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The Mechanism, Existing Challenges, and Optimization Pathways of Artificial Intelligence in Driving High-Quality Development of the Digital Economy

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Abstract: The digital economy has become a core pillar of China's national economic growth, and promoting its high-quality development is crucial for building a modern industrial system and achieving economic transformation and upgrading. As a new generation of general-purpose digital technology, artificial intelligence (AI) offers capabilities such as perception, computation, decision-making, and optimization, which allow it to permeate the entire chain of production, circulation, and social governance. It reshapes the operational logic of the digital economy and serves as the key driving force in unlocking its potential and overcoming the challenges of extensive growth. Although China's digital economy continues to expand in scale, significant shortcomings remain in the deep integration between AI and the digital industry. This paper adopts a literature review approach to analyze the internal mechanisms through which AI empowers high-quality development of the digital economy from three dimensions: production, factor circulation, and digital governance. It systematically identifies current bottlenecks and underlying causes in the integration process and proposes targeted optimization pathways across four dimensions: core technology breakthroughs, marketization of data elements, tiered industry empowerment, and institutional system improvement. The findings offer theoretical guidance for local governments to advance the deep integration of AI with the digital economy and formulate supportive policies for the digital sector, helping the digital economy shift from a sole focus on scale expansion toward innovative, coordinated, green, and inclusive high-quality development.

Keywords: artificial intelligence; digital economy; high-quality development; mechanism of action; industrial integration

1. Introduction

With the widespread adoption of digital infrastructure and the continuous growth of the big data industry, China's digital economy has entered a transformative phase characterized by equal emphasis on scale and quality. The government has repeatedly introduced targeted policies, explicitly advocating for the use of digital technologies such as artificial intelligence (AI), big data, and cloud computing to enhance the quality and efficiency of the digital economy, and positions AI as a core technological enabler for empowering the real economy and fostering new quality productive forces. Traditional models of digital economic development have heavily relied on traffic expansion and incremental investments in hardware, resulting in inefficient resource allocation, relatively low industrial value-added, widening regional disparities, and inadequate digital

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governance capabilities—hallmarks of extensive, unsustainable growth. Relying solely on internet platforms and conventional digital tools is no longer sufficient to overcome growth bottlenecks, making it imperative to develop new technological engines to support high-quality development.

Existing academic research has extensively discussed AI applications and pathways for digital economic development; however, most studies remain confined to specific industry contexts, lacking comprehensive and systematic frameworks for analyzing how AI drives high-quality digital economic growth. Some literature focuses narrowly on technical advantages without fully addressing practical barriers encountered during implementation, and proposed optimization strategies often lack a layered, actionable logic. Against this backdrop, clearly delineating the transmission mechanisms through which AI enables high-quality digital economic development, accurately identifying current challenges in integration, and constructing a long-term optimization system suited to China's industrial realities are of significant theoretical and practical importance.

This paper primarily adopts a literature review approach to systematically synthesize domestic and international research on high-quality digital economic development and AI-driven industrial empowerment, establishing a theoretical analytical framework. Using logical deduction, it dissects the internal pathways of AI empowerment across three dimensions: production, factor circulation, and public governance. Drawing on the current state of China's digital industry, the study identifies existing shortcomings and proposes tiered, implementable optimization strategies. The research aims to address the systemic gaps in prior studies, provide theoretical foundations for government industrial planning and corporate digital transformation, facilitate the full realization of AI's technological dividends, and accelerate the process of high-quality digital economic development.

2. Relevant Theoretical Foundations

High-quality development of the digital economy differs from early-stage extensive digitization, with its core connotations reflected in five dimensions: innovation-driven growth, where technological advancement replaces factor input as the primary driver; coordinated and balanced development, promoting digital progress across regions, between urban and rural areas, and among enterprises; green and low-carbon transformation, leveraging digital technologies to reduce resource consumption; inclusive sharing, ensuring small and medium-sized enterprises and the public equally benefit from digital dividends; and security and controllability, enhancing digital safety and data governance [1]. The central objective is to improve total factor productivity. Artificial intelligence, as a key technology, connects computing power, data, and industrial applications, serving as a core tool for achieving high-quality development goals [2].

The theory of general-purpose technology (GPT) provides foundational support for this study. Characterized by permeability, improvement, and complementarity, GPT can be widely applied across industries and continuously iterated and optimized, complementing and synergizing with capital, labor, and data [3]. Artificial intelligence is a typical next-generation GPT, adaptable to diverse economic contexts. Its continuously evolving large models, computer vision, and intelligent decision-making technologies consistently enhance industrial operational efficiency. The theory of digital element value realization emphasizes that data only generates productive value after cleaning, modeling, and intelligent analysis—mere data storage cannot create economic returns [4]. Artificial intelligence precisely fulfills the core function of transforming data value, using machine learning to uncover hidden patterns within vast datasets, converting static data into dynamic production decision-making inputs, thereby enabling the resource- and asset-based utilization of data elements. This represents the fundamental advantage of AI over traditional digital tools.

The transmission mechanism of technology-enabled development of the digital economy consists of three layers: the foundational layer of computing power and data infrastructure, the intermediate layer of artificial intelligence application, and the upper layer of digital economy industries and governance applications. The foundational layer provides essential support, including computing centers and sector-specific databases; the intermediate layer processes data through large models and intelligent forecasting technologies; and the upper layer drives industrial production and public governance, ultimately influencing key indicators such as productivity and security in the digital economy [5]. Based on this three-layer framework, this paper establishes an analytical system to examine the mechanisms through which artificial intelligence enables high-quality development of the digital economy.

3. Multidimensional Mechanisms of Artificial Intelligence Empowering High-Quality Development of the Digital Economy

3.1. Production-Side Mechanism: Restructuring Production Processes and Enhancing Total Factor Productivity in the Digital Industry

At the production stage, artificial intelligence reshapes traditional production logic through automation and intelligent upgrading, and drives high-quality development via two main pathways. First, intelligent upgrades reduce marginal production costs. In industry, AI-powered quality inspection, automated production lines, and AI-based production scheduling systems replace repetitive manual labor, reducing workforce requirements and minimizing losses due to human error. In agriculture, smart remote sensing, AI-driven pest identification, and unmanned farming equipment enable precision cultivation, reducing waste of water, fertilizers, and pesticides. In services, intelligent customer service and automated warehouse sorting systems shorten response times and increase labor productivity per unit. By leveraging AI technology, traditional industries can embrace digitalization without heavy reliance on labor or physical infrastructure, replacing technological inputs for traditional factors to achieve green and efficient production—aligning with the green and innovative requirements of high-quality development. Second, intelligent innovation fosters new digital business models. Generative AI rapidly completes product design, marketing strategies, and software code development, significantly shortening R&D cycles for new products and services. AI-powered personalized recommendation algorithms have given rise to emerging digital sectors such as live-stream e-commerce, customized digital services, and personalized content industries, expanding the boundaries of the digital economy and creating new growth drivers through innovation-led development. Meanwhile, AI forecasting models anticipate shifts in market demand, guiding enterprises toward demand-driven production, mitigating overcapacity issues in traditional industries, and improving supply-demand matching efficiency [6].

3.2. Factor Circulation Mechanism: Activating Data Elements and Optimizing Cross-Regional Allocation of Digital Resources

Data is a core production factor in the digital economy; however, fragmented and siloed data cannot generate scalable value. Artificial intelligence plays a central role in integrating production factors and unlocking their potential. On one hand, AI breaks down data barriers across organizations, enabling efficient circulation of resources. Intelligent data cleaning and federated learning technologies allow cross-enterprise and cross-regional joint modeling without direct sharing of raw data, eliminating data silos among government, enterprises, industries, and regions, and promoting free data flow. Smart computing power scheduling systems coordinate regional computational resources, balancing disparities in computing capacity between developed and underdeveloped areas, thus facilitating balanced allocation of digital resources and supporting coordinated development of the digital economy. On the other hand, AI uncovers latent data value, enhancing the appreciation of data value. Traditional digitization merely involves data storage and basic analytics, whereas large-scale models and machine learning can deeply analyze massive datasets on consumer behavior, industrial production, and urban operations, providing precise decision-making support for enterprise management and industrial planning. This transforms static data into productive assets capable of generating revenue, thereby increasing the overall added value of the digital economy. Additionally, intelligent supply-demand matching platforms leverage AI algorithms to connect upstream and downstream segments of industrial chains, optimizing material and product distribution channels and reducing logistics losses and transportation costs [7].

3.3. Digital Governance Mechanism: Strengthening Digital Regulation and Ensuring Safety for High-Quality Development

The rapid expansion of the digital economy has brought governance challenges such as platform monopolies, data breaches, algorithmic discrimination, and fraudulent activities. Artificial intelligence provides essential technical tools for modern digital governance. First, intelligent regulation enhances the efficiency of digital market oversight. AI-powered content moderation and big data risk detection systems monitor violations in e-commerce platforms,

short videos, and digital financial services in real time, overcoming limitations of manual supervision—such as narrow coverage and delayed responses—to standardize platform operations, curb disorderly competition and malicious monopolies, and maintain a fair and orderly digital market environment, ensuring inclusive and equitable development of the digital economy. Second, intelligent public administration helps narrow the digital divide between urban and rural areas. AI-powered government service terminals and intelligent government Q&A systems simplify online procedures, lowering the digital access barriers for rural populations and older adults, thereby promoting equitable access to public digital services. Smart city AI scheduling systems integrate digital resources across transportation, healthcare, and education, optimizing public service delivery and narrowing regional disparities in digital development. Third, AI-based digital security systems help mitigate developmental risks. Technologies such as intelligent encryption, anomaly traffic detection, and data breach early warning establish a comprehensive digital security framework, safeguarding against cyberattacks, privacy breaches, and digital financial risks, thus ensuring secure, stable, and high-quality growth of the digital economy [8].

4. Current Outstanding Issues in AI-Driven Digital Economy Development

First, China leads the world in AI application scenarios, but faces significant gaps in foundational technologies that hinder long-term empowerment effects. Core technologies such as chips, high-end computing servers, general large-model frameworks, and high-precision industrial algorithms heavily rely on overseas imports. Supply of high-performance computing chips is constrained, driving up costs for domestic enterprises to train large models. The localization level of fundamental algorithm frameworks remains low—most companies directly adopt open-source foreign frameworks, creating risks related to backdoors and intellectual property vulnerabilities. Meanwhile, basic AI R&D investment is concentrated among leading internet firms, while small and medium-sized digital enterprises lack strong R&D capabilities. There is insufficient supply of industry-generic, lightweight AI models, making it difficult for SMEs to afford high AI technology procurement costs. This results in a fragmented landscape where "large players are strong, while SMEs remain weak," undermining balanced development of the digital economy [9].

Second, the marketization of data elements in China is still in its early stages, and data barriers have not been fundamentally resolved. Government and enterprise data remain severely siloed—government administrative data, corporate industrial data, and public service data belong to different entities, lacking unified and compliant data-sharing mechanisms. Data standards vary across industries, with significant differences in formats and statistical metrics among manufacturing, finance, agriculture, and cultural tourism sectors, making cross-industry AI joint modeling highly challenging. Moreover, systems for defining data ownership, establishing data trading rules, and allocating data-generated benefits remain underdeveloped. Firms are reluctant to share proprietary data due to commercial privacy concerns, resulting in vast amounts of industrial data remaining stagnant and unusable. Additionally, some regions overemphasize data collection while neglecting data governance, leading to a high proportion of low-quality, fragmented, and ineffective data, which significantly reduces AI model accuracy and limits the full realization of data element value [10].

The integration of AI with the digital economy also exhibits clear stratification and imbalance. High-end manufacturing, leading internet platforms, and first- and second-tier cities enjoy relatively high AI penetration rates, whereas traditional agriculture, small and medium-sized manufacturers, third- and fourth-tier cities, and county-level areas show extremely low levels of AI adoption. Most SMEs remain at an early stage of digitalization, limited to online storefronts and basic office software, unable to deploy intelligent production lines or advanced data analytics systems. County-level digital economies still revolve around traditional e-commerce, lacking new AI-powered business models such as deep processing, smart logistics, and digital cultural tourism. Furthermore, certain industries suffer from superficial AI applications—companies blindly implement intelligent systems without optimizing their internal processes, causing AI tools to become disconnected from actual operations. This results in a "heavy on procurement, light on operation" phenomenon, greatly diminishing empowerment effectiveness and widening regional and industrial disparities in the digital economy [11].

Finally, the rapid iteration of AI technologies far outpaces updates in laws, regulations, and industry oversight, leading to noticeable institutional lag. Legal details regarding algorithm transparency, algorithmic

bias, big-data price discrimination, and user privacy protection remain incomplete. It is difficult to precisely define and penalize unfair competitive practices enabled by AI algorithms. Rules for classified and tiered data security management and cross-border data flows are inadequately implemented, leaving enterprises vulnerable to persistent data breach risks. In addition, the digital talent supply system fails to meet the demands of AI integration, resulting in a notable shortage of interdisciplinary professionals who combine practical industry experience with AI technical expertise. University programs tend to focus narrowly on pure technical or managerial disciplines, lacking interdisciplinary training curricula. Regional digital infrastructure development is uneven, with delays in building computing centers and high-speed communication networks in counties, constraining the deployment and implementation of AI at lower levels [12].

5. Optimized Pathways for AI to Drive High-Quality Development of the Digital Economy

First, coordinate national-level projects for computing power and AI-specific research, focusing on technological breakthroughs in high-end computing chips, domestically developed foundational algorithm frameworks, and lightweight general-purpose industrial large models to strengthen the domestic AI technology industrial chain and reduce reliance on foreign technologies. Establish a public computing service platform offering low-cost, on-demand computing resources for small and medium-sized enterprises (SMEs), thereby reducing hardware costs for AI model training. Second, promote deep integration among industry, academia, and research by encouraging universities, research institutes, and digital enterprises to jointly develop lightweight, industry-specific AI tools, and to launch low-cost, standardized intelligent quality inspection, inventory management, and marketing systems tailored to SMEs' financial and technical capabilities. Third, improve intellectual property protection mechanisms for AI, incentivize local enterprises to innovate in fundamental technologies, and alleviate R&D investment burdens through tax reductions and research subsidies, narrowing the technological gap between leading firms and SMEs [13].

Second, accelerate the establishment of a unified and standardized data element circulation system, clearly defining ownership rights, trading rules, and responsibilities regarding data security. Build integrated regional and sectoral data sharing and exchange platforms, promoting collaborative modeling techniques such as federated learning and privacy-preserving computing that do not disclose raw data, thus balancing data flow with privacy protection. Standardize data collection, storage, and statistical practices across industries to reduce cross-sector AI data integration costs. Foster a compliant data trading market, establish mechanisms for data asset valuation and revenue distribution, and encourage enterprises to commercially release anonymized industrial data. Simultaneously advance comprehensive data governance initiatives, guiding companies in data cleaning and standardization to enhance basic data quality and provide high-quality inputs for AI-driven deep analysis [14].

Third, develop differentiated AI digital transformation strategies for different industries and regions. In manufacturing, prioritize full-process intelligent upgrades for large and medium-sized factories, while offering low-cost modular AI solutions for smaller factories. In agriculture, promote smart remote sensing, unmanned farming machinery, and AI-based traceability systems for agricultural products, fostering new digital business models in smart agriculture. In services, leverage AI to expand customized digital services, smart tourism, and intelligent logistics. At the regional level, increase investments in computing centers, 5G, and IoT infrastructure in county-level and third- to fourth-tier cities, extending AI-powered government services and smart agriculture to rural markets. Introduce supportive policies for digital industries at the county level, encouraging leading digital enterprises to deliver lightweight AI solutions to smaller cities, thus balancing regional digital development. Meanwhile, establish an evaluation mechanism to assess enterprise AI transformation outcomes, preventing the superficial procurement of smart devices, and guiding businesses to implement AI applications aligned with their operational processes [15].

Fourth, expedite revisions to specialized AI legislation, refining regulations on algorithm governance, consumer privacy protection, and digital anti-monopoly measures. Establish AI algorithm registration and review systems to regulate platform-based intelligent algorithm operations. Improve tiered data security management mechanisms and strengthen accountability for corporate data breaches. Develop a multidisciplinary talent cultivation system: universities should introduce interdisciplinary programs combining AI with industry,

and enterprises should collaborate with academic institutions to build internship and training bases, cultivating professionals with both industry experience and AI expertise. Establish interdepartmental coordination mechanisms for digital economy governance, integrating digital planning across sectors including industry and information technology, market regulation, government affairs, and agriculture, while simultaneously enhancing emergency response and prevention systems for digital security. Through institutional, talent, and infrastructure support, ensure AI continues to drive high-quality development of the digital economy [16].

6. Conclusions

High-quality development of the digital economy is the core direction for China's economic transformation and upgrading. As a new generation of general-purpose digital technology, artificial intelligence forms a complete enabling mechanism across production, data circulation, and digital governance: enhancing industrial productivity through intelligent transformation and giving rise to new digital business models; leveraging data mining and cross-domain scheduling to unlock the value of data elements and optimize digital resource allocation; and relying on intelligent regulation and equitable digital services to improve the digital governance system, balancing multiple development goals including innovation, coordination, security, and inclusiveness.

Currently, China's integration of AI and the digital economy still faces four core challenges: insufficient self-reliance in key technologies, prominent barriers to data element circulation, imbalanced regional and industrial integration, and lagging institutional and regulatory frameworks. These constraints hinder the full realization of AI's enabling potential. To fully harness AI's driving force, coordinated efforts are needed across four dimensions to build a long-term, synergistic system that integrates technology, resources, industries, and institutions, thereby removing various bottlenecks in integrated development.

This study has certain limitations: it primarily relies on theoretical reasoning and literature analysis, lacking quantitative empirical analysis based on multi-regional and multi-sectoral data; it also does not develop differentiated empowerment models for specific sub-sectors of the digital economy. Future research could incorporate panel data for empirical validation, comparing AI-enabled impacts across industrial, agricultural, and service sectors. Additionally, further studies could extend into emerging areas such as generative AI, computing power networks, and low-carbon digital economies, continuously enriching the research framework on AI-driven high-quality development of the digital economy.

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