ISSN 2616-5902 Vol. 6, Issue 11: 192-199, DOI: 10.25236/AJBM.2024.061128

Research on governance structure and mechanism optimization of digital business ecosystem under platform economy

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Abstract: *This study discusses the optimization of the governance structure and mechanism of the digital business ecosystem under the platform economy in the context of the global information transformation and the evolution of management thought and methodology. This study combines the theory of multilateral governance, resource dependence and ecosystem to explore how to cope with the complexity of the digital business ecosystem under the platform economy. Through literature review, case analysis and theoretical discussion, this paper provides systematic insights and practical strategies for the healthy and sustainable development of the digital business ecosystem under the platform economy, and puts forward corresponding optimization countermeasures, including the establishment of a combination mechanism of internal autonomy and external co-governance, innovative laws and regulations and other means. This study aims to promote the evolution of platform economy to a more just, transparent and efficient form, build a bridge between theory and practice, and promote the development of the digital economy era.*

Keywords: *Platform Economy, Business Ecosystem, Digital Business Ecosystem, Governance Structure*

1. Introduction

With the development of science and technology and the application and popularization of Internet technology, the global economy is undergoing a profound transformation from the industrial age to the information age. In this process, the platform economy, as an emerging form of economic organization, has risen rapidly and become an important force to promote digital transformation and industrial upgrading. With the reform and development of the economic form, the management idea is also being innovated. In the early stage, Taylor's scientific management was more focused on standardization. Now, system theory has gradually emerged, advocating a holistic and dynamic review of the relationship between organizations and the environment, emphasizing the dynamic interaction and balance inside and outside the organization, which is especially applicable in the context of platform economy. The platform is not only a place for transactions, but also a multi-lateral interaction and value creation ecosystem, and we must effectively manage its complex network relationships to promote the co-evolution of various participants in the ecosystem.

Therefore, the study of the governance structure and mechanism of the digital business ecosystem under the platform economy is not only a practical application of the system view in modern management thought, but also an exploration of the construction of economic order in the new era. By analyzing the governance structure and mechanism, this study aims to provide theoretical support for the healthy operation of the platform economy, and has important practical significance for guiding practical operation, optimizing policy formulation, and promoting high-quality economic development. In addition, this study aims to deeply analyze the governance challenges faced by the digital business ecosystem under the platform economy, including but not limited to the increasing market monopoly trend, the vulnerability of data security and privacy protection, the complexity of cross-border regulation, and the difficulty of balancing the interests of various stakeholders within the ecosystem. Further, this study will explore the diversity of existing governance structures and their adaptability and effectiveness in different platform types and market environments, and analyze how they promote or hinder value creation and fair competition.

ISSN 2616-5902 Vol. 6, Issue 11: 192-199, DOI: 10.25236/AJBM.2024.061128

2. Literature review

2.1. Characteristics and types of platform economy

2.1.1. Theoretical review and characteristics of platform economy

As a new form of economic organization, the core feature of platform economy lies in its unique market structure and interaction mechanism, which fundamentally shapes its economic influence and growth potential. There is no consensus among scholars on the definition of platform economy. Li Ling pointed out that platform economy is a concrete manifestation of business model innovation in the Internet era and provides a path for building an effective market [1]. "Platform economy is a new type of economy that provides different services based on information technology such as the Internet, and then optimizes their resources and relationships to maximize their benefits," Ye wrote in his article. [2] Xie Fusheng, Wu Yue and Wang Shengsheng put forward: "The core of platform economy is digital platform, which is based on keen data transmission and collection system, powerful computing power and advanced data processing algorithm. It can integrate production, distribution, exchange and consumption across time and space, across borders and across departments, and promote the process of social production and reproduction." [3] The primary feature of platform economy is the existence of two-sided market, a concept first proposed by Rochet and Tirole, which means that the platform serves two or more interdependent user groups at the same time, such as suppliers and consumers, content producers and viewers, and the value of the platform increases with the growth of the number of users on each side. Creating what's called a network effect. Network effects are divided into direct network effects and indirect network effects. The former is reflected in the fact that users directly benefit from the increase in the number of users on the other side. For example, the more friends in a social network, the more attractive the platform is. The latter involves an increase in third-party developers or complementary products, such as the abundance of apps in smartphone app stores that boost sales.

2.1.2. Type and operation mode of platform economy

The diversity of the platform economy is reflected in its wide range of industry applications and unique modes of operation, which are mainly divided into four categories. First of all, e-commerce platforms, such as Amazon and Alibaba, whose operation model is based on online transactions of goods or services, reduce transaction costs by providing search ranking, credit evaluation, payment security and other services, and use big data analysis to realize personalized recommendation and enhance user experience and purchase intention. The second is social media platforms. Platforms such as Facebook and wechat fall into the category of social media platforms, which attract users by promoting information sharing and social interaction among users. Their profit models usually rely on advertising, virtual goods sales or value-added services, and network effects are particularly significant. Third, sharing economy platforms, such as Uber and Airbnb, can innovatively transform idle resources owned by individuals into services provided to the demand side, emphasizing real-time matching, trust mechanism and flexible employment, changing the operation mode of traditional industries. Fourth, financial technology platforms, such as Alipay, can integrate financial services and technology, provide convenient payment, transfer, credit and other services, and improve the availability and efficiency of financial services through data analysis.

2.2. Business Ecosystem and Digital Business Ecosystem (DBE)

2.2.1. Business ecosystem

Moore (1996) put forward the concept of "business ecosystem" for the first time in Harvard Business Review, defining business ecosystem as "an economic organism based on the coordinated role of organizations and individuals". In this commercial ecosystem, there are various species, the production, consumption, transformation of the material of the commercial ecosystem, and various species interact with each other to form a good applicability of the ecosystem. [4] Combined with the internal and external environment and stakeholders faced by enterprises in the process of operation, the structure of business ecosystem can be divided into four levels, including external environment system, supporting system, core system and competitive system, emphasizing the interdependence between various participants in the ecosystem and the overall adaptability and evolution of the ecosystem. Subsequently, Iansiti and Levien (2004) further extended this concept, proposing the idea of a "value network", which emphasizes the dynamic processes of value creation and value acquisition in an ecosystem. Adner and Eisenman (2011) then refined the mechanisms of value co-creation and capture in ecosystems, pointing out that the key to ecosystem success lies in coordination and cooperation among participants. Domestic scholars

ISSN 2616-5902 Vol. 6, Issue 11: 192-199, DOI: 10.25236/AJBM.2024.061128

have different research emphases on business ecosystem. For example, Zhang Jie and Liang Yunwen [5] have studied knowledge chain dissemination, value structure, innovation system and strategic model in business ecosystem.

2.2.2. Digital business ecosystem

The Digital Business Ecosystem was first proposed in 2002. In 2003, the European Union launched the Digital Business Ecosystem Project, which aims to create a networked digital business ecosystem for smes. In order to assist smes in their Digital transformation, the United States launched the Sustainable Digital Data Preservation and Access Net-work Partner program in 2007. DataNet is dedicated to solving data infrastructure, key technologies and implementation issues.[6] Chesbrough and Appleyard (2007) first described how digital technology changes the relationship between enterprises and the way of value creation, pointing out that open innovation, platformization and data-driven are the core characteristics of digital business ecosystem. On this basis, Cusumano et al. (2019) analyzed in detail how digital platforms, as the core of DBE, promote the development and evolution of the ecosystem through network effects, data accumulation and analysis capabilities, and emphasized the key role of data in value creation and distribution.

Xie Weihong divided the digital business ecosystem into three perspectives: public management, technology management and strategic management.[7]The public management perspective, proposed by Nachira[8], refers to the creation of an integrated and distributed local digital ecosystem to promote the adoption of information and communication technology (ICT) by enterprises, and to help smes solve the digital divide and other problems brought by large enterprises. From the perspective of technology management, digital business ecosystem is a distributed computing infrastructure that provides global competitiveness for smes [9], which emphasizes the digital ecosystem composed of information and communication technology networks, social networks and knowledge networks. From the perspective of strategic management, digital business ecosystem includes two aspects: digital ecosystem and business ecosystem [10]. This study considers that digital business ecosystem is a complex network jointly constructed by a variety of participants, which mainly includes three types of participants: platform enterprises, users and third-party service providers; It is composed of three core elements: technical infrastructure, data flow, value creation and distribution mechanism.

2.2.3. Comparison between digital business ecosystem and traditional business ecosystem

Compared with the traditional business ecosystem, the digital business ecosystem presents several unique features. First, the widespread application of information and communication technology (ICT) has greatly improved the speed of information flow and interaction efficiency within the ecosystem (Autio et al., 2018). Second, the emergence of digital platforms makes ecosystem boundaries more blurred, participants more diverse, and innovation and cooperation models more open (Tiwana, 2013). Moreover, data becomes a core asset, and its collection, analysis and application become an important source of competitive advantage for enterprises (Brynjolfsson and McAfee, 2014). DBE, as a platform designed to support the flexible development and composition of business services, aims to support enterprises to co-evolve in a competitive but at the same time collaborative environment, which also brings unique challenges to the digital business ecosystem [6].

3. Digital business ecosystem governance challenges under the platform economy

3.1. Market monopoly and competition imbalance

China's digital economy has been developing for more than 20 years, and it has obviously brought huge benefits to consumers. For example, people can use search engines to get the information they need, video calls with friends around the world through social networks, and convenient shopping for various goods and services on e-commerce platforms, so that life becomes more colorful and convenient. At present, the number of Internet users in China exceeds 1 billion, and the digital economy accounts for more than 40% of GDP, which shows that the digital economy is very important to the national economy and people's livelihood. However, on the other hand, due to the obvious economies of scale and network effects of Internet platforms, platform operators provide services through data collection, integration and analysis, and big data has become a huge obstacle for latecomers to enter the market, resulting in the obvious trend of monopoly or oligopoly in the field of platform economy [11]. When a platform has access to a large amount of user data and market access, and has the ability to consolidate its market position through strategies such as self-preferential treatment and exclusive agreements, the barriers to entry for new entrants will increase sharply and the vitality of market competition will be blocked, which may

ISSN 2616-5902 Vol. 6, Issue 11: 192-199, DOI: 10.25236/AJBM.2024.061128

eventually lead to limited consumer choice and limited innovation. Take global e-commerce giant Amazon for example, its powerful network effects and data-driven personalized recommendation system have made it the preferred platform for many consumers to shop, while also attracting a large number of third-party sellers. However, this market dominance has raised concerns about monopoly. Amazon has been accused of using its market position to impose unfair terms on third-party sellers, such as charging high commissions and promoting its own branded products while suppressing the visibility of third-party goods, which not only limits competition in the market but may also stifle innovation. Regulators are facing the challenge of finding a balance between promoting prosperity in the digital economy and preventing excessive concentration of market power. In addition, frequent mergers and acquisitions among platforms further aggravate market concentration and make anti-monopoly supervision face a severe test. How to find a balance between promoting innovation and maintaining market fairness has become an urgent problem to be solved.

3.2. Data security and privacy protection

Data, as the blood of the platform economy, is also the focus of differentiation between DBE and the traditional business ecosystem. Its collection, processing and utilization not only promote personalized services and improve efficiency, but also cause a wide range of data security and privacy leakage problems. Platform enterprises often have a large number of sensitive user information, once the data protection measures are insufficient, it is easy to happen data leakage, resulting in infringement of user privacy, and may even lead to more security risks.

3.3. The dilemma of cross-border supervision

A sound governance structure and regulatory system are key factors for DBE sustainability. The unique business model of DBE is innovative and diverse, offering members new products, ideas and services, but to fully mobilize this innovative resource, the right regulatory, technological and social conditions need to be created. [6] Platform economy, as an emerging system, has blurred the boundaries of traditional industries, making it difficult for the original regulatory framework to effectively cover them, and the original management concept also has certain limitations, leading to the emergence of regulatory blind spots.

On the one hand, due to the differences in regulatory policies in different countries and regions, as well as the lack of unified international coordination mechanism, regulatory fragmentation has increased the compliance costs of enterprises to a certain extent, affecting the smooth development of cross-border services. On the other hand, the rapid iteration and cross-border integration of the platform economy also require a high degree of flexibility and foresight in the regulatory system.

3.4. The balance of stakeholders' rights protection

In the ecosystem of platform economy, the issue of balancing the rights and interests of multiple stakeholders such as users, platform enterprises, third-party service providers and workers is prominent. As the producer of data, users' data rights are often ignored. While enjoying the convenience of market access provided by the platform, third-party service providers are also faced with uncertainty risks brought about by changes in platform policies. Food delivery platforms, represented by Meituan and Ele. me, have developed rapidly in China, while also drawing attention to the working conditions of delivery riders. The labor rights and interests of riders, such as wage security, work safety, social insurance, etc., become the focus. The contradiction between the flexibility of the platform economy and the protection of workers' rights and interests requires the platform enterprises, the government and the society to jointly explore a suitable labor rights and interests protection mechanism. In addition, the protection of workers' rights and interests under the flexible employment model has become increasingly prominent. How to ensure that all participants can benefit equitably in the ecology and maintain the healthy and sustainable development of the ecosystem while pursuing efficiency and innovation has become the core consideration in the design of the governance structure.

4. Theoretical framework and practical path of optimization of DBE governance structure and mechanism

With the further development of the platform economy, it is more important to build an effective, fair and sustainable governance structure for the digital business ecosystem. This chapter reviews and

ISSN 2616-5902 Vol. 6, Issue 11: 192-199, DOI: 10.25236/AJBM.2024.061128

integrates recent advances in governance theory, in particular theoretical models applicable to digital business ecosystems. Based on the theory of multilateral governance (Williamson & Zuckerman, 2010), resource dependence theory (Pfeffer & Salancik, 1978) and ecosystem theory (Moore, 1996), a comprehensive theoretical framework of governance is constructed. The framework highlights how to balance the interests of multiple parties and create value in a complex and dynamic digital ecosystem through cooperation, negotiation, rule-making and enforcement, transparency, and incentive design.

4.1. Theoretical framework of DBE governance

4.1.1. Extension of multilateral governance theory

Multilateral Governance Theory, originally proposed by Williamson & Zuckerman (2010), emphasizes how to reach consensus through cooperation, coordination and negotiation when multiple stakeholders are involved. In a two-sided market, a platform is the basic product, service and technology framework through which other players provide complementary products [12]. The essence of multilateral platform is the structure of multi-subject interaction, and its core screening criteria are the openness of "contract control" and the existence of inter-group network effects [13].

In the digital business ecosystem, this theory is applied to understanding how platforms act as coordinators, balancing relationships among multilateral stakeholders such as consumers, suppliers, and third-party service providers. Multilateral platforms promote high-quality interaction and value creation by bringing together multilateral users, matching supply and demand, and reducing interaction costs [14]. In the process of promoting the value interaction of multilateral user groups, multilateral platforms play the roles of interest link, supply and demand match, space or market provider and rule designer [15].

For example, the platform demonstrates the role of multilateral governance in value co-creation by designing incentives to encourage content creators while ensuring the consumer experience.

4.1.2. Deepening of resource dependence theory

Resource dependence theory is not only an important theory of organizational change, but also an important school of organizational theory. The resource dependence theory emerged in the 1940s, and was widely used in the study of organizational relations after the 1970s. Resource Dependence Theory, developed by Pfeffer & Salancik (1978), states that organizations depend on external environments for critical resources and must manage these dependencies to ensure survival and success. Resource dependence theory points out that organizations establish cooperative relations with external entities to exchange resources for the purpose of survival, and their demand for obtaining external resources leads to their dependence on the external environment (Hillman et al., 2009) [16]. The nature and scope of such dependence depend on the importance and scarcity of external resources to the firm, as well as the autonomy in the use of resources and the availability of alternative resources [17]. In the digital business ecosystem, the platform's high dependence on data, technology, talent and other resources requires it to build a sensitivity and adaptation mechanism to the external environment. For example, through partnerships, investments in research and development, platform companies continuously acquire and protect critical resources to ensure competitive advantage.

4.1.3. Innovation of ecosystem theory

In 1993, James F. Moore first proposed the concept of "business ecosystem" in his article "Predator and Prey: The New Ecology of Competition" in the Harvard Business Review. He pointed out that "business ecosystem is an economic association based on the interaction of organizations and individuals" [18]. The business ecosystem theory proposed by Moore (1996) regards enterprises as species in the ecosystem and emphasizes interaction and symbiosis. Zhao Xianglian and other scholars believe that the common point between commercial ecosystem and natural ecosystem is that the members share the same destiny with the system. The difference is that members of the natural ecosystem adapt passively to the environment, while members of the commercial ecosystem can actively position themselves according to their own characteristics and identify their roles in the commercial ecosystem [19]. In the digital age, this theory has been given a new connotation, the digital business ecosystem not only includes the traditional sense of the enterprise, but also includes data, algorithms, user behavior and other elements. Together, these elements form a dynamic, complex network in which the platform acts as a "hub" in the ecosystem, maintaining the ecological balance and promoting healthy circulation.

4.1.4. Construction of comprehensive governance framework

Based on the above theories, this study explores the construction of a comprehensive governance

ISSN 2616-5902 Vol. 6, Issue 11: 192-199, DOI: 10.25236/AJBM.2024.061128

theoretical framework applicable to DBE, which emphasizes the coordination between internal autonomy and external co-governance. Internal self-regulation can be achieved through algorithmic governance and norms, and external co-governance can be achieved through the supervision of external forces. At the same time, legal norms should not be ignored. We should not only pay attention to the adaptability of existing laws in the new situation, but also seek its innovation and new ethical challenges in the digital age. In addition, the governance innovation of digital technology is also very important, including three aspects: blockchain technology, artificial intelligence, and cloud computing.

4.2. Self-governance mechanism and joint governance

As the core of the internal governance of the digital business ecosystem, autonomous mechanism refers to the process by which the platform autonomously manages its internal affairs through self-designed rules, procedures, algorithms and standards. In terms of theoretical support, the autonomy mechanism draws on the internalization theory in the new institutional economics (Coase, 1973), which emphasizes the improvement of internal decision-making efficiency by reducing transaction costs. In practice, the autonomy mechanism is reflected in the self-regulation of platform enterprises through transparency enhancement, algorithm optimization, community rules formulation and other means. Amazon's seller rating system is a typical example of an autonomous mechanism. The system forms a seller's reputation score through buyers' public evaluation of goods and services, which directly affects their exposure and sales on the platform. This mechanism not only promotes market transparency, but also self-selects high-quality suppliers through the user feedback mechanism, reflecting the effectiveness of the autonomous mechanism in maintaining market order and improving user experience.

The co-governance mechanism emphasizes multi-subject participation, including the government, industry associations, non-governmental organizations, user groups, third-party institutions and so on. The theoretical basis is derived from the theory of global governance (Kooiman, 2001), which emphasizes that in the context of globalization, governance needs to go beyond the level of a single country and form multi-level and multi-subject collaboration. In the digital business ecosystem, the co-governance mechanism is embodied in the form of multilateral regulation, industry self-discipline, and public participation. With the increasing perfection of DBE, the importance of co-governance mechanism has become increasingly prominent, involving the cooperation of multiple subjects such as government, industry associations, user groups, and third-party supervision agencies. The European Union's General Data Protection Regulation (GDPR) is a typical example of a co-governance mechanism. GDPR requires multinational platforms to comply with strict standards when processing EU citizens' data, which not only strengthens government supervision, but also activates users' awareness of data rights, encourages public supervision, and encourages enterprises to self-discipline, forming a trilateral governance model of government, enterprise and public interaction. The implementation of GDPR demonstrates a new paradigm of regulatory cooperation with business.

We need to note that autonomy and co-governance are not contradictory, but can complement and integrate each other's governance mechanisms, and we need the joint role of autonomy and co-governance.

4.3. Adaptability and innovation of legal and regulatory framework

With the vigorous development of platform economy, traditional laws and regulations are facing unprecedented challenges. The cross-border nature of digital platforms, the borderless nature of data flows, and the emergence of new business models not only require the legal system to adapt to these changes, but also to find a balance between protecting personal privacy, maintaining fair competition in the market, and promoting technological innovation.

4.3.1. The adaptability challenge of laws and regulations

First of all, we need to pay attention to the balance between technology neutrality and technology-specific regulations. The establishment of the principle of technology neutrality aims to avoid the rapid obsolescence of regulations due to the rapid development of technology, but when facing new problems caused by specific technologies, such as data privacy infringement and algorithm discrimination, technology-specific regulations need to be formulated to regulate them. We also take the EU GDPR as an example, which directly responds to the needs of personal information protection in the era of big data by establishing provisions such as data subject rights and data processing principles, demonstrating the necessity of technology-specific regulations. At the same time, the global nature of the platform economy has led to cross-border legal conflicts, especially in areas such as data jurisdiction and consumer

ISSN 2616-5902 Vol. 6, Issue 11: 192-199, DOI: 10.25236/AJBM.2024.061128

protection. Resolving such conflicts requires international cooperation and coordination, such as the provisions of the United States-Mexico-Canada Agreement (USMCA) on cross-border data flows, which attempt to establish uniform data protection standards among trading partners.

4.3.2. Innovation and reform of laws and regulations

Taking sandbox regulation and principle-based regulation as an example, traditional compliance regulation often lags behind in the face of emerging formats. The UK's Regulatory Sandbox document describes sandbox regulation as: "A sandbox is a 'safe space' in which companies can test innovative products, services, business models and delivery mechanisms without immediately incurring all the normal regulatory consequences of engaging in such activities." [20] It was introduced by the UK Financial Conduct Authority (FCA) as an innovative approach that allows businesses to test new technologies and business models in specific environments without having to meet all existing regulations immediately. Principled regulation emphasizes setting general principles rather than specific rules, giving more flexibility to regulated objects, such as Singapore's Payment Services Act. In addition, in order to cope with a rapidly changing technological environment, laws and regulations need to be flexible and responsive. The California Consumer Privacy Act (CCPA) and subsequent amendments demonstrate the legislature's immediate response to technological developments and citizen needs.

4.3.3. Legal Ethics and Social Responsibility in the digital age

Along with innovative practices, the formulation of laws and regulations should also take into account ethical and social responsibility issues in the digital age. This includes, but is not limited to, data ethics, algorithmic transparency, ethical frameworks for AI, etc., with the aim of ensuring that technological advances benefit society rather than exacerbate inequality or cause other negative effects.

4.4. Technology-driven governance innovation

The governance of the digital business ecosystem is also inseparable from the support and drive of technology. The theoretical framework of technology-driven governance innovation is rooted in the theory of technology neutrality and technology determinism, emphasizing the profound impact of technological progress on organizational form and governance mode. In the digital business ecosystem, technology is not only a tool for governance, but also a part of the governance structure, such as the decentralized nature of blockchain challenges traditional centralized governance, and the decision support of AI optimizes the efficiency of resource allocation. We will analyze from three aspects: blockchain technology, artificial intelligence, and cloud computing. First of all, as an immutable distributed ledger technology, blockchain is widely used in the improvement of supply chain transparency, data tracking, and intellectual property protection, which significantly improves information transparency and enhances the trust mechanism to a certain extent. The intelligent algorithm of AI also plays an important role in the governance of DBE, which can optimize resource allocation and risk control through automated decision-making, and improve the efficiency and accuracy of governance. In addition, cloud computing, as the infrastructure for data storage and processing, also provides flexible and scalable service effects for the digital business ecosystem.

5. Conclusion

Through in-depth analysis of the governance structure and mechanism of the digital business ecosystem under the platform economy, this study reveals its existing challenges and conducts optimization research. The main contribution of this study is that we integrate multilateral governance theory, resource dependence theory and ecosystem theory to propose a comprehensive theoretical framework, which provides systematic theoretical support for DBE governance. The framework emphasizes that in a complex and dynamic environment, the balance of multi-party interests and value co-creation can be achieved through the combination of internal autonomy and external co-governance, legal and regulatory innovation, technology-driven governance, and value co-creation and sharing mechanisms. In addition, through case analysis and literature review, this study clarified the specific path of governance optimization, and provided an operable plan for the healthy development of platform economy.

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