# Digital-Real Economy Integration: Empowering New Quality Productive Forces

Zhou Yahong, Lang Xuhua*

*School of Economics, Shanghai University of Finance and Economics (SUFE), Shanghai, China*

***Abstract:*** *The deep integration of the real and digital economies ("digital-real economy integration") is emerging as a new growth driver for China's high-quality economic development. In the context of digital-real economy integration, the development of new quality productive forces has four main advantages: improving the quality and efficiency of factors, deepening the division of labor and collaboration, expanding market space, and innovating resource allocation. These advantages are embedded in every aspect of corporate manufacturing and macroeconomic operations, resulting in inherent dynamism for the development of new quality productive forces. With a focus on high-quality industrial development, these distinct advantages of digital-real economy integration are reflected throughout the development mechanisms of new quality productive forces. Specifically, specialized industrial production, industrial chain restructuring, and resource integration of industrial clusters result in a more comprehensive and coordinated modern industrial system, as well as an interconnected and structured development system for new quality productive forces. Given the challenges facing China's development of new quality productive forces in the context of digital-real economy integration, it is critical to enhance market-based factor mechanisms, industrial innovation mechanisms, investment and financing mechanisms for new industries and business models, and the corresponding institutional frameworks in order to fully support the development of new quality productive forces. This will unleash the technological, systematic, and synergistic advantages of digital-real economy integration.*

***Keywords:*** *New quality productive forces, digital-real economy integration, development advantages, future trajectory*

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## 1. Introduction

The Third Plenary Session of the 20th Central Committee of the Communist Party of China (CPC) called for "improving digital-real economy integration systems" and approved new strategic plans to advance new industrialization, establish institutional systems for developing the digital economy, and

* CONTACT: Lang Xuhua, email: langxuhua@mail.shufe.edu.cn.

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improve digital industrialization and industrial digitalization. Since the 20th CPC National Congress in 2022, the Chinese government has prioritized the "Digital China" Initiative and the development of the digital economy as strategic priorities. In the midst of a new round of technological revolution and industrial change, China is well-positioned to seize new opportunities by developing its digital economy and capitalizing on its enabling effect on the real economy. Policymakers should prioritize the holistic, systematic, and coordinated nature of digital-real economy integration when developing new productive forces. They must emphasize the importance of the real economy and the role of the digital economy in enhancing its quality and efficiency. Clearly, the deep integration of the real and digital economies ("digital-real economy integration") is emerging as a new growth driver for China's high-quality economic development.

In order to develop a modern industrial system, it is critical to promote the deep integration of the real and digital economies, which have grown in importance to the national economy. In terms of aggregate volume, China's digital economy now accounts for 42.8% of its GDP, contributing 66.45% to GDP growth in 2023. In terms of structure, China's industrial digitalization as a share of its digital economy continued to increase to 81.3% in 2023, and the digital economy's adoption rate in the secondary industry surpassed 25% for the first time, indicating continuous progress in digital-real economy integration[1]. Meanwhile, the development of the digital economy helps break the inherent limitations of geographical space, better tap into local advantageous resources, aggregate to form regional characteristic industrial clusters, and continuously optimize the inter-regional industrial collaborative layout. This makes it an important driver for fostering and developing new quality productive forces through revolutionary technological breakthroughs, innovative allocation of production factors, and promoting deep transformation and upgrading of industries.

There have been lively discussions in academia regarding the relationship between the digital economy and development of new quality productive forces According to Li (2019, 2023), Hu (2024), and Sun (2024), new quality productive forces are defined by disruptive innovations, new industrial chains, and high development quality, which are combined with the integrated and pervasive nature of digital technologies. New technologies, factors, and business models emerging from the digital economy are indications of China's new economic dynamism in the new stage, with digital-real economy integration serving as a defining feature of China's high-quality economic development. According to Ren and Wang (2023), digital new quality productive forces arising from the digital-real economy integration are a specific manifestation of new quality productive forces, as well as critical factors for high-quality economic growth. Shen et al. (2024) believed that ongoing digital innovations had transformed the mode of production, acting as a key driver for the formation of new quality productive forces and enabling high-quality economic development. Hong (2024a, 2024b) emphasized the importance of the digital economy in creating a modern industrial system and paving the way for the development of new quality productive forces. While existing research has provided a comprehensive understanding of the development of new quality productive forces in the context of digital-real economy integration, more holistic and systematic research is still needed. This paper aims to identify the developmental advantages of the digital economy and uses this as a foundation to systematically construct the intrinsic logic for developing new quality productive forces under the integration of digital and physical economies. It also analyzes, from a comprehensive perspective, the current challenges,

[1] Source: China Academy of Information and Communication Technology ("CAICT"). Research Report on China's Digital Economy Development (2024) [EB/OL]. August 28, 2024 [September 18, 2024]. http://221.179.172.81/images/20240828/53111724804104890.pdf.

bottlenecks, and obstacles that China faces in better facilitating the development of new quality productive forces. Furthermore, it intends to provide policy insights and recommendations for realizing the surge and burst of advanced productivity through digital-real economy integration.

## 2. Digital-Real Economy Integration: Four Advantages of Developing New Quality Productive Forces

The digital economy arose from a series of network economy activities, including the widespread commercialization of internet applications (Tapscott, 1996). The extensive development and application of information technologies, as well as the digitalization and intelligence of social and economic activities, have resulted in an abundance of economic activities based on the widespread use of information and communication technologies (ICTs). They include the use and evolution of digital technologies, the accumulation of digital capital, and the creation and distribution of digital goods and services (Kotarba, 2017). The digital economy is distinguished by the typical features of ICT-based applications, open integration, and ubiquity (Mei, 2022). These three features of the digital economy are combined with the real economy in terms of market development scope and industrial participation depth, resulting in unique advantages of new quality productive forces at the factor, industry, and market levels.

### 2.1 Advantage of Enhancing Quality and Efficiency of Factors

The development of traditional productive forces is defined by large-scale production and a focus on quantitative growth, in which social and economic activities are carried out through the mass accumulation of physical factors such as means of production and labor force. In contrast, the development of new quality productive forces centers around increasing efficiency per unit of output while also improving the quality of the means of production and labor force through the pervasive and disruptive nature of digital innovations to increase productivity and capacity utilization within unit time. The advantages of improving factor quality and efficiency are manifested in the following two aspects:

First, digital technologies and the data factor help to improve factor quality and efficiency by recombining different production factors in manufacturing and management activities. To begin with, the widespread adoption of digital technologies such as artificial intelligence (AI), block chains, big data, and cloud computing has enabled automated management and intelligent control of manufacturing processes. Data processing and precise analysis of people, material, financial, and information flows have enabled the overall coordination and loss-free transmission of value creation and realization activities (Hong and Ren, 2023), resulting in significantly less information loss due to management hierarchies and interpersonal communications and thereby increasing productivity. Another benefit of transforming data into a factor of production is that it allows other factors of production to unleash their innovation potential. By adjusting the input proportion of production factors through analysis and calculation and recombining the mode of production, manufacturers can achieve a higher return with less input of production factors, thus increasing capacity utilization.

Second, digital technologies and data have made it possible to improve the quality and efficiency of traditional production factors. In terms of the means of production, the combination of traditional machinery with sensors and industrial software enables manufacturers to meet the demands for differentiated and customized flexible production, achieving integrated manufacturing and distribution on both the supply and demand sides while increasing factor utilization. In terms of labor force, the widespread adoption of digital technologies and the data factor has generated highly qualified workers

who are skilled at intellectual activities and adaptable to changing market conditions. The improvement of human capital structure has further eliminated unnecessary losses caused by inferior and inefficient traditional factors of production, facilitating product quality and efficiency improvements (Huang et al., 2024).

### 2.2 Advantage of Deepening Division of Labor and Cooperation

The socialization of production is an important aspect of market-based economic activities. With their ubiquitous connections, digital technologies serve as the technological foundation for the correlation of various industrial sectors, resulting in a brand-new digital space in which informatization spearheads a broader and more coordinated division of labor, raising social productivity to new levels of development quality and efficiency. This new division of labor system has the following new features:

First, the internal production processes of businesses show a growing trend of socialization in the use of the means of production. The division of labor in businesses is becoming increasingly reliant on digital industries, particularly industrial software, for data collection, processing, and extraction, as well as socialized analysis of demand data. According to the Chinese Ministry of Industry and Information Technology's (MIIT) Research Report on China's Industrial Software Development (2024), China's industrial software market was worth 241.4 billion yuan in 2023, up 12.3% from the previous year, and the numerical control ratio of critical work processes in industrial software enterprises reached 62.2%[2]. An industrial ecosystem is rapidly developing for socialized data access.

Second, socialized data and information networks, as well as the socialized distribution of labor and production means, have transcended the current organizational form and spatial limitations of enterprises. This has led to a networked mode of collaboration in which leading enterprises operate core businesses and numerous outsourced businesses participate in production and operations, as evidenced in the division of labor and collaboration between enterprises. In this mode of collaboration, leading enterprises and outsourced businesses specialize their respective main businesses while deepening the production socialization process based on internet-based factor flow, resulting in commodity production activities at a higher level and on a larger scale (Wang and Li, 2022). Take service outsourcing, for instance: the value of service outsourcing contracts signed by Chinese enterprises in 2023 increased by 17.6% year on year. Offshore IT outsourcing, business process outsourcing, and knowledge flow outsourcing volumes grew by 13.1%, 17.8%, and 18.4%[3] year on year, respectively. Service outsourcing has emerged as a key driver of demand for digital products and services.

### 2.3 Advantage of  Broadening Market Space

Constrained by differences in geographical space, cultural customs, and institutional environments, traditional productivity tends to create market segmentation and resource misallocation , thus limiting market expansion and economic development. In the digital economy, increasing computing power and improving algorithms have resulted in the development of cloud computing, edge intelligence, and other technologies that enable distributed and intelligent socialized mass production. New technologies have created new quality productive forces in open and integrated production across industries.

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[2] For data source, please refer to: the China Association of Small and Medium Enterprises. Report: China's Industrial Software Market Hit 241.4 Billion Yuan in 2023. [EB/OL], (June 25, 2024) [September 18, 2024], https://www.ca-sme.org/content/Content/index/id/51161/isadmin/1.

[3] Source: The Ministry of Commerce of the People's Republic of China. Head of the Service Trade Department of the History of Commerce on China's Service Outsourcing Industry Development in 2023 [EB/OL], February 4, 2024 [September 18, 2024] [September 18, 2024], https://www.mofcom.gov.cn/xwfb/sjfzrfb/art/2024/art_6f2a80a5ed2a42358972dc80396e4dbd.html.

In this process, "scenarios" represent a specific type of various production organizations and relationships in industrial activities. While computing power and algorithms created new scenarios, digitally integrated innovations in various application scenarios expanded and broadened the growth space of industrial development. On the one hand, digital technologies effectively combine industrial demand with social perceptions and production organizational forms through technological availability, which manifests as a ubiquitous digital intelligence network, generating viable options for scenario applications (Melville, 2010). On the other hand, digital iterations of scenarios are conducive to the dynamic optimizations of the production characteristics, linkages, and development positioning of various industries (Woodruff, 1997), further enhancing the forward, backward, and lateral industrial correlations to liberate and develop social productive forces while advancing industrial value co-creation.

**2.4 Advantage of Innovating Resource Allocation**

With its technological characteristics, the digital economy is well-positioned to extract, collate, calculate, and process data from real-world scenarios, reshaping economic production and distribution processes. The clustered and interactive development of digital technologies such as mobile internet, cloud computing, big data, and AI has not only reshaped industrial development and collaboration paradigms, but has also transformed market-based resource allocation, laying the groundwork for the development of new quality productive forces.

On the factor side, digital technologies have brought innovations to the market-based allocation of production factors based on the operation of a technology innovation system, as evidenced by the following three aspects: (1) The massive data generated by the industrial digital transition has transformed the R&D paradigm, increased knowledge production and commercialization efficiency in technological innovation activities, and facilitated the shift from quantitative competition to qualitative competition, thereby accelerating the clustering of high-quality production factors such as talent and capital at the front end of industrial activities. (2) Digital technologies have created additional avenues and modes for knowledge diffusion, and the emergence of platform organizations has significantly increased the instantaneity and accuracy of production-distribution matching, prompting the rapid turnover and refined allocation of production factors, as well as change in the forms of production organization, such as flexible manufacturing. (3) The integration of the digital and real economies has transformed the mode of knowledge application by creating an ecosystem of factor support, industrial coordination, and digital governance, resulting in a complete closed-loop of factor formation and allocation within and between systems, facilitating the emergence and development of new quality productive forces.

On the industrial side, digital technologies have resulted in innovations for coordinated resource allocation supported by industrial system modernization. (1) As a result of the widespread integration of digital technologies, local advantageous and leading enterprises have expanded industrial chains, allowing factor concentration in the process of industrial and supply chain cooperation to develop industrial clusters integrating R&D, manufacturing, and services, thereby completing the primary allocation characterized by inter-regional resource agglomeration. (2) The spillover and diffusion effects of digital technologies contribute to increasing the level of technology applications for upstream and downstream enterprises, deepening the division of labor, facilitating value chain upgrades to mid- and high-end links, and completing the secondary allocation of regional resources along industrial chains. (3) Because of their boundaryless nature, digital technologies facilitate the dissolution and re-creation of

boundaries between regions and industries, as well as the integration of their business, organizational, managerial, and market resources across industries to form new technologies, business models, and paradigms that support the development of advantageous industries in various regions, completing the third allocation of inter-regional resources.

In a nutshell, the development of new quality productivity in the context of digital-real economy integration, leveraging its four advantages of improving factor quality and efficiency, deepening division of labor and cooperation, broadening market space, and innovating resource allocation, has driven the reshaping of socio-economic forms under high-quality development, from micro-level enterprise production processes to macro-level economic operation mechanisms.

## 3. Developing New Quality Productive Forces: Four-Pronged Rationale for High-Quality Industrial Growth

New quality productive forces are advanced forms of productivity that result from revolutionary technological breakthroughs, creative allocation of production factors, and profound industrial transitions. They are critical to the high-quality development of the real economy. The digital economy, with its ingenuity, penetration, and broad coverage, contributes significantly to the high-quality, efficient, and systematic development of the real economy, fostering the development of new quality productive forces with robust dynamism. Using the four dimensions of industries, industrial chains, industrial clusters, and industrial systems, we can gain a comprehensive understanding and assessment of the development mechanism of new quality productive forces in the context of digital-real economy integration.

### 3.1 Advantage of Improving Factor Quality and Efficiency: Nurturing Local Distinctive Industries Through Capitalizing on Factor Endowment Potentials

New quality productive forces must be developed based on such factors as natural resource availability, soil, topography, and climate. The enabling effect of science and technology should be fully applied to land productivity distribution using local natural resources. With its advantage of improving factor quality and efficiency, the digital economy is conducive to not only activating industrial stock but also stimulating industrial growth. As a production factor: (1) Data allows for the identification of potential demand that would otherwise be impossible to find under the traditional development model, as well as the integration of idle, sporadic, and otherwise uncorrelated factors to produce an "incremental supplement" effect (Wu and Ren, 2022). (2) Real-time data from production scenarios can be integrated to improve production efficiency and commodity quality by transforming manufacturing and management processes. Data, through its indirect effect, (1) can be applied to traditional production factors such as labor force and means of production, allowing for the renewal of labor skills as well as adequate utilization and iteration of means of production to explore factor potentials from inventory. (2) Data analytics based on market demand and production processes aid in identifying industrial development paths that align supply-demand and provide distinct advantages. Open innovations in digital intelligence technologies drive industrial innovation and spur the growth of factor endowment.

Localities must foster competitive advantages and new quality productive forces by developing local digital economy industries. According to the *China Association of Software Industry's Manufacturing Digital Transition Development Index Report* (2024), China's prosperous eastern and coastal regions maintained their lead in digital transition in 2023, while western and northwestern regions lagged behind. Furthermore, manufacturing digital transition is closely related to the level of manufacturing

development in various regions and has a clustered distribution. Heavy industrial sectors, such as iron and steel, chemical engineering, energy, and building materials, are particularly behind in their digital transition. These industrial sectors have the potential to become new tracks and hotspots for digital-real economy integration.

### 3.2 Advantage of Deepening Division of Labor: Promoting Energy-Efficient and Resilient Industrial Chains through Optimal Industrial Coordination

Developing characteristic industries makes it easier for localities to leverage their economic advantages in order to foster locally advantageous and leading enterprises. Meanwhile, regional industrial advantages open up opportunities for partnership and collaboration with businesses outside the region. Because of its ubiquitous connectivity, openness, and inclusiveness, the digital economy brings together the demonstration and spillover effects of advanced manufacturing processes during industrial development across various regions. As advantageous industries thrive, the digital economy enables the level of industrial chain division of labor between upstream and downstream enterprises in regional industries to be continuously deepened, hastening the upgrade of industrial, supply, and value chains to mid- and high-end links. Second, the new infrastructure system that underpins the growth of the digital economy overcomes past limitations of the regional concentration of the workforce and the socialized division of labor to specific regions. It facilitates industrial coordination and convergence and acts as an efficient vehicle for new technologies and factors. Third, the service sector promotes financial intermediation and intellectual support for industrial chain enterprises through its enabling and permeation effects on the digital economy, resulting in a complete industrial development chain that includes R&D, commercialization, industrial application, and market exploration. In this way, the service sector strengthens the inherent development resilience of industrial chains.

Industrial chain efficiency and resiliency are China's industrial development strengths in resisting external shocks, unleashing endogenous growth dynamism, and expanding socioeconomic service capabilities. They also play an important role in China's development of new quality productive forces. The emergence of digital technologies has eliminated barriers to industrial chain coordination, resulting in new development dynamism. Shein is a typical cross-border apparel e-commerce company that operates on the "small orders and quick reorders" model. Customer orders, production material turnover, inventory monitoring, production, quality inspection, and logistical distribution are all integrated into the company's WeChat platform. Through industrial chain integration based on dataset, the company has explored a new business model for apparel sales characterized by "short cycle, rapid turnover, small quantity, and instant distribution", avoiding the hefty warehousing costs due to apparel production backlogs[4] and ensuring effective coordination among upstream and downstream industrial chain enterprises.

### 3.3 Advantage of Expanding Market Space: Fostering Quality-Oriented Industrial Clusters through Resource Agglomeration

The digital space, which is composed of new-generation digital intelligence technologies, Web3.0, and data factor, has opened up new opportunities for the real economy to create value, reduce costs, and increase efficiency. First, digital space generates broad experiment scenarios for various industries in the real economy, enabling full-lifecycle simulation of the real economy from R&D to design and manufacturing. With its timeless, spaceless, boundaryless, and open characteristics, digital space is

[4] Tencent Research Institute. 2023 Digital Economy High-quality Development Report[EB/OL].(2023-09-26)[2024-09-19], https://new.qq.com/rain/a/20230926A08F5U00.

ideal for bringing together private actors to create an industrial innovation network through openness and integration, resulting in a complete industrial innovation ecosystem. Second, digital space enables the convergence of business scenarios, talent, capital, and data beyond the geographical limitations of traditional industrial development, allowing for a broader and deeper approach to addressing "chokepoint" problems in the critical technologies of the real economy. Factor and technology clusters are resource spaces that result in high-quality, efficient industrial clusters. Third, the iteration of production management, technology innovation, and the development paradigm through digital space is conducive to the realization of R&D, design, manufacturing, marketing, and coordination capabilities in various industries linked by digital technologies. The resulting industrial sophistication and modernization paved the way for the emergence of quality-oriented industrial cluster nodes, allowing for the construction of development space within a favorable industrial ecosystem.

In the context of global industrial and supply chain restructuring, China is undergoing a digital industrial transformation and relocation, necessitating the formation and competition of industry chains. Similarly, industrial chains are critical for the creation of competitive, efficient, and resilient new quality productive forces. Currently, China's industrial cluster distribution is more concentrated in the eastern and southern regions than in the western and northern regions. The eastern region is home to more than half of China's critical industrial clusters, particularly those related to ports, shipping, and trade. However, there is still room for improvement in infrastructure connectivity, coordinated development among leading supply chain enterprises and participating companies, integrated supply chain services, and a coordinated supply chain security system.

### 3.4 Advantage of Innovating Resource Allocation: Fostering a Complete, Advanced, and Secure Modern Industrial System amid Positive Interactions Between Industrial Digitalization and Digital Industrialization

Digital industrialization and industrial digitalization together form an important pillar for the digital economy's development. While the former supplies the real economy with technologies, products, and services, the latter drives the comprehensive renovation and upgrade of various industries. Their innovative development and combined effects have accelerated the innovative allocation of industrial land factor resources, thereby providing solid support for the development of new quality productive forces. On the factor side, digital industrialization generates new business models for industrial development in the real economy by promoting digital technology innovations as well as industrial and commercial data applications (Ren, 2023). New forms of technology and knowledge-intensive industrial development driven by new business models have restructured and optimized the combination of various production factors in specific production processes, allowing for further improvement in the quality of productive forces (Huang and Liu, 2023). From an industrial standpoint, industrial digitalization has enabled dynamic optimization of the proportion and efficient coordination of factor input in the manufacturing process. Continuous input of the data factor and intermediate data products promotes, deepens, and even restructures the resource distribution and division of labor among various industries. While increasing the value creation of traditional industries, such input paved the way for the development of strategic emerging and future industries that comprise a comprehensive, sophisticated, and secure modern industrial system and strengthen new quality productive forces.

Obviously, the development of new quality productive forces in the context of digital-real economy integration results from the joint effects of the preceding four elements. With its innovativeness, the digital economy not only relies on specialized production at the industrial level to support distinct regional industrial advantages, but it also generates forward, backward, and lateral correlations between

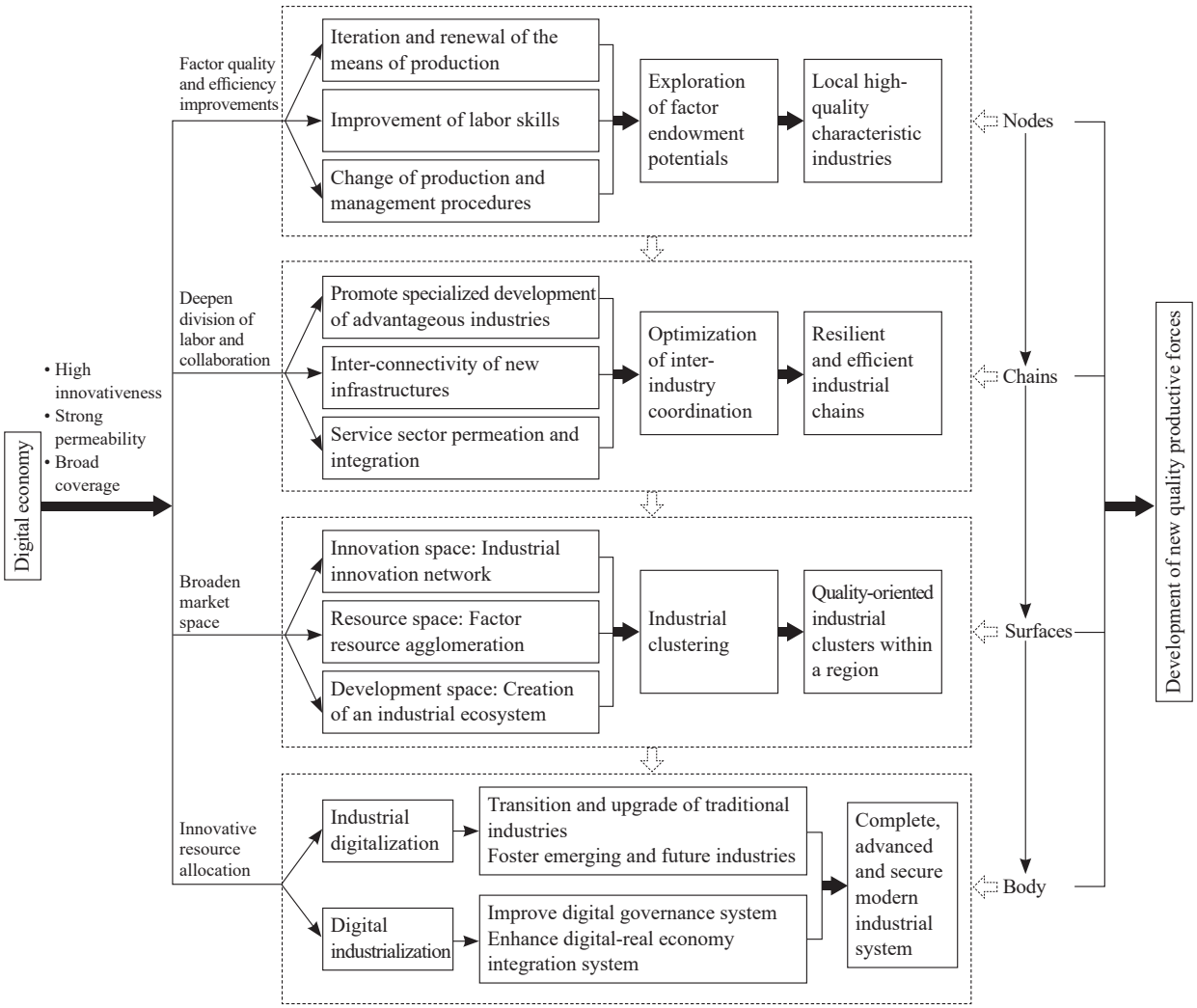


**Figure 1: Theoretical Mechanism of New Quality Productive Forces in the Context of Digital-real Economy Integration**

various industries at the industrial chain level due to its high permeability. The digital economy, with its broad coverage, breaks down development barriers at the industrial cluster level, bringing resources together and forging a broader and more coordinated modern industrial system by allocating innovation resources to foster new quality productive forces. The development of new quality productive forces in the context of digital-real economy integration is to develop a system that is interconnected, mutually integrated, and structurally three-dimensional. It takes industries as "nodes", industrial chains as "chains", industrial clusters as "surfaces", and the modern industrial system as the "body" (Figure 1).

## 4. Problems and Challenges in Developing New Quality Productive Forces under the Integration of the Digital and Real Economies

Integration of the digital and real economies can help to develop new quality productive forces. However, in practice, this process is fraught with problems such as the divide between real and digital economies, horizontal industrial competition and homogeneous development, a lack of synergy between

the institutional and policy systems to support digital-real economy integration, and deficiencies in the security and stability of digital-real economy integration. These issues have limited the impact of the four benefits provided by digital-real economy integration, undermining the level and efficiency of new quality productive forces.

### 4.1 Corporate Level: Divide in the Digital-Real Economy Integration

Intelligent manufacturing is the foundation and manifestation of China's digital-real economy integration strategy. It also serves as an important link in the development of new quality productive forces. However, intelligent manufacturing has a limited penetration. The divide between digital and real economies persists, limiting the digital economy's ability to improve factor quality and efficiency.

First, smaller and less regulated businesses lack the drive to embrace digitalization. The digital transition is the process of incorporating AI, cloud computing, big data, and other new technologies into traditional industries. The digitalization and scientific analysis of upstream and downstream corporate production factors, as well as organizational collaboration relationships, will help to optimize factor resource allocation and improve corporate economic performance. Despite widespread agreement on the importance of embracing digital transition, some businesses are hesitant or unwilling to do so due to concerns about the high costs and uncertain business outlook. According to the *Digital Transition Development Report* (2022-2023), China's corporate digital transition reached 51.8 in 2022. The level of performance is judged based on the total score of the corporate digital transition assessment as well as scores on various dimensions. They represent overall scores for the corporate digital transition. On an increasing scale, L1 represents entry level and L5 represents excellence level. Enterprises that are still at the entry level (L1)[5] or have yet to implement digital transition accounted for 42%, with the majority being small and medium-sized enterprises (SMEs). Manufacturing sectors such as light industries, textiles, packaging, building materials, and waste recycling have lower industry average profitability rates and fewer process control requirements, resulting in a digitalization rate of less than 50%.

**Table 1: Level of Digital Transition for Some Manufacturing Enterprises in China (2022)**

| Manufacturing sectors | Score of digital transition level |
|---|---|
| Electronics | 58.0 |
| Transportation equipment manufacturing | 57.5 |
| Petrochemicals | 55.3 |
| Pharmaceuticals | 52.7 |
| Food | 50.9 |
| Metallurgy | 50.8 |
| Machinery | 50.4 |
| Light industry | 48.9 |
| Textiles | 48.1 |
| Packaging | 46.3 |
| Building materials | 45.4 |
| Waste recycling | 41.8 |

Source: *Research Report on the Hierarchical and Classified Assessment, Diagnosis and Benchmarking Model for Corporate Digital Transition*, cited from the *Digital Transition Development Report* (2022-2023).

[5] The term "level of performance" refers to the total score of the corporate digital transition assessment, as well as the scores on various dimensions, which represent the overall scores for the level of corporate digital transition, with L1 representing entry level and L5 representing excellence level, in that order.

Second, enterprises that have embraced the digital transition place a higher value on scenario-based applications of digital technology, but there is still room for basic R&D of digital technologies and commercialization of R&D results. Specifically, (1) enterprises making the digital transition devote a small portion of their total budget to R&D, reflecting their limited original innovation capacity. Limited R&D investment makes it difficult for them to generate disruptive and novel technological breakthroughs, innovations, and potential productivity gains. A comparison of overall R&D intensity data between Chinese and Western enterprises reveals that the R&D intensity of Chinese enterprises tripled between 2010 and 2020, from 1.2% to 3.6%, but it was only 46.2% of the overall R&D intensity of US enterprises during the same period of time in 2020 (see Figure 2). (2) China's digital transition has yet to improve its innovation and commercialization capabilities. In 2022, China's commercialization rate of sci-tech research results was only about 30%, which pales in comparison to developed countries such as the United States and the European Union, which were 60% to 70%. This demonstrates that China has significant room for improvement in its construction of the industry-university-research-application integration capabilities. And the connection between the scientific research achievements of universities and research institutions and the technological application achievements of enterprises is still inadequate.

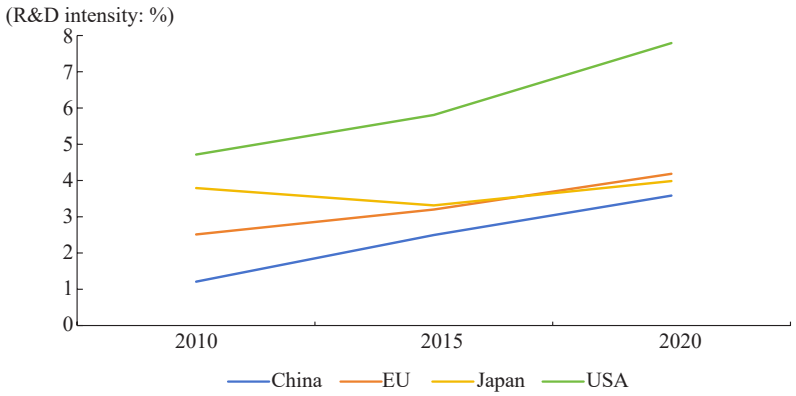


**Figure 2: Comparison of Overall R&D Intensity between China and Developed Countries (2010-2020)**

Notes: R&D intensity = R&D spending / net sales volume.

### 4.2 Homogeneous and Uneven Development Persists in Digital-Real Economy Integration at the Regional Level

Balanced and coordinated industrial development is an important path for new quality productive forces to emerge on a larger scale and with higher quality. However, China's current digital-real economy integration still falls short of this vision, making it difficult to fully realize the advantage of the digital economy in deepening industrial cooperation.

First, the stampede for digital industries in some localities has exacerbated homogeneous industrial competition, as evidenced by a rush to develop chip manufacturing and AI while regarding traditional industries as "low-end" sectors to be relocated elsewhere. Emerging industries have technology and capital-intensive characteristics, necessitating more factor accumulation and a stronger industrial base. In the integration of the digital and real economies, some localities have jumped on bandwagons and followed technology trends by developing industries that lack proper industrial conditions, human

resources, and technological reserves. This has resulted in low-level repetitive construction in the digital industry in certain areas. Low-end industrial development and homogeneous competition have resulted in a low degree of compatibility between real and digital economies. Uncompleted projects caused more resource waste and severe resource allocation distortions.

Second, the differences in industrial infrastructure conditions across different regions lead to weak digital collaboration capabilities at the regional level, highlighting prominent issues of uneven development. In 2003, digital technology adoption rates in China's primary, secondary, and tertiary industries were 10.78%, 25.03%, and 45.63%, respectively, highlighting the issues of inadequate and uneven development across industries. China's industrial structure varies significantly by region. The level of digitalization is higher in the eastern coastal region, which is dominated by the service sector, but it is relatively low in some parts of the central and western regions, where the manufacturing and even agricultural sectors predominate. This contrast highlights the west-east industrial digitalization disequilibrium. It also restricts the implementation of digital technology capabilities for improving industrial coordination and resource allocation on a larger market scale.

### 4.3 Opportunities for Enhancing Security and Robustness in Digital-Real Economy Integration

The security and stability of digital-real economy integration are critical to the resilience of new quality productive forces. However, China's digital economy continues to face numerous risks and challenges in terms of data, computing power, and algorithms, limiting its ability to explore market space and innovate resource allocation.

First, the unclear boundary of rights, limited technological means, and gaps in standardization have discouraged and disabled data openness, shared access, and transactions in China. There are significant contradictions between data property rights and segmentation, as well as between openness and protection. The problem of "data islands" persists. The market, pricing, and distribution mechanisms for the data factor are still in their early stages (Li, 2022). As a result, the data factor's role in increasing productive capacity and matching supply and demand cannot be fully realized, and data security risks remain.

Second, China is facing the following three challenges in developing computing power: (1) Computing power coordination is insufficient. There is room to improve the computing power structure of nodes through the "East Data, West Computing" project, as well as coordinate computing power between the eastern and western regions. (2) The computing power ecosystem is imperfect. Data centers built in certain parts of China (primarily in the central and western regions) fall short of their intended computing capacity due to disparities in digitalization levels across regions. Furthermore, there is insufficient coordination between upstream and downstream enterprises in the development of an application ecosystem market (Guo, 2024). (3) The rate of computing power development is insufficient. There are still weaknesses in China's computing power for core technology innovation. Its reliance on foreign sources of chips and software poses a chokepoint risk. This is not only detrimental to the development of high-performance computing power, but it also raises concerns about future computing power applications, as well as secure operations and maintenance.

Third, unreasonably aggressive algorithmic development may pose risks and challenges to market competition, industrial coordination, and other critical factors in developing new quality productive forces. (1) Barriers to fair market opportunities. Algorithmic operations are not fully transparent. Many large internet platform enterprises use algorithm-based technologies, decision-making, and recommendations to develop their data and user advantages while obstructing fair competition with other

market entities through their dominant market position. Such impediments do not contribute to fully unleashing the market competition mechanism and economic dynamism. (2) The creation of algorithmic barriers that impede industrial coordination. Some businesses have implemented algorithmic barriers to limit data factor flow and sharing across various industrial sectors, reducing the effectiveness of industrial coordination and worsening the industrial ecosystem.

## 5. Practical Directions for Developing New Quality Productive Forces in the Context of Integrating the Digital and Real Economies

To develop new quality productive forces in the context of digital-real economy integration, it is essential to concentrate on leveraging the four key strengths of integrating the digital and physical economies to foster advanced productive capabilities. This involves addressing various aspects including resources, sectors, and markets. By refining and enhancing the institutional frameworks supporting this integration, a cohesive systemic force would be built to drive the growth of high-quality productivity.

### 5.1 Enhancing Market-Based Factor Mechanisms to Release Dynamism for New Quality Productive Forces

First, the data factor market should be developed in collaboration with other factor market systems, with the goal of breaking down institutional barriers to free factor flow and improving factor quality and efficiency. This includes two key elements: (1) In terms of the data factor market, it is critical to remove barriers to internal and external data circulation, establish complete and efficient public data sharing mechanisms, as well as data distribution and transaction rules, and allow for the mass flow and reasonable use of data. (2) In terms of the data factor's enabling effect on other factors of production, it is suggested to coordinate the flows of materials, information, and data within regions by developing new infrastructure. Market thresholds should be lowered to break unnecessary institutional barriers on the basis of unified policies, rules, regulations, and standards, and promote the flow and distribution of production factors on a broader market scale.

Second, priority should be given to addressing market application challenges, developing industrial ecosystems, beginning with factor and innovation ecosystems, and optimizing factor market operational mechanisms. Specifically, (1) the government should improve and expand the types of factor transaction platforms, enact market rules for the cultivation and transaction of innovative and new-type production factors, proactively expand the functions of existing public resource transaction platforms, investigate transaction linkage mechanisms for factor transaction platforms, and promote the free flow and effective combination of new and traditional factors. (2) More efforts should be made to improve the mechanisms for transacting, commercializing, and distributing scientific research results, to strengthen the intellectual property rights protection system, and to promote the free flow of innovation factors such as knowledge, technology, and talent.

The third step should be to develop nationally unified quality and standard systems, proactively implement mutual recognition and adoption of standards across regions, and promote fair, flexible, coordinated, and compatible factor transition and resource allocation.

### 5.2 Enhancing Industrial Innovation Mechanisms to Convert Sci-Tech Outputs into Productivity

First, reforms should be implemented to remove institutional barriers in the field of technology, conduct scientific research to meet the needs of the country, people, and market, and smooth the "technology development, commercialization, and product application" cycle (Li, 2022). All sources

of innovation should be fully utilized by linking scientific research with experimental development and commercialization.

Second, steps should be taken to bring together industries, universities, research institutions, and users, to facilitate the links between technology R&D and industrial chains, to encourage the creation and commercialization of technology patents, and to promote the full lifecycle allocation of innovation resources across R&D, commercialization, and application. It is suggested to promote the openness and shared access of technology patents ready for industrial applications, fully unleash market entities' dynamism and ingenuity, and encourage market entities to establish innovation platforms through multiparty collaboration and shared access to technology in order to explore new development and collaboration mechanisms for future frontier technologies.

Third, it is critical to improve the industrial innovation system by balancing the government-market relationship and better aligning technological innovation with socioeconomic development. The government should direct the efficient and reasonable allocation of technology innovation resources to meet market demands and improve the synergy of innovation activities that create value. Industrial innovation activities should emphasize the importance of enterprises as the foundation of innovation. Various factors and resources should be directed toward enterprises, industries, and industrial clusters to help enterprises improve the entire system of production innovation activities, including technology innovation decision-making, R&D spending, scientific research organization, and commercialization. To promote government-market synergy for innovation, socil entities and enterprises should be encouraged to participate in specific activities and rule-making on major technology planning, key product R&D, and commercialization.

### 5.3 Enhancing Investment and Financing Mechanisms for New Industries and Business Models to Boost Capital Utilization Efficiency

First, priority should be given to investment and financing matchmaking. Investment and financing activities establish links between projects and funds. They are subject to mutual compatibility in terms of project and fund nature, characteristics, duration, and entity. Steps should be taken to break the vicious cycle of over-reliance on debt financing and increase efforts to develop feature, specialized, sophisticated, unique, and innovative industries, as well as forward-looking industries. Government fund guidance should be combined with private-sector investment and financing to help commercialize new business models for digital-real economy integration.

Second, significant efforts should be made to expand direct financing and promote the role of a multi-tiered capital market. The Sci-Tech Innovation Board (SSE STAR Market), the ChiNext board, and the Beijing Stock Exchange (BSE) are all important platforms for developing new quality productive forces. The capital market should improve its service capabilities for high-tech sectors in order to foster new productive forces and create new industries, business models, and paradigms. Financing activities should support specialized, sophisticated, unique, and innovative enterprises with a strong technological focus. Specifically, the SSE STAR Market should continue to improve its financing support system for high-tech and strategic emerging industries that are at the forefront of global technology and are critical to international economic competition and major national needs. The securities regulator is advised to diversify public listing criteria based on the "R&D results commercialization" standard and to improve information disclosure rules. The ChiNext board should encourage innovative, creative, and entrepreneurial ventures that incorporate new technologies, industries, business models, and paradigms. It should motivate traditional industries to unleash their innovations through means such as technology

renovation and equipment renewal under the standard of "enterprise growth potential". With its strategic mandate to serve specialized, sophisticated, unique, and innovative SMEs, the Beijing Stock Exchange (BSE) should promote the emergence of industrial innovation in a variety of sectors through the "enterprise development in vertical market segments".

### 5.4 Strengthening Institutional Assurance to Harmonize Regional Development Patterns and Boost Development Vitality

First, it is critical to develop sci-tech innovations by enhancing the system of national mobilizaion in order to accelerate digital-real economy integration. On the one hand, it requires a capable government to create new quality productive forces. The government should conduct forward-thinking reflections, overall planning, strategic arrangements, and comprehensive implementation to foster the development of new quality productive forces. It should speed up major breakthroughs in critical and disruptive technologies, work to resolve "chokepoint" issues, and establish China's new technological competitive advantages. On the other hand, an effective market must be proactive in developing new quality productive forces. Market economic entities should be proactive in responding to government policies, pursuing frontier technologies, and generating new quality productive forces through major breakthroughs in science and technology.

Second, it is critical to establish effective mechanisms for coordinating development models at the local, regional, and inter-regional levels in order to capitalize on the opportunities presented by digital-real economy integration and foster new quality productive forces tailored to local conditions. (1) Local governments are encouraged to use resources more efficiently when attracting investment in new industries, business models, and dynamism in their jurisdictions based on local resource endowment. (2) They should use ubiquitous and connected digital technologies to create more inclusive and equitable institutional conveniences for effectively developing industrial clusters in the region, as well as foster a regional development environment for industrial regeneration, complementarity, and symbiosis. (3) It is recommended that the central government coordinate the differentiated allocation of new production factors across regions, resulting in a landscape of regionally differentiated development and the symbiosis of new quality productive forces. CE

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