Digital Economy Empowering Chinese Modernization: Postprint

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Abstract

The article first elaborates on the significant importance of developing the digital economy for achieving Chinese-style modernization from the perspective of the inherent consistency between the connotation of Chinese-style modernization and the characteristics of the digital economy, revealing the inherent logic through which the digital economy empowers the construction of Chinese-style modernization; it then analyzes the problems that need to be addressed in the construction of Chinese-style modernization regarding the capacity building of digital economy sci-tech infrastructure, data factor coordination mechanisms, structural imbalances in digital development, and governance and security systems; finally, by combining the actual national conditions of China's new development pattern, it proposes policy recommendations from four aspects: deepening mechanisms to strengthen core technology R&D, improving the construction of data infrastructure systems, ameliorating issues of unbalanced and insufficient development, and innovating collaborative governance mechanisms between government and market.

Full Text

Digital Economy Enables Chinese Path to Modernization

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Abstract

This article first elucidates the significance of developing the digital economy for achieving Chinese path to modernization from the perspective of the internal consistency between the connotations of Chinese path to modernization and the characteristics of the digital economy, revealing the underlying logic through which the digital economy empowers the construction of Chinese path to modernization. It then analyzes the challenges that need to be addressed in building Chinese path to modernization, including the construction of basic scientific and technological capacity for the digital economy, coordination mechanisms for data elements, structural imbalances in digital development, and governance and security systems. Finally, drawing upon China's actual national conditions within the new development pattern, the article proposes policy recommendations across four dimensions: deepening mechanisms to strengthen core technology research and development, improving the construction of data infrastructure systems, addressing imbalances and inadequacies in development, and innovating collaborative governance mechanisms between government and market.

Keywords: Chinese path to modernization, digital economy, Internet spirit

1 The Internal Logic of Digital Economy Enabling Chinese Path to Modernization

Chinese path to modernization encompasses all domains of economy, society, culture, and environment, involving the modernization of both productive forces and production relations. The deep integration of the digital economy with the real economy serves as a crucial engine for advancing Chinese path to modernization in the digital era.

1.1 Digital Economy Unleashes New Demographic Dividends China's enormous population represents a fundamental national condition for Chinese path to modernization, with 18% of the global population having fueled rapid economic growth over the past four decades of reform and opening up. However, population aging and declining fertility rates pose challenges to the sustainability of this demographic dividend. The digital economy reshapes population advantages by enhancing labor efficiency, improving labor structures, upgrading population quality, and stimulating innovation potential. First, digital technologies transform labor tools and methods through their unique virtual, open, and shared characteristics. The marginal returns to data elements increase with richer application scenarios, substantially improving labor efficiency. Second, the process of digitalization and intelligence further transforms labor structures.

Routine and repetitive tasks are increasingly replaced by machines, enabling people to devote more energy to creative and emotional work, thereby raising overall population quality and human capital levels [3]. Third, data elements have become a powerful tool for innovation entities to seek inspiration, assess market trends, and optimize R&D layouts [4]. Innovation is no longer a sequential fixed process but emphasizes dynamic interaction through open innovation and continuous iterative optimization [5]. Leveraging the strong computing power of digital technologies, innovation entities can rapidly obtain feedback during product design and innovation processes, reducing time and labor costs while significantly decreasing uncertainty in innovation activities, thereby activating the innovation potential of the vast population. The new fields and tracks emerging in the digital economy have become fertile ground for the diffusion and application of technological innovation.

1.2 Digital Economy Promotes Common Prosperity for All Achieving common prosperity for all people represents not only an essential feature of Chinese path to modernization but also a fundamental requirement of socialism [6]. The digital economy can not only reduce market transaction costs and improve total factor productivity to drive general macroeconomic growth but also address imbalances and inadequacies in development through its inclusive and equitable technological characteristics. On one hand, data elements empower traditional factors of production by removing bottlenecks in production, operation, circulation, and service segments of the real economy. Digital technology-driven improvements to enterprise value creation models promote supply chain and industrial chain coordination [7], effectively addressing the "small, scattered, and weak" problems prevalent in many Chinese industries and enhancing overall market resource allocation efficiency while opening up entirely new growth points. The division of labor and collaboration across industries has undergone tremendous changes in the digital era. With its strong permeability and broad coverage, the digital economy breaks down barriers between different industries, driving the transformation from internal division of labor to external collaboration and fostering a new industrial development pattern characterized by open integration and coordinated division of labor. On the other hand, the integration of digital technology with education, healthcare, and finance has created new business forms that expand coverage and increase access to resources for small and medium-sized enterprises and low-to-middle income groups, promoting equalization of basic public services. The open sharing of data elements helps bridge traditional resource endowment gaps, improves the 普惠化 (universal accessibility) of data resources, and facilitates coordinated regional development and common prosperity.

1.3 Digital Economy Strengthens Coordinated Development of Material and Spiritual Civilization Meeting people's needs for a better life constitutes the fundamental goal of Chinese path to modernization. In the new era, the structure of people's needs has exhibited two key characteristics: first,

demands have become more diverse and personalized, with greater attention to product and service quality; second, as living standards improve, people's spiritual and cultural pursuits also require "resonance at the same frequency," continuously enriching and elevating. The digital economy can promote coordinated development of material and spiritual civilization. In terms of material civilization, data elements empower traditional factors such as land and labor, further improving resource allocation efficiency and generating enormous wealth creation effects [8] to meet people's multi-level product demands. Regarding spiritual civilization, digital technologies have propelled the prosperity of digital culture industries, providing more effective means for disseminating Chinese culture. New business forms such as digital culture-tourism and e-government have developed rapidly, greatly enhancing people's experiences and sense of well-being while further satisfying demands for high-quality spiritual civilization development.

1.4 Digital Economy Strongly Supports Green Development for Harmonious Coexistence Between Humanity and Nature Harmonious coexistence between humanity and nature represents a fundamental pathway of Chinese path to modernization, focusing on balancing economic development and ecological civilization. Promoting such harmony requires creating more material and spiritual wealth to meet people's growing needs for a better life while simultaneously satisfying the need for a beautiful ecological environment [9]. The digital economy helps foster green and low-carbon production and lifestyle patterns. On the production side, technologies such as big data, artificial intelligence, and digital twins enable intelligent and green transformation of traditional industries. The flow of data and knowledge reduces unnecessary physical movement and optimizes energy and resource allocation efficiency [10], making smart energy and green factories key directions for enterprise transformation and upgrading. Digital technology can be applied not only in energy production and environmental monitoring to improve monitoring precision but also to accelerate energy structure transformation, promote innovation in new energy and green technologies, enhance the marketization capacity of green industries, and further increase the proportion of green GDP. On the consumption side, digital applications such as bike-sharing, online offices, and smart government services have rapidly proliferated, helping to drive transformation in consumption patterns and social governance through green concepts, prompting the entire society to consciously participate in ecological protection and earnestly practice green development principles. The deepening of digital economy ecologization and ecological economy digitalization will enable digital productivity to generate greater ecological benefits, and applying digital technology to transform ecological industries across entire value chains can effectively promote integrated development of the green and digital economies.

1.5 Digital Economy Helps Build a Peaceful Path for a Community with a Shared Future in Cyberspace Peaceful development constitutes a

distinctive feature and essential path of Chinese path to modernization. The digital economy dramatically shortens the spatiotemporal distance of human economic activities, and deep integration between the digital and real economies facilitates the formation of a unified large market, enabling virtuous cycles of production factors both domestically and internationally [11] while significantly enhancing the connectivity and resilience of economic systems. The development of digital payment systems and modern logistics can effectively reduce costs of international trade and economic-technical cooperation, thereby facilitating cross-border factor flows and commodity circulation. The transformation of global governance systems brought about by digital technology development will connect countries more closely, making win-win cooperation the greatest intersection of interests for all parties and promoting global industrial division of labor and collaboration. The widespread application of digital technology increasingly blends national cultures, enhancing exchanges and cooperation while reducing confrontation and conflict. Aligning with informatization and intelligentization development trends, the further strengthening of global digital infrastructure connectivity helps eliminate digital divides, promotes information sharing and mutual trust-based cooperation, unleashes new drivers of digital economy growth, and thereby drives all countries to jointly build a community with a shared future in cyberspace and create a mutually beneficial and win-win path of peaceful development.

2 Challenges Facing Digital Economy in Enabling Chinese Path to Modernization

While fully recognizing the enabling role of the digital economy in Chinese path to modernization, we must also attend to the challenges and constraints it faces in the new development stage.

2.1 Digital Economy's Scientific and Technological Foundation Needs Further Strengthening Scientific and technological foundation capacity provides the material, technical, and institutional-cultural environment for scientific and technological innovation, offering a long-term mechanism for the digital economy to support Chinese path to modernization. From the perspective of global digital economy development, China's digital economy still lags behind developed countries such as the United States, with prominent problems of being "large but not strong" and "fast but not excellent." China remains relatively weak in critical basic materials, advanced basic processes, and core technology R&D, with obvious shortcomings in its scientific and technological foundation capacity. For instance, global Internet standards are primarily dominated by the United States; electronic design automation (EDA) tools for chip design rely on foreign sources, and high-end photolithography machines remain monopolized by foreign companies. China depends on imports for 95% of high-end specialized chips, over 70% of intelligent terminal processors, and the vast majority of memory chips. Following the intensification of China-U.S. economic and trade friction, the United States has launched broader and more intensive

technological "decoupling" against China, making the construction of China's digital technology foundation capacity particularly crucial. Only by grasping the "bull's nose" of independent scientific and technological innovation can China better leverage its institutional and market advantages to provide innovative momentum for Chinese path to modernization.

2.2 Obstacles to Data Factor Circulation Need to be Removed The modern industrial system constitutes the material foundation for Chinese path to modernization, and deep integration between the digital and real economies represents an important characteristic of modern industrial development. How to promote data factor circulation and sharing to leverage its leading, optimizing, and coordinating role in resource allocation is an urgent problem for supporting high-quality development of the real economy. Although China possesses advantages in data factor scale—according to IDC estimates, China's total data generation is expected to reach 48.6 ZB by 2025, accounting for approximately 27.8% of the global total—problems such as low data quality, limited data value, and persistent circulation obstacles mean that most traditional industries remain in the initial stages of digitalization. Data resource systems covering supply chains, value chains, and industrial chains have yet to be constructed, and data factors face circulation barriers and coordination difficulties, making it hard to realize their potential value in supporting economic management decisions and demonstrating limited practical utility in promoting the aggregation of technological innovation factors and industrial transformation and upgrading.

2.3 Structural Imbalances in Digital Development Persist From the perspective of socioeconomic digitalization development, structural imbalances remain at regional, industrial, and demographic levels. At the regional level, significant disparities exist in digital infrastructure investment and construction progress across different areas, resulting in pronounced imbalances in digital economy development between eastern and western regions and between urban and rural areas. Generally, more economically developed regions have more active digital economies and stronger leading roles in the national economy, while digital infrastructure in different regions fails to achieve effective interconnectivity. At the industrial level, the service sector oriented toward consumption has undergone relatively rapid digitalization, while digitalization in manufacturing remains in its infancy, and digital penetration in agriculture is the lowest. At the demographic level, digital skill disparities among groups are significant during the digital wave, with particular vulnerabilities among the elderly and other groups in various digital applications.

2.4 New Security and Governance Systems Need Further Improvement In enabling Chinese path to modernization, the digital economy must balance the relationship between development and security. The modern industrial system integrating digital and real economies represents a new form

of industrial upgrading, making the construction of its new security system particularly important. Currently, the technological environment of various emerging modern industries is complex, with risk hazards remaining in security system construction and new security governance concepts urgently needing to be established. Simultaneously, China must accelerate the independent R&D of core technologies in the security domain to enhance modern industrial security management capabilities. Furthermore, public service platforms for modern industrial systems require further development. By improving national, regional, and industry-level big data center systems, China should accelerate the establishment of reliable and secure data collection and exchange systems, and improve data sharing systems, data management systems, orderly data development and utilization systems, and data security systems. Regarding digital platform governance, significant room for improvement remains in governance systems and models for scientifically handling the boundaries between government and market and properly managing the relationship between development and fairness.

3 Policy Recommendations for Digital Economy Enabling Chinese Path to Modernization

(1) Deepen mechanisms to strengthen core technology R&D and enhance digital economy's scientific and technological foundation capacity. Independent and integrated innovation in core technologies constitutes a key pillar for the digital economy to enable Chinese path to modernization. Digital technology R&D and application involve large investments, long chains, and high uncertainty. The government should take the lead in integrating research forces from industry-leading enterprises and research institutes, increasing investment in basic and common technologies for the digital economy as well as intelligent systems and software. A collaborative industry-academia-research mechanism aligned with the technology innovation diffusion cycle should be established. During the basic research phase, research institutes and universities should play leading roles, with deeper "decentralization, management, and service" reforms establishing trust, integrity, and 容错 (error-tolerant) mechanisms suitable for original innovation to drive organized scientific research through institutional traction. During technology evaluation and application phases, enterprises should participate in jointly advancing 成果转化 (achievement transformation) to achieve independent controllability of key digital technologies and enhance the digital economy's scientific and technological foundation capacity. Simultaneously, mechanisms for deepening the integration of digital technology with industries should be advanced. In industrial R&D and design, vigorously develop applications of intelligent technologies such as digital twins and simulation modeling to reduce product design and development costs while improving quality. In production processes, explore and develop independent perception recognition, machine vision, and intelligent analysis technologies to achieve large-scale personalized customization and multi-variety flexible production. By optimizing production methods to substantially improve production efficiency, China's modern industrial system can enhance its international com-

petitiveness. Additionally, safeguard measures for universal digital technology adoption should be established, encouraging the development of modular, easy-to-learn digital technology tools to lower learning and usage thresholds, with emphasis on digital skills training in traditional industries and specific fields to achieve smooth labor structure transformation.

(2) Improve data infrastructure system construction to activate data factor potential. Data infrastructure system construction represents top-level institutional design for coordinating data resources and enabling modernization through the digital economy. At the 26th meeting of the Central Committee for Comprehensively Deepening Reform, General Secretary Xi Jinping emphasized that data infrastructure system construction concerns national development and security, requiring protection of national data security and personal and commercial information while promoting efficient data circulation and utilization to empower the real economy. This involves coordinating data property rights, circulation and trading, income distribution, and security governance to accelerate the construction of a data infrastructure system. This guidance points the direction for leveraging data factor potential to support modernization. First, accelerate the establishment of data classification and grading systems, combining the economic and legal attributes of data resources to construct classification and grading standards and usage norms for public data, enterprise data, and personal data, fostering a sound data factor industry ecological environment. Second, actively explore innovations in data trading systems and technologies, build full-factor data circulation platforms, encourage connections between data trading markets and data parks or industrial clusters, and cultivate emerging vertical data markets. Third, strengthen the development of industry data sharing and exchange platforms to break down inter-departmental data barriers, facilitate data openness and sharing and efficient management, activate the value of public and industrial data, and collaboratively promote informatization, urbanization, new industrialization, and agricultural modernization.

(3) Address imbalances and inadequacies to explore effective paths for coordinated development. The core of industrial development imbalances and inadequacies lies in uneven allocation and differential benefit transformation of factors such as labor, capital, technology, and data. Regarding digital infrastructure construction, coordination and top-level design should be strengthened, with increased construction efforts in remote areas to narrow gaps between urban and rural areas and across eastern, central, and western regions. Digital transformation and upgrading of traditional infrastructure should be promoted to achieve interconnectivity across regions. At the industrial level, with technological innovation as the guide and market orientation, internationally competitive digital industry clusters should be built to form a modern industrial system with Chinese characteristics integrating digital and real economies. Big data and other intelligent technologies should be applied to resolve market uncertainties and enhance industrial development resilience. Additionally, safeguard measures for universal digital technology adoption need to be established, encouraging the development of modular, easy-to-learn digital technology tools to

lower learning thresholds, with emphasis on digital skills training in traditional industries and specific fields to achieve smooth labor structure transformation.

(4) Strengthen security system construction and innovate collaborative governance mechanisms between government and market. The modern industrial system represents a new industrial upgrading form integrating various high technologies, making the establishment of its security system and governance mechanisms particularly important. First, establish new security management concepts that integrate security system construction into the entire process of modern industrial planning, operation, and management. Fully consider various risk hazards in complex environments and new technology integration, establish appropriate security system construction standards, and formulate full-lifecycle security management norms and safeguard policies tailored to different industrial characteristics. Second, with government as the leading actor, integrate public data resources to effectively compile government, industrial, and enterprise data. Establish differentiated data supervision standards based on data importance and risk levels, and improve data sharing systems, data management systems, orderly data development and utilization systems, and data security systems. Third, with market entities as the foundation and digital government as the vehicle, innovate regulatory approaches. Uphold inclusive and prudent regulatory principles to guarantee equal rights, opportunities, and rules for all market entities, and encourage more enterprises to assume social responsibility through institutional incentives, innovating a "government + market" collaborative governance mechanism.

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Note: Figure translations are in progress. See original paper for figures.