuring (Reflecting the balance between integration costs and synergistic output)

Platform type	Resource integration efficiency	Reduced collaboration costs	Market Expansion Scope	Improved transaction efficiency	Enterprise participation	Ecological synergy
Industrial Internet Platform	68%	42%	Expand 3-5 times	55%	75%	82%
e-commerce platform	72%	38%	Expand 5-8 times	65%	85%	78%
Industry service platform	65%	35%	Expand 2-4 times	48%	70%	75%
Supply chain collaboration platform	70%	45%	Expand 3-6 times	58%	72%	80%
Technology Innovation Platform	62%	32%	Expand 2-3 times	42%	68%	73%

B. THE PATH TO INDUSTRIAL ECOSYSTEM RECONSTRUCTION SUPPORTED BY DIGITAL PLATFORMS

Digital platforms are key carriers of the digital economy. They integrate industrial chain resources, connect supply and demand, and provide comprehensive services, thereby changing the form of industrial organization and the way of value creation. Industrial Internet platforms connect various industrial links, and R&D, manufacturing, logistics, after-sales and other links are interconnected to form an efficient industrial ecosystem. E-commerce platforms have broadened the market space of industries, shortened circulation links, reduced transaction costs and improved market allocation efficiency. Industrial service platforms gather innovative elements such as technology, capital and talent, and provide comprehensive support for industrial development [9]. Digital platforms break through enterprise boundaries, promote the improvement and efficient use of internal and external resources of industries, and promote the transformation of industries from linear value chains to networked value ecosystems. However, achieving high synergy within these ecosystems does not rely solely on immediate cost reduction. As shown in Table 2, while collaboration costs for Industrial Internet Platforms are reduced by a moderate 42%, the ecological synergy reaches 82%. This indicates that high synergy is driven by the 'network effect' and shared data assets rather than a total elimination of transaction costs. In fact, the moderate nature of cost reduction reflects the necessary investment in digital integration and platform fees required to maintain such a high level of collaborative innovation. The platform-based development model makes industries more flexible and adaptable, and can promote the sharing of resources and cooperation among small and medium-sized enterprises, realize the coordinated development of large, medium and small enterprises, and thus improve the overall competitiveness of industries [10].

The data suggests that the 82% synergy level is an outcome of deep technical alignment and resource pooling, which remains a high-value proposition even though the initial 'Reduced collaboration costs' (42%) are tempered by the ongoing costs of platform participation and digital maintenance.

C. THE PATH TO INDUSTRIAL VALUE INNOVATION EMPOWERED BY DATA ELEMENTS

Data, as an important production factor in the digital economy era, has opened up a new path for industrial value innovation. By collecting, integrating, and analyzing massive amounts of data from the entire production and operation process, industries can gain a deep understanding of market demand, optimize production processes, improve product design, and innovate business models. Data-driven precision marketing improves market development efficiency, data-driven flexible production meets personalized needs, and data-driven predictive maintenance reduces operational risks [11]. By integrating and analyzing industrial data, industry data, and market data, scientific basis can be provided for strategic decision-making, improving the foresight and accuracy of industrial development. The circulation and trading of data elements generate new business forms such as data services, expanding the value space of industries. While many firms utilize data primarily to optimize internal operational efficiency, the effective use of data elements can also act as a strategic catalyst that promotes the potential transformation of industries from a traditional product economy to a service and solution-oriented economy. By leveraging data for deeper customer insights, enterprises have the opportunity to shift from selling standardized products to providing customized solutions, resulting in a fundamental change in the value creation model for those pursuing service-led growth. Data-driven innovation serves a dual purpose: it can be applied internally to improve the value and efficiency of existing businesses, or externally to create new value growth points through service innovation, injecting strong momentum into the sustainable development of industries [12]. The evaluation metrics in Table 3 reflect the secondary strategic outcomes that stem from the

primary technical gains listed in Table 1. For instance, the 'Intelligent decision-making' accuracy improvement (50%) in Table 3 is logically supported by the high-intelligence data processing capabilities of AI (35-45% efficiency) and Cloud Computing (40-50% efficiency) e stablished i n the preceding path.

TABLE 3. Evaluation of the effect of data elements in empowering industrial value innovation (Strategic Impact Analysis)

Data application scenarios	Improved decision-making accuracy	Reduced operating costs	Revenue growth rate	Improved customer satisfaction	Innovation Capability Index	Market Response Speed
Precision Marketing	45%	28%	32%	38%	85	Increase by 60%
Flexible production	42%	35%	28%	42%	88	Increase by 55%
Predictive maintenance	38%	40%	25%	35%	82	Increase by 50%
Intelligent decision-making	50%	32%	35%	40%	90	Increase by 65%
Personalized services	48%	25%	38%	45%	87	Increased by 58%

IV. TRANSLATING THEORETICAL PATHWAYS INTO REGIONAL IMPLEMENTATION FRAMEWORKS

The empowering role of the digital economy, as analyzed in the preceding mechanistic study, is operationalized through a systematic framework encompassing infrastructure, industrial deep integration, and cluster ecosystems. This section examines the empirical conditions under which the three theoretical pathways—technology, platform, and data—converge into a cohesive regional strategy. Figure 1 illustrates the implementation strategy, process, and logical relationships for the digital economy to empower regional industrial structure.

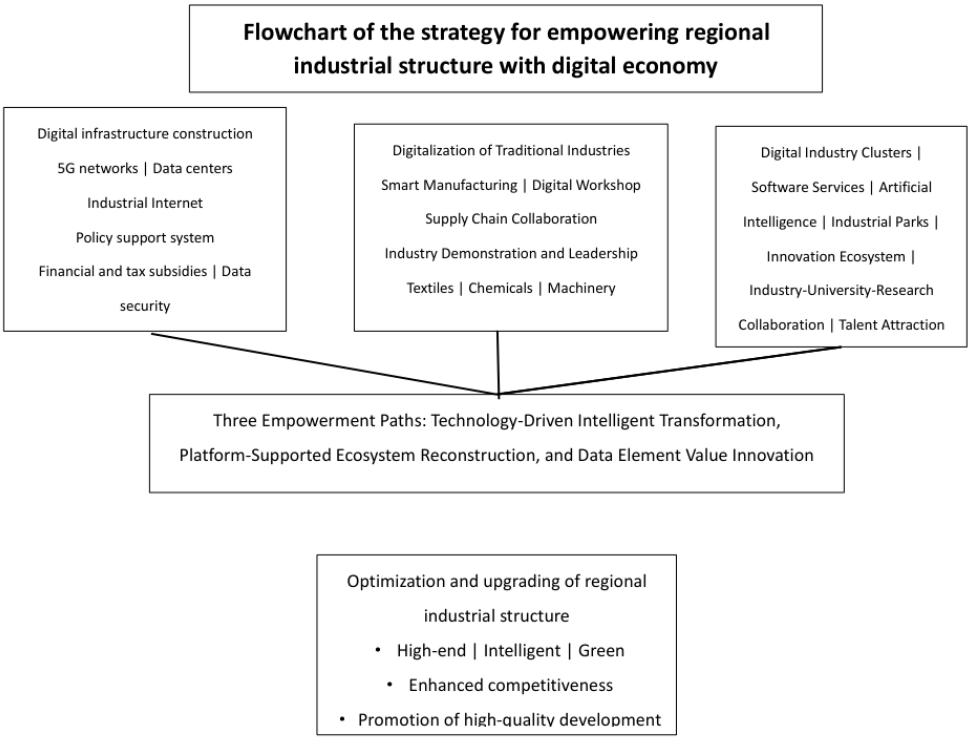

FIGURE 1. Flowchart of the Implementation Strategy for Digital Economy Empowering Regional Industrial Structure

A. IMPROVE THE DIGITAL INFRASTRUCTURE AND POLICY SUPPORT SYSTEM

Digital infrastructure is the foundation of digital economic development. Regions should accelerate the construction of new infrastructure and build a high-speed, ubiquitous, and intelligent digital network system. Focus on promoting the construction of information infrastructure such as 5G networks, gigabit optical networks, data centers, and cloud computing platforms. To substantiate the claim of green development, regions must prioritize 'green data centers' that utilize renewable energy and advanced cooling technologies. Without addressing the high energy demand of these facilities, the digital economy risks shifting environmental burdens from the factory floor to the power grid. Consequently, providing support for industrial transformation must include standards for energy-efficient computing to ensure that structural upgrades remain genuinely sustainable. Build integrated infrastructure such as industrial internet and Internet of Things to open up channels for industrial data circulation, so that equipment can be interconnected and data

can be shared. While improving digital infrastructure, it is also necessary to create a systematic policy support system [13]. The government should formulate a plan for the development of digital economy and define the development path and key tasks of industrial digital transformation. Introduce incentive policies such as fiscal subsidies, tax incentives, and financial support to reduce the cost of digital transformation for enterprises and stimulate their enthusiasm for transformation. Establish a digital economy statistical monitoring system to scientifically evaluate the development level and empowerment effect of digital economy. Strengthen legislation on data security and privacy protection to create a safe and reliable digital development environment. Furthermore, a robust policy framework must proactively address the 'digital divide' inherent in rapid transformation. While digital infrastructure provides the foundation, there is a systemic risk that the regional industrial structure could become fragmented if the high costs of technologies—such as Cloud Computing and AI mentioned in Table 1—disproportionately exclude small and medium-sized enterprises (SMEs) from the empowerment process. Strengthen intellectual property protection and safeguard the right to digital innovation. Rely on the two-pronged approach of infrastructure and policy to provide equitable conditions for the digital economy to drive industrial structure. Policy interventions should prioritize subsidizing digital access for smaller players to ensure that 'optimization' refers to a cohesive regional upgrade rather than a polarized industrial landscape where only capital-intensive firms thrive, thereby mitigating the risk of structural fragmentation [14].

B. PROMOTE THE DEEP INTEGRATION OF TRADITIONAL INDUSTRIES AND DIGITAL TECHNOLOGIES

The digital transformation of traditional industries is an important part of industrial structure optimization. It is necessary to systematically promote the in-depth application of digital technology in various fields of traditional industries. In the production and manufacturing process, promote intelligent manufacturing technology, build intelligent factories and digital workshops, and realize the automation, intelligence and flexibility of the production process. Use digital twin technology to improve the production process, thereby improving production efficiency and product quality. In supply chain management, use Internet of Things and blockchain technology to realize full-process visualization and traceability of the supply chain, and improve the collaborative efficiency and risk resistance of the supply chain. From the perspective of marketing, use big data analysis to accurately grasp consumer demand and carry out personalized marketing and customized services. Traditional industries should actively embrace the platform economy, enter industrial Internet platforms and e-commerce platforms, expand market channels, and obtain platform resource support. Focus on promoting the digital transformation of traditional advantageous industries such as chemicals and machinery, and create industry digital transformation benchmarks. Establish a digital transformation public service platform to provide SMEs with technical consulting, talent training, and scalable, low-cost solutions. By reducing the financial and technical threshold, the region can prevent the digital economy from inadvertently widening the gap between industry leaders and smaller participants, ensuring that the empowerment path remains inclusive and logically aligned with the goal of overall structural upgrading. Promote the digital transformation of traditional industries with three aspects of demonstration and guidance, policy support and service guarantee, promote the effective conversion of new momentum and old momentum, and improve industrial competitiveness [15].

C. CULTIVATING DIGITAL INDUSTRY CLUSTERS AND INNOVATION ECOSYSTEMS

Digital industry clusters are crucial carriers for the development of the digital economy. Regions should cultivate competitive digital industry clusters based on their own resource endowments and industrial foundations. The focus should be on developing core digital industries such as software and information services, electronic information manufacturing, digital content, and artificial intelligence, creating industrial agglomeration areas and innovation hubs. The integration of digital industries with traditional advantageous industries should be promoted to form distinctive digital industry clusters. A comprehensive supporting system for industrial clusters should be established, creating digital economy industrial parks and providing excellent infrastructure, public services, and a favorable business environment. Creating an open and collaborative innovation ecosystem is essential for sustainable industrial development. Collaborative innovation among government, industry, academia, research, and application should be promoted, increasing cooperation among universities, research institutes, and enterprises to accelerate the transformation of scientific and technological achievements. Innovation platforms, pilot production bases, and incubators should be established to tackle key core technologies and promote innovative applications. A sound innovation investment and financing system should be established to guide social capital investment in digital industries and innovation projects. A talent attraction and cultivation program should be implemented to cultivate and attract high-end talent in the digital economy field, building a high-quality digital talent pool. The empowering effect of the digital economy on regional industrial structure is reflected in profound changes across multiple dimensions. Figure 2 compares and contrasts the traditional industrial model and the digital empowerment model in terms of production methods, industrial organization, resource allocation, innovation capabilities, and development characteristics, providing a clear goal orientation for the formulation of implementation strategies.

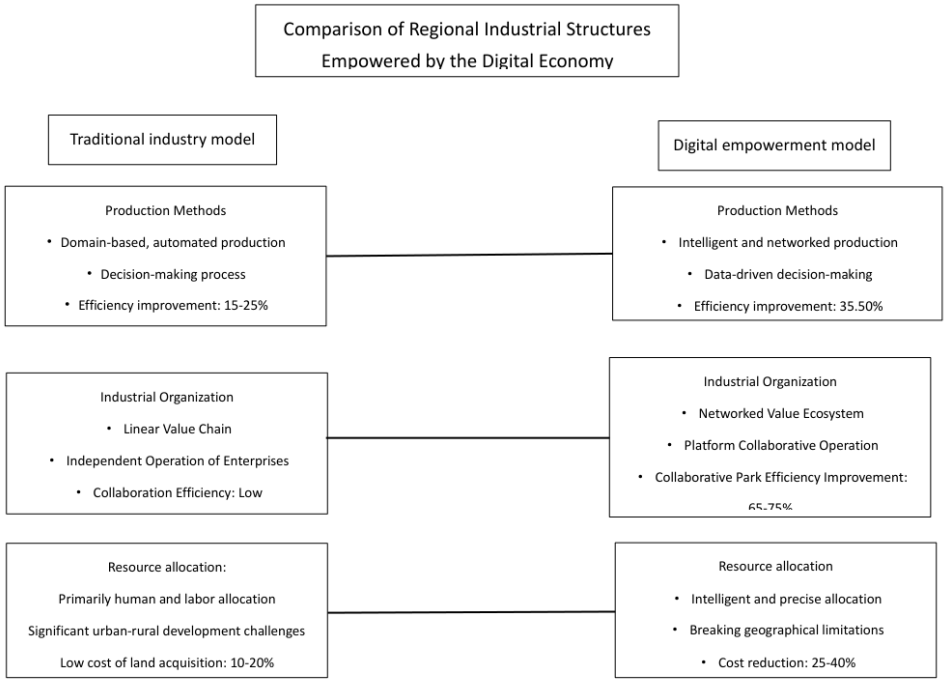

FIGURE 2. Comparison of Regional Industrial Structures Empowered by the Digital Economy

V. CONCLUSION

The digital economy empowers regional industrial structures systematically and long-term, relying on the synergy between smart manufacturing, business model innovation, and institutional shifts to integrate digital jacquard techniques and intelligent fiber monitoring into high-quality development. Through various pathways, including intelligent transformation driven by digital technologies, ecological restructuring supported by digital platforms, and value creation driven by data elements, the digital economy is changing the form of regional industrial structures, propelling industries towards high-end, intelligent, and green development. Given the historical opportunities presented by the development of the digital economy, regions must accurately grasp the trend of digital transformation, improve the construction of digital infrastructure, promote the digital transformation of traditional industries, cultivate digital industrial clusters, and build an innovative ecosystem to maximize the empowering role of the digital economy. Only by continuously promoting the integration of the digital economy with the real economy can we accelerate the transition from traditional weaving to intelligent manufacturing, thereby optimizing the industrial structure and enhancing the competitive advantage of high-performance fabric development for regional high-quality development.

AUTHOR CONTRIBUTIONS

Conceptualization –Jie Han and Kai Duan; methodology – Jie Han and Kai Duan; investigation – Jie Han and Kai Duan; writing-original draft preparation – Jie Han and Kai Duan. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

[1] H. J. Chen, S. L. Hu, G. Zeng, X. P. Chen, J. W. Wang, and Y. Y. Wan, "The impact mechanism of digital economy on green development efficiency in the Yangtze River Delta region," Economic Geography, vol. 45, no. 5, pp. 13-22, 2025.

[2] S. Z. Ma, D. H. Zhang, and Z. X. Hu, "How digital knowledge flow can promote coordinated regional development—and discuss the dual goals of economic growth and balanced development," China Industrial Economics, no. 2, pp. 80-98, 2025.

[3] Y. Wu and F. Zhang, "Research on the impact of digital economy on regional green innovation efficiency - a dual examination based on mediation effect and threshold effect," Ecological Economics, vol. 40, no. 10, pp. 47-57, 2024.

[4] Y. L. Hu, C. J. Liu, J. Y. Tan, and H. Q. Li, "Digital economy empowers urban development quality: theoretical mechanism and empirical test," Statistics and Decision, vol. 39, no. 23, pp. 95-100, 2023.

[5] D. C. Fan and W. X. Xiao, "Environmental regulation, data element allocation level and industrial structure adjustment," Statistics and Decision, vol. 40, no. 2, pp. 105-110, 2024.

[6] Y. Lü and X. Shi, "Can the development of the digital economy promote the increase of urban fiscal revenue? Empirical hypothesis and test," Soft Science, vol. 38, no. 7, pp. 64-70, 2024.

[7] Z. Li, W. Kong, and Z. Li, "Division or Integration: How the Digital Economy Affects China's Urban and Rural Labor Employment Market," Journal of Guizhou University of Finance and Economics, no. 2, pp. 31-40, 2024.
[8] J. Wang, X. Ma, and Y. Fan, "Research on the impact of the synergistic effect of digital economy and technological innovation on high-quality economic development," Statistics and Information Forum, vol. 39, no. 4, pp. 46-62, 2024.
[9] Y. Zhang, Y. Zhu, and J. Du, "A comparative study on the coupling and coordination of digital economy and new urbanization in the Yangtze River Economic Belt and Yellow River Basin," Economic Geography, vol. 44, no. 2, pp. 61-70, 2024.
[10] D. Fan and W. Xiao, "How the digital economy has become a new driving force for regional innovation and development - an empirical analysis based on factor integration," Science and Technology Progress and Policy, vol. 42, no. 5, pp. 69-81, 2025.
[11] Z. Huang, "EU "Industrial Digitalization" and China-EU Digital Relations," Foreign Affairs Review (Journal of China Foreign Affairs University), vol. 40, no. 4, pp. 129-154, 2023.
[12] W. Chen and X. Wang, "Building a digital foundation for Chinese-style modernization: the institutional construction of the integrated computing power market in China," Journal of Hohai University (Philosophy and Social Sciences Edition), vol. 26, no. 6, pp. 31-44, 2024.
[13] H. Liang, "Mechanism and path of digital economy driving consumption growth under the new development pattern of "dual circulation": based on the test of moderated mediation effect," Journal of Chongqing University (Social Sciences Edition), vol. 29, no. 3, pp. 34-46, 2023.
[14] B. Sheng, M. Lü, and P. Zhu, "How the development of the digital economy can empower China's dual circulation economy: a study based on the provincial and industry levels," International Trade Issues, no. 6, pp. 1-20, 2024.
[15] Y. Xia, "Digital technology, industrial structure upgrading and urban resilience," Statistics and Decision, vol. 41, no. 11, pp. 133-138, 2025.