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Research on the Data Elements Enabling New Quality Productivity Mechanisms, Challenges, and Pathways

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Abstract. Data component, as a novel production element, is the primary catalyst for advancing new quality productivity. This paper finds that there are three mechanisms for data factors to empower new quality productivity. First, data factors give birth to new quality production materials such as artificial intelligence model; Second, data factors have broken through the objective limitations of traditional production factors and created a large number of new industries, new forms of business and new models. Third, under the interaction between data elements and employment practices, a new quality labor force adapted to the development of the digital economy era has been cultivated. In view of the triple contradictions between openness and security, efficiency and fairness, and property rights and income in the process of empowerment, this study puts forward the triple ideas of establishing a standardized and transparent data governance system, constructing a "technology-ethics" dynamic adjustment mechanism, and innovating value distribution mode, so as to further promote the release of data element value and promote the development of new quality productivity. At the same time, it provides a reference for relevant scholars to understand the relationship between data elements and new quality productivity.

1 Introduction

In March 2025, Premier Li Qiang pointed out in the Government work report that the Party and the government are actively accelerating the construction of digital China, and the added value of core industries in the digital economy will account for about 10% of GDP.

With the rapid development of digital technology, data factors, as new factors of production, have the characteristics of non-competitive [1-2], strong replicability [1,3] and low marginal cost [4,5], breaking through the limitation of scarcity of traditional factors of production, injecting new momentum into economic development and becoming the core driving force to foster the advancement of innovative, high-quality productive capabilities [6]. In the era of digital economy, data elements promote the transition from traditional productivity to new quality productivity through its unique value creation mechanism. New

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quality productivity is an advanced form of productivity driven by data, supported by digital technology and led by innovation. Data elements are reconstructing industrial ecology and value creation system by optimizing resource allocation, improving production efficiency and innovating business models. From the digital transformation of enterprises at the micro level, to the reconstruction of industrial chain at the meso level, and to the high-quality economic development at the macro level, data elements play a key role. However, the process of enabling new quality productivity by data elements still faces many challenges, including institutional barriers such as data rights confirmation, data security and data monopoly, as well as practical problems such as technological innovation, talent training and infrastructure construction. Investigating in depth the internal mechanisms, coping mechanisms, and practical pathways of data variables that enable new quality productivity for fostering high-quality economic development is both theoretically and practically significant. In order to offer theoretical justification and useful direction for advancing productivity reform in the age of the digital economy, this study intends to methodically examine the mechanism of data factors enabling new quality productivity, investigate its realization path, and make corresponding recommendations.

2 Literature review

At present, some scholars have paid attention to the connection between data elements and new quality productivity. Some experts argue that market-oriented allocation of data components can lessen firms' perceptions of uncertainty, improve the investment efficiency of enterprises, and suppress the risk of innovation activities of enterprises [7], which can significantly improve the efficiency of resource allocation of enterprises [8], as a result, the value of data factors is released, promoting the establishment of new enterprise productivity levels. Some researchers feel that establishing data exchanges and trade platforms can successfully stimulate the development of new quality productivity[9]. By improving the industrial structure and encouraging the aggregation of scientific and technology talents, data exchanges have significantly improved the marketization level of data elements in the city [10]. Feng et al. felt that data elements, as the basic factors of production in the era of digital economy, may support the upgrading of industrial structure and be the main driving force for the development of new quality productivity[6] .

The process of enabling new quality productivity by data elements is fraught with issues, nevertheless. Cao believes that the current digital economy is developing rapidly on a global scale, and data is not only injecting new impetus into the development of all parties, but also becoming an important barrier to competition [5]. Ding also pointed out that relevant enterprises can use data advantages to understand the market environment, set up market barriers, and hinder fair competition, which is more hidden than the monopoly of transmission [11]. In addition, the issue of data rights since October 2019, when the Party Central Committee first listed data as one of the elements along with traditional elements such as land, labor, capital, and technology, there has been a significant divergence in the academic community between the rights doctrine and the behavioral regulation doctrine, which argues that the boundaries of the property rights of data should be clarified to protect the contributions of all parties and to promote the flow of data and its efficient allocation, while the behavioral regulation doctrine advocates that the privatization of data may affect the reasonable and fair utilization [12], thus affecting the process of data empowering new quality productivity. The U.S. communications operator AT&T revealed on July 12, 2024, that it had been the victim of a massive hacking attack between April 14 and April 25, 2024, in which the data of approximately 110 million users had been illegally downloaded and the data of all mobile users involved in the company had been leaked. Data security is also a crucial issue in this process, Yuan et al. [13] pointed out that the lack of data protection mechanisms is the most important issue in the current global data protection system.

3 China's policy changes to encourage the development of data elements

The policies that have been implemented in China over the past few years to encourage the growth of data elements are summarized in the table. The term "big data" was first used in the "Government Work Report" in March 2014, and the State Council first proposed the creation of a "data power" in 2015 with the "Outline of Action for Promoting the Development of Big Data," making it clear that "data is a basic strategic resource of the country." The CPC Central Committee and State Council published and put into effect the Opinions on Constructing a More Perfect Institutional Mechanism for the Market-based Allocation of Factors in 2020. This document provided guidance for market-based reforms, including pricing, trading, and determining data rights, and for the first time explicitly stated that "accelerating the cultivation of the data factor market" was important. The "Twenty Articles on Data," or Opinions on Constructing a Data Base System to Better Utilize the Role of Data Factors, were released by the CPC Central Committee and State Council in 2023. They creatively presented the four-in-one system and the fundamental three rights of the separation of powers. The "Three-Year Action Plan for Data Elements ×" (2024-2026) was developed and released in 2024 by the National Data Bureau and 17 other departments. It encourages the reuse and integration of data elements with the real economy in all domains and moves away from system construction to scenario-based value creation.

Table 1. China's policy changes to encourage the development of data elements

Year	Policy	Significance
2014	Report on the Work of the Government	“Big data” written into the government work report for the first time
2015	Outline of Action for the Promotion of Big Data	First proposed to build a "data power"
2016	Plan for the Development of the Big Data Industry (2016-2020)	The first national special plan for big data industry
2017	Guidelines for Cataloguing Government Information Resources (Trial)	crack "data islands"
2018	Pilot Work Program on Openness of Public Information Resources	Systematically explore open paths for public data
2019	conference resolution	Historical inclusion of data as a factor of production
2020	Opinions on Building a More Perfect Institutional Mechanism for the Market-based Allocation of Factors	For the first time, it explicitly “accelerates the cultivation of the data factor market”
2021	Data Security Law of the People's Republic of China	Establishing a rule of law framework for data security governance
2022	Opinions on Accelerating the Construction of a National Unified Market	It requires the establishment of unified institutional rules for data factor market
2023	Opinions on Building a Data Base System to Better Utilize the Role of Data Elements (“Data 20”)	It puts forward a “three-rights, four-in-one” basic system
2024	Three-Year Action Plan “Data Element x” (2024-2026)	Promote the integration and reuse of data elements with the entire field of the real economy
2025	Interim Measures for the Registration and Management of Public Data Resources	To build a core institutional framework for the management of public data resources

4 Mechanisms for data elements to enable new quality productivity

4.1 Generating new qualitative means of labor

According to the definition of Marxist political economy, the means of labor are the material conditions or tools used by laborers to influence and transform the object of labor in the production process. In the current era of digital economy, no matter it is the personal online browsing records, clothing, food, housing and transportation consumption records, or corporate purchasing records, profitability analysis disclosed in the financial report, or social unemployment rate, national GDP growth rate, have become a variety of “data”. Under the objective requirements of summarizing, organizing and applying these huge data, cloud computing (such as Ali Cloud and Tencent Cloud), artificial intelligence models (such as Deep seek, Doubao, Wenxin Yiyin and Tongyi Qianqian) and other “new quality labor data” continue to appear and innovate, and have become a new type of tool for people to understand and transform the world, and a powerful tool. New labor materials are constantly emerging and innovating, becoming new and powerful tools for people to understand and transform the world. New quality labor information is deeply integrated into the whole process of production and life. Enterprises can use AI risk control, AI identification, and other technologies to control the project during its execution process, access market data and gain insight into the market environment when making decisions in advance, and then access all of the data in the entire chain to summarize and analyze them generally in order to provide data support for the company's subsequent decision-making. The interaction between data elements and digital intelligence technology can run through the whole process of production and decision-making, driving the overall reset of the sequence of resource elements with the “hand of data”, optimizing the allocation of resources, enhancing the efficiency of the use of elements [14], promoting the development of new quality productivity.

4.2 Nurturing of new labor objects

In addition to being a new material, data is also a new object of labor as a new factor of production. In Marxist political economy, the objects of labor are defined as the material objects that are transformed or changed by the laborers through their work in the production process. These material objects are the direct objects of labor, which are processed, transformed, or reconfigured during the labor process so that they become part of the final product. Data elements with its non-competitive [1-2], strong replicability [1, 3], low marginal cost [4, 5] and other characteristics, breaking through the scarcity of the traditional labor objects, from the data side to break through the limitations of the “limited resources, unlimited demand”, to create a new point of economic growth, gave rise to numerous new sectors and algorithms, including personalized recommendation systems and artificial intelligence. With the rapid development of application technology, algorithms and a plethora of new industries, forms, and models are driving the development of new quality productivity. The breadth and depth of data applications continue to expand, encompassing the economy, business, public administration, national security, scientific research, and many other fields and sectors [15–17].

4.3 Fostering a new quality workforce

The widespread use of data elements has increased demand for high-tech talent in the digital economy's era of mass entrepreneurship and innovation. In particular, the "new quality labor force" that can effectively utilize data elements and new quality labor materials to transform new quality labor objects is in high demand.According to Li et al., as the digital intelligence revolution intensifies, AI models like deepseek will have the disruptive potential to change the labor market's structure and employment model [18]. For a long time, the relationship between supply and demand and the employment model mainly relies on manual judgment and traditional market mechanism [19], but the intervention of technology greatly promotes the reshaping of labor structure including but not limited to job substitution, skill transformation, and labor force structure [20], and emerging occupations such as data analysts, AI trainers, and so on, that require practitioners to have higher technical literacy and interdisciplinary comprehensive ability [21-22].

5 Challenges of data elements to enable new quality productivity

5.1 The game of openness and security

In essence, the process of using data pieces to enable new, high-quality productivity is a continuous game of security and openness. Data circulation is a crucial step in the creation and development of new quality productivity, according to Deng et al., and encouraging high-level data circulation while resolving the issues it causes is a practical necessity for fostering the development of new quality productivity [23]. For instance, Google processes 4 billion user searches daily, Facebook tells advertisers it can monitor vast volumes of posts and photos in real time to determine and influence the emotional state of young people [24–25], and the UK's National Health Service (NHS) adopted a strategy of sharing patient information with DeepMind for the development of AI diagnostic tools that sparked public concern [26]. Google processes 4 billion user searches per day, based on which behavioral data has long been captured and used for profit reengineering, and Facebook claims to advertisers that it can monitor massive amounts of posts and photos in real time to determine and influence the emotional states of young people [24-25]. This deep dichotomy between the unpaid privatization of the "data labor" of the masses reflects the harsh reality that the unpaid privatization of "data labor" may be emerging as a new form of exploitation in the age of digital capitalism. As Shoshana points out in The Age of Surveillance Capitalism, capital is expanding its power by "transforming human experience into free raw material" [27].

5.2 Imbalance between efficiency and equity

Behind the leap in productivity driven by data technology, there lurks a "siphon effect" in the distribution of resources - efficiency gains do not bring benefits to all, but rather, under the double filtering of technical thresholds and capital barriers, a digital dilemma of the strong getting stronger is formed. For example, data elements, digital technology in agricultural drone plant protection application, through high-precision farmland data modeling, large farms to achieve crop yield and pesticide use of precision control, while small farmers are unable to afford the cost of data collection equipment and algorithms, and face the "mechanization elimination" or "high-debt transformation" choice. Zhu Mingxuan pointed out that the current plant protection drone is a typical digital farm equipment, but it has the problem of expensive new machine price and maintenance cost, which is not affordable for most farmers [28]. Algorithmic recommender system also exposes this paradox, it is undeniable that the platform to "accurate matching" does optimize the platform user's consumption experience [29], but will be confined to the user in the information cocoon [30], the user receives the information by the algorithm and the historical data directed. Similarly, problems such as data monopolization are frequent. This imbalance between efficiency and fairness reveals a deep structural contradiction in the data economy - the speed of technology iteration is too fast and the social and ethical construction and institutional construction are difficult to keep up.

5.3 The tug-of-war between property rights and revenues

The ambiguity of data property rights creates a quagmire in the distribution of benefits - the traditional logic of property rights is difficult to play a role in the data domain. When enjoying “free services”, users seem to make their own choices, but they are actually forced to be involved in an invisible transaction, with their social data being transformed into raw materials for accurate advertising, and attention resources becoming “unpaid labor” for the platform's capital appreciation [31], forming a digital platform based on the continuous operation of data and algorithms to achieve in-depth control over laborers in a seamless manner across time and space [32], and the formation of a digital platform based on the data and algorithms. The digital platform, through the continuous operation of data and algorithms, realizes in-depth control over laborers in all time and space without any gaps [32]. The blurring of the boundaries of whether social data, attention resources, etc. belong to users or platforms is essentially determined by the characteristics of the data elements themselves. Data can be infinitely replicated and shared by multiple parties, with replicability [1][3] and non-exclusivity [1-2] but the distribution of rights and interests is difficult to find a universal standard at this stage.

6 Paths to solving the challenges faced

6.1 Creation of a uniform, open, and equitable data governance framework

To promote the creation of new, high-quality productivity using data elements, the first step is to clarify the source and attribution of data. Clarify the boundaries of the property rights of all parties to the data, to safeguard each party's unique contributions across the data's entire life cycle [12, 18], affirm the right to expedite the creation of data property rights associated with market transaction identification, the distribution of rights and interests, interest protection system, to improve the data security governance and regulatory capacity, and to establish a highly efficient, convenient and safe mechanism of cross-border flow of data. Through compliance and rights, data resources can be legally guaranteed and safely and legally participate in market transactions. At the same time, we need to establish a sound data asset management system, good data asset management can effectively promote the industry's high degree of competition, high-tech, large-scale enterprises to collaborate on innovation, and promote the “four chains of integration” [19]. Establishing the fundamentals of data security, strengthening data security rules and regulations, and forming the value of data elements all depend on a strong data security framework. Simultaneously, to offer market participants opportunities for trial and error, to safeguard the security of data circulation, and to encourage the vitality of data innovation.

6.2 Constructing a dynamic regulatory mechanism for the synergistic development of “technology-ethics”.

To address the contradiction between technological iteration and social ethics, it is necessary to establish a governance system in which technological development and ethical regulation are bi-directionally embedded. First, at the technical level, fairness assessment should be incorporated into the whole process of algorithm development. For example, it is worthwhile to learn from the mechanism of “risk-graded regulation” proposed in the EU's Artificial Intelligence Act, which aims to build a legal and regulatory framework in an ethical and comprehensive way [33]. Secondly, the mechanism of “socio-technical experimentation” is constructed to delineate a safe testing ground for technological innovation through sandbox regulation. Zhang et al. believe that the competition of AI is essentially the competition of AI regulation, and the regulatory sandbox is favored because it can balance the dynamic relationship between the two [34]. Finally, the establishment of an ethical governance structure with multi-body participation, including the establishment of industry ethics committees, the development of algorithm auditing toolkits, etc., to form a tripartite check and balance between technology developers, policy makers and the public.

6.3 Innovative models of inclusive distribution and value-sharing of data elements

Reconstructing the distribution logic of the data value chain, i.e., creating new ways of distributing data value, is a powerful countermeasure to the “siphon effect” of resource distribution.The first step in creating a public data asset operating system is to attempt to convert the fundamental data that the government, some businesses, and organizations own into universal production factors. This will either directly or indirectly support the creation of new, high-quality productivity [35]. Secondly, the establishment of a data factor redistribution fund, such as a special tax on enterprises that frequently utilize user data, such as Joyo, Taobao, etc., and the extraction of a special fund from the tax on data transactions for the popularization of digital skills and the digital empowerment of vulnerable groups.

7 Conclusion

The path, difficulties, and procedures of data elements that enable the creation of new high-quality productivity are examined in this research, and finds that data elements with replicability and non-competitive characteristics realize productivity innovation through a threefold path: first, it gives birth to intelligent labor materials represented by Deepseek and Wen Xiaoyan; second, it builds and nurtures new types of labor objects based on digital elements; and third, it fosters new types of labor groups mastering new types of digital technologies. technology of a new type of labor group. This linkage development mechanism between data elements and new quality productivity effectively realizes the liberation of the value of traditional factors of production and the value of digital components being released, which opens up a new avenue for productivity growth in the digital economy.

The intention of data opening for public service is accompanied by the threat to data security, the efficiency is improved but at the same time there is a loss of fairness, and there is a lack of a universal distribution standard for the benefits generated by data elements. It is further proposed that the development dilemma of data factor-driven new quality productivity can be solved through the triple synergistic path of institutional construction, technical regulation and distribution innovation. By establishing a data rights system and cross-border flow mechanism to build a solid foundation for development, relying on the “technical-ethical” dynamic adjustment mechanism to balance the innovation risk and governance effectiveness, and realizing the value of universal sharing with the help of public data openness and factor redistribution.

This paper did not test the data on how data factors affect the new quality productivity, though, because the market for data factors is still in its early stages of development and improvement, making it difficult to obtain relevant data. Once the data is available, we can further empirically test the influence mechanism of this paper to provide more data support.

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