Analysis of the Theoretical Logic, Internal Contradictions, and Governance Paradigms of the Digital Economy

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Abstract: The digital economy, as a new economic form born from the new round of technological revolution, takes data as the core production factor, relies on networks, computing power, and algorithms to reconstruct the entire chain of production, distribution, exchange, and consumption, and expands and challenges the traditional economic theoretical framework. This article starts from a purely theoretical perspective, sorts out the conceptual connotation and core element attributes of the digital economy, analyzes the internal mechanism of digital economy reshaping economic operation, explores the endogenous theoretical contradictions in its development process, and finally explores the governance logic and theoretical path that are suitable for the digital economy. The research does not rely on empirical data, but focuses on theoretical aspects such as factor characteristics, market mechanism failures, and institutional adaptation to deepen the theoretical understanding of the operating laws of the digital economy.

Keywords : digital economy; Data elements; Network effect; Transaction costs; digital governance

1 Introduction

In the era of industrial economy, land, labor, and capital are the core elements of social production. Production activities follow the law of diminishing marginal returns, and market transactions are based on physical goods and clear property rights[1]. With the iteration of technologies such as big data, cloud computing, and artificial intelligence, digital technology is deeply embedded in the entire process of social reproduction, giving birth to the new technological and economic paradigm of digital economy. The digital economy is not simply a superficial combination of "technology+traditional industries", but a systematic transformation of China's social sciences from production factors, organizational models, value creation methods to market competition logic[2][3][4] .

The current academic research on the digital economy focuses heavily on empirical calculations, industry cases, and policy effectiveness evaluations, but there is still a need to deepen the understanding of the underlying theoretical logic[5][6][7]. Traditional economics was born in the context of industrial material production, and its factor assumptions, property rights logic, and competition theory are difficult to fully explain the new phenomena that have emerged in the digital economy, such as non competitive use of data, platform network effects, blurred production and consumption boundaries, and winner takes all market patterns, all of which

expose the limitations of traditional theory in explaining the Chinese people Based on this, this article avoids empirical testing and analyzes the operational logic of the digital economy from a theoretical perspective, identifies its inherent contradictions, explores the theoretical direction of governance, and provides theoretical references for understanding the high-quality development of the digital economy.

2. Theoretical attributes of the connotation and core elements of the digital economy

2.1 Definition of Digital Economy

The digital economy is the sum of various economic activities that are driven by digital technology clusters, carried by network systems, and use data as key production factors to reconstruct social production and exchange methods[5][6]. It includes two dimensions: digital industrialization and industrial digitization Digital industrialization refers to the industrial sectors formed by digital technology itself; Industrial digitization refers to the transformation of production modes through the introduction of digital elements in traditional agriculture, manufacturing, and service industries. Different from industrial economy, the core feature of digital economy lies not in the production of material products, but in the collection, storage, calculation and reuse of information. Data flow leads the allocation of technology flow, capital flow, talent flow, and material flow, amplifying the output efficiency of factors.

2.2 Theoretical Characteristics of Data as a New Factor of Production

Traditional factors such as land, labor, and capital are competitive and consumable. When one party uses these factors, other entities cannot use them simultaneously. Factors are lost during the production process and follow the law of diminishing marginal returns. And the data elements exhibit significant differentiation characteristics[7][8][9].

Firstly, non competitiveness and replicability. The same dataset can be used by multiple entities to carry out production activities simultaneously, and the data will not experience physical loss or be consumed due to multiple mining operations. This attribute breaks the traditional constraint of total factor supply and has the potential foundation of increasing returns to scale. But non competitiveness does not equate to non exclusivity. In reality, companies can achieve artificial exclusivity of data through technological encryption and platform permission settings, thus creating a tension between theoretical attributes and practical systems.

Secondly, the conditional dependence of value realization. Data itself is only an information carrier, and raw data does not directly generate economic value. It must be processed and processed through computing power, algorithms, labor, and capital in order to be transformed into usable information and knowledge for production. Without algorithms and computing power, massive raw data is just a collection of symbols in storage media, unable to empower production. The value of data is the result of the collaboration of multiple factors, rather than the independent creation of a single factor by Tsinghua University Press [10][11].

Thirdly, the uncertainty of value and secondary appreciation. The value of material goods is basically determined upon completion of production; The value of data will change with the application scenario, and the value of the same set of data varies greatly in different business scenarios. After multiple mining and fusion, new value can continue to be generated, and there is no one-time depletion state. This characteristic makes it difficult to directly apply traditional cost pricing theory to data asset pricing.

Fourth, strong externalities. Data activities have both positive and negative externalities. Data sharing can improve the efficiency of resource allocation throughout society and create positive externalities; However, data abuse, privacy breaches, and algorithm discrimination can bring social costs that are often not borne solely by platform enterprises, resulting in negative externalities and an important source of market spontaneous regulation failure.

2.3 Fundamental Supporting Role of Computing Power, Algorithms, and Networks

Data is the raw material for production, computing power is the material ability to process data, algorithms are the logical rules for processing data, and networks are the channels for the flow of elements. Together, they form the technical foundation for the operation of the digital economy. The network brings network effects, and the more users participate in the network, the higher the utility of the network to each participant. Network effects are divided into direct network effects and indirect network effects: direct network effects are reflected in the expansion of user scale to enhance user utility; The indirect network effect is reflected in the increase of users on one side of the platform, which drives the improvement of utility for users on the other side. The network effect is the core theoretical driving force behind the evolution of digital platform market structure.

3. The internal theoretical mechanism of digital economy reshaping economic operation

3.1 Structural changes in transaction costs

The transaction cost theory divides transactions into stages such as search, negotiation, and performance supervision. Digital technology does not simply reduce transaction costs across the board, but rather leads to structural differentiation. On the one hand, digital platforms greatly reduce the information search and matching costs for both supply and demand sides, break down geographical barriers, expand market boundaries, and enable a large number of dispersed individuals to participate in market transactions, giving rise to new formats such as platform economy and sharing economy. On the other hand, new transaction costs arise in the digital environment: data compliance costs, performance risks brought about by algorithmic games, and bargaining costs brought about by platform rules. The platform holds the power to formulate rules, and the negotiation costs of both parties in the transaction are transferred, with some transaction costs shifting from explicit to implicit.

3.2 Transformation of Production Organization Mode: Melting of Production and Sales Boundaries

In the industrial economic system, the identities of producers and consumers are clear, production activities are concentrated within the enterprise, and consumers only assume the function of consumption. In the digital economy environment, ordinary users generate behavioral data while consuming, providing materials for platform production and forming the phenomenon of "production consumption integration", blurring the boundary between production and consumption. In addition to the traditional vertically integrated enterprise organizational model, distributed networked organizations have emerged, with a large number of individuals relying on digital platforms to collaborate. The organizational boundaries of enterprises continue to soften, and intermediate forms between the market and enterprises have emerged in large numbers.

3.3 Reconstruction of Market Competition Logic through Increasing Returns Mechanism

The industrial economy generally follows a diminishing marginal return, and the unit output cost increases after the production scale expands to a certain stage. The development of digital products has the characteristics of high fixed costs and extremely low replication costs. After the software and digital services are developed, the marginal cost of adding one more user approaches zero. The superposition of network effects and the expansion of market size will lead to a sustained decrease in average costs, forming a mechanism of increasing returns to scale.

The combination of increasing returns and network effects creates a positive feedback loop of 'the stronger the stronger'. The top platforms accumulate more users, obtain more data, further optimize algorithm services, attract more users to enter, form a self reinforcing cycle, and give birth to a "winner takes all" market pattern. This is in sharp contrast to the competitive logic of traditional industrial markets, where traditional antitrust theories rely on market share as the core criterion for judgment, and their explanatory power is weakened in the context of digital

platforms.

3.4 Transformation of Value Distribution Logic

In traditional allocation frameworks, element rewards are allocated based on element contributions. The participation of data elements in distribution faces theoretical challenges: data comes from massive user behavior, processed by platform algorithms, and the value of data is jointly created by user digital labor, platform capital, and technical personnel labor. However, under the existing distribution mechanism, a large amount of benefits brought by data flow to the platform capital side, and ordinary data providers find it difficult to obtain corresponding returns, resulting in contradictions at the distribution level. This is also an important proposition that digital economy theory needs to respond to.

4. Theoretical contradictions and market failures inherent in the digital economy

While the digital economy unleashes growth momentum, the inherent characteristics of its elements can lead to multiple endogenous contradictions, resulting in market failure and the inability to rely solely on spontaneous market regulation to achieve optimal resource allocation.

Firstly, there is a contradiction between the non competitiveness of data elements and the property rights system. The traditional property rights system is based on competitive physical property and emphasizes clear exclusive ownership. However, data naturally has non competitive attributes, and at the same time, a single piece of data can be used by multiple parties. Simply applying the ownership model of physical property is not conducive to data circulation and sharing, and it is also difficult to balance personal information rights. The ownership boundaries of public data, enterprise data, and personal data have not yet formed a unified consensus at the theoretical level, which directly leads to difficulties in data pricing and transactions, and the construction of data factor markets faces institutional bottlenecks.

Secondly, network effects bring about the contradiction between efficiency and monopoly. The network effect brings about an increase in scale efficiency, and larger platforms can provide lower cost and higher quality services; However, the expansion of scale also brings about the concentration of market power, which is prone to problems such as platform exclusivity, exploitation of small and medium-sized operators, and algorithmic collusion. A theoretical dilemma arises here: splitting large platforms would disrupt network scale efficiency; Allowing platform expansion to continue will damage the vitality of market competition, and the traditional either or anti-monopoly approach is no longer fully applicable.

Thirdly, the contradiction between innovation incentives and data openness and sharing. If enterprise data assets are strictly protected, it will suppress data circulation and reduce the overall efficiency of social resource allocation; If there is an excessive emphasis on data openness and sharing, it will weaken the innovation incentives for enterprises to invest in data collection and algorithm research and development, and reduce the motivation for enterprises to carry out digital technology innovation. The balance point between the two is difficult to spontaneously form through the market and requires institutional regulation.

Fourth, the contradiction between efficiency improvement and digital divide. The digital economy brings overall efficiency improvement, but accessing networks and using digital services require equipment, skills, and other conditions. There are differences in digital capabilities among different groups and regions, and technological dividends do not automatically benefit all members of society. The digital divide is divided into access divide and usage divide. Some entities are unable to participate in digital economic activities, which will further widen the development gap. This is an external problem brought about by the digital economy.

Fifth, the conflict between algorithmic tool rationality and diverse social values. Algorithms aim to optimize efficiency and profitability, but social operation also requires multiple values such as fairness, privacy, and security. In the process of pursuing commercial efficiency, algorithms are

prone to problems such as algorithm discrimination, privacy infringement, and information cocoons. The algorithm itself is a technical tool, but the training data and objective function of the algorithm are embedded with the value orientation of capital. Relying solely on algorithm self optimization cannot automatically achieve the maximization of social comprehensive value.

5. Theoretical governance path for high-quality development of digital economy

Based on the inherent contradictions of the digital economy, neither completely laissez faire free market nor completely administrative control is the optimal solution. A governance theoretical framework that adapts to the characteristics of digital economy elements should be constructed, taking into account multiple goals such as innovative development, fair competition, and security and inclusiveness[12][13][14][15].

Firstly, establish a property rights and circulation system that adapts to the characteristics of data elements. Abandoning the idea of simply copying physical property ownership, distinguishing between data ownership, usage rights, and revenue rights, and promoting data classification and hierarchical governance. Emphasize the protection of personality rights and interests for personal data; Promote compliance and openness towards public data; Protect the property rights and interests formed by the labor and technological input of enterprise data. Beijing Social Science Center does not pursue absolute ownership clarity, but promotes the circulation of data elements with the transfer of usage rights as the core, balancing the dual goals of data protection and data utilization[16][17][18] .

Secondly, establish a modern competition governance theory that adapts to the characteristics of the platform. We cannot simply follow the static market share standards of the industrial era. We need to pay more attention to market entry barriers, data transferability, innovation vitality, and operator behavior. Distinguish between platform scale itself and platform monopoly behavior. Large scale does not necessarily mean illegal behavior. Focus on regulating exclusive and predatory business practices that use data and algorithms to maintain market competitiveness and protect the survival space of small and medium-sized enterprises.

Thirdly, we must adhere to both incentivizing innovation and risk constraints. Digital technology is highly uncertain, and governance should maintain moderate flexibility, reserve institutional space for technological innovation, establish risk warning mechanisms, conduct compliance assessments for new technologies such as algorithms and large models, and achieve inclusive and prudent supervision. The government, platforms, industry associations, and the general public collaborate to build a diverse governance pattern and avoid the limitations of single subject supervision[19][20].

Fourth, bridge the digital divide and achieve universal digital dividends. Digital economy governance cannot only focus on industrial efficiency while also taking into account social equity. Through infrastructure construction and digital literacy education, we aim to narrow the digital capability gap between different groups and regions, enabling the digital economy dividend to cover more groups and dissolve the differentiation effects brought about by the digital economy.

Fifth, promote the value embedding of algorithms. Algorithms cannot solely focus on commercial efficiency as their sole goal. It is necessary to embed social values such as fairness, security, and inclusiveness into algorithm design and review processes, establish transparency and accountability mechanisms for algorithms, constrain negative externalities of algorithms, and

achieve the unity of technological tool rationality and social value rationality.

6、 Conclusion

The digital economy is not a simple technological phenomenon, but a profound economic paradigm shift. The non competitiveness, network effects, increasing returns, and melting of production and sales boundaries of data elements have led to the expansion of explanatory boundaries in traditional industrial economic theories. The digital economy itself has multiple inherent contradictions: the conflict between property rights system and factor attributes, the balance between scale efficiency and market monopoly, the balance between innovation incentives and data sharing, and the game between commercial efficiency and social fairness. These contradictions cannot be completely resolved spontaneously by the market and require institutional adaptation and adjustment.

From a theoretical perspective, the core proposition of digital economy governance is to construct an institutional system that adapts to the characteristics of new elements, while unleashing the growth potential of digital technology and resolving its inherent market failures, while balancing multiple goals of efficiency, fairness, and security. The theory of digital economy is still in a stage of continuous development, and with the continuous iteration of technology, related theoretical discussions will continue to deepen, providing theoretical support for the high-quality development of digital economy.

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