

## Research Article

# Gravitational Agglomeration of Local Synchronization Data Set in Innovation Ecosystem: A Game between Innovation and Institutional Governance

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Innovation and governance have become new driving forces for the high-quality development of the innovation ecosystem under the new normal. This study is inspired by the universal gravitation model. The model of element agglomeration is constructed in the innovation ecosystem, which deals with the local synchronization problem of innovation and institutional governance's data set. Based on the perspective of fluctuation, the agglomeration of elements produces fields in the innovation ecosystem. The relationship between innovation and governance is simulated and analyzed to game theory in the innovation ecosystem. In addition, the effects of different parameter conditions on synchronous clustering of data set are explored. The empirical results show the following: (1) The government's investment in innovation elements and institutional governance elements is directly proportional to the obtained benefits. The government's high-intensity support is greater than the benefits obtained from low-intensity support. (2) The emergence of enterprise synchronization is in line with the principle of moderation. The threshold is approximately 0.5, which can realize the accumulation and superposition of the effectiveness of innovation field and institutional governance field. Besides, neither high probability nor low probability synchronization of innovation and institutional governance's data set can reach the optimal solution. (3) It indicates the higher the coupling investment of university and scientific research institute, the higher the income. Meanwhile, increasing the coupling investment can help universities and research institutions save the cost of research time. Finally, energy superposition can be realized through simultaneous gathering of innovation elements and institutional governance elements to achieve the aim of promoting high-quality development in innovation ecosystem. Moreover, it provides reference for deepening the development of innovation ecosystem.

## 1. Introduction

There is an old saying in the Song History of China that "There are inheritance and innovation in the methods of systematic governance, but they are all to meet the needs of the times and achieve the purpose of governance." How to give full play to the "dual driving" role of innovation and institutional governance is an important content of Xi Jinping Thought for the New Era [1]. Innovation has undergone an update from incremental innovation of version 1.0 to systematic innovation of version 2.0 and then to innovation ecosystem of version 3.0 [2]. Innovation and governance have become the daily behaviors in enterprises.

Under the influence of the innovation foundation and the uneven distribution of resources, the occurrence factors tend to gather in a certain region. Institutional governance becomes an indispensable means to realize the transformation of innovation ecosystem from version 0 to version 1. Innovation ecosystem is a space that can accommodate the convergence of innovation elements and institutional governance elements. It is characterized by diversity symbiosis, self-organizing evolution, open collaboration, and so on [3]. With regard to common technology innovation knowledge sharing, self-organization innovation iteration, and governance as well as foreign cooperation, the game may also arise from the relationship among the main bodies in the

innovation ecosystem. Cooperation and antagonism will further attract the agglomeration of innovation factors and institutional governance factors. The transformation from innovation management to innovation governance accelerates in the innovation ecosystem. It promotes the adjustment of R&D activities from low-level disorder to high-level order. Therefore, the evolution of the relationship between innovation and institutional governance has become a normal state in the innovation ecosystem [4]. At present, the application of scientific management tools remains incomplete. Institutional governance is still mainly supported by government departments. However, behaviors such as institutional guidance and institutional incentive have not been fully utilized and applied. It is urgent for the enterprises to cultivate and excavate a large number of managers who value the importance of system. Besides, those managers can foster the enterprises to fabricate more competitive jetton during the process of institutional innovation. To satisfy the needs of innovation and development, subversive innovation in the innovation system can easily lead to institutional iteration and reform. Meanwhile, during the process of innovating institutional governance, the discovery of governance targets, the proposal of complementary systems and the game, and the implementation of institutional schemes can stimulate the progressive development of innovation. Therefore, it is reasonable to define the innovation ecosystem as a process in which innovation and governance are coupled and coexist to drive the evolution of the system.

Synchronization has been deeply investigated in various fields of people's production and life [5–7]. Numerous scholars have carried out relevant work. In particular, the research of the Kuramoto model has become a hot topic [8, 9]. In the innovation ecosystem, there exists a dynamic evolution process between the coupling between innovation and governance with the synchronization phenomenon in this process. Data sets signify the aggregation of class of the same features in the innovation ecosystem space. There is a certain probability of local population synchronous fluctuation after clustering. The law of universal gravitation [10] and coupled wave theory are referenced in this study [11]. The innovation subsystem in the innovation ecosystem is regarded as a collection of innovation elements. The institutional governance subsystem is regarded as a collection of many institutional elements. These elements can be simply regarded as particles, and there are interaction forces among particles [12]. According to the field theory of Bourdieu [13], law of gravity [14], and second law of Newton [15], mutual attraction can be found from different energy levels. The elements (particles) are mutually attracted to form an aggregation field over time, and different elements (participles) differ in energy levels in this process.

It is found that the clustering algorithm can well explain the agglomeration of subsystem and scale of innovation ecosystem [16]. Therefore, this study constructs a gravitational agglomeration model. Energy superposition can be realized through simultaneous gathering of innovation elements and institutional governance elements to achieve the purpose of promoting high-quality development in the

innovation ecosystem. It will promote the release of innovation potential and accumulate energy for the realization of major innovation achievements and key technologies, which is also conducive to the leap of the innovation value chain to the middle and high ends. Innovation subjects are boosted to thrive in a healthy ecological environment.

## 2. Literature Review and Theoretical Basis

### 2.1. Fluctuation of Innovation and Institutional Governance.

The research of fluctuation is mainly based on physics, informatics, and so on [17, 18]. Some scholars transplanted such fluctuation to the field of economics and management. Previous studies showed the volatility of innovation behavior [19, 20]. Sun et al. believed in the presence of capital constraint in technological innovation during industrial agglomeration. Due to the asymmetry of market information, there was volatility in the innovation supply chain [21]. Under the influence of innovation factors, industrial productivity in China showed the periodic rise and fall alternating fluctuations. Cao et al. combined the resilience of economic development with fluctuation and found that such volatility had a superposition effect [22]. As suggested by Wang, regional differences existed in the changes in China's industrial production efficiency, and fluctuation of technological innovation efficiency could accelerate regional development [23]. Liu et al. studied the economic development of the United States and found that there was a fluctuating relationship between economic development and innovation. Furthermore, the assumption that technological innovation was the core of economic growth had been tested again [24]. For the Japanese and US economies, the level of innovation determines the development trend of global economy. The United States prefers disruptive innovation, while Japan prefers incremental innovation. A further research by Ping found that institutional behavior was an important factor affecting the relationship between national innovation system and economic fluctuations in Japan [25]. In agreement with the view, many scholars paid more attention to the fluctuation impact of institutional governance [26, 27]. The research about institutional governance mostly focused on economy, stock, competitive market, etc. Deng et al. indicated that institutional governance had a fluctuating effect, which provided support for the high-quality development of enterprise technological innovation [28]. Su et al. also emphasized that institutional governance had always been the main force to stimulate enterprise innovation activities. Institutions could produce fluctuations in the form of signal transmission [29]. At present, countries all over the world are busy with the governance of carbon integration and carbon peak. Carbon emission rights have become the focus of attention. Lv et al. believed that carbon emission trading price was susceptible to institutional governance, and it was restricted in the form of wavelet and multifrequency [30]. The quality of institutional governance directly affected the capital level of the financial industry. Que et al. explored the relationship between institutional governance and financial industry from the perspective of volatility, finding that high-quality institutions could

promote regional economic development [31]. Hu et al. also emphasized that the cycle impact of institutional governance was the driving force of high-quality economic development [32]. In other research fields, Yuan took the shock fluctuations of land system governance as a starting point. It provided a new direction for the increase in regional financial fund income [33]. Nevertheless, Yao paid more attention to the periodic fluctuations of the system during the tenure of government officials. This revealed that the implementation of leadership system presented an inverted U-shaped distribution to local economic development [34]. In conclusion, scholars paid more attention to the research of innovation or institutional governance, but few studies combined the two. As Chinese economy kept pursuing high-quality development, innovation and institutional governance had become an essential dynamic factor [35].

*2.2. Gravitational Agglomeration under Innovation Ecosystem.* The innovation ecosystem is a composite system [36]. This study refers to the principle of universal gravitation, indicating the larger the scale or mass of the object, the greater the gravitation [37]. Under the action of universal gravitation, the larger the scale of innovation ecosystem, the easier the same element community after element aggregation [38]. In terms of the research on gravitational agglomeration of innovation ecosystem, some scholars concentrated on the relationship between radiation force and gravity of regional innovation. Wang et al. defined the scope of innovation attraction, which was based on the synergy of Beijing-Tianjin-Hebei regional innovation ecosystem. Moreover, it provided reference for the evolution of innovation space in Beijing-Tianjin-Hebei region [39]. In the regional innovation system, the research of Liu et al. had confirmed that factor gravity intensity could drive the fluidity of innovation activities. In addition, they found that the distance between cities is related to the gravity degree of innovation factors [40]. Certainly, some scholars analyzed the agglomeration of data set in the innovation ecosystem from the perspective of evolution. Zhu held that the construction of national innovation system needed the support of ecological technology innovation. Incorporating green technology innovation elements was an inevitable way for enterprises to pursue high-quality development [41]. The attraction of innovation network also brought the agglomeration of elements to intercity regional cooperation. Therefore, Zhu et al. indicated that the spatial evolution of innovation cooperation network presented a differentiated agglomeration featuring a strong potential in the east and a weak potential in the west among all Chinese provincial capitals [42]. The evolution of innovation network might take the form of network centrality or condensed subgroup in clustering. The attraction of innovation had also been strengthened with the increase in network density [43]. Others had focused on cluster ecology. Wen et al. analyzed the NSF database in the United States and subdivided the element agglomeration in the innovation cluster [44]. The work provided a new research paradigm. On the spatial clustering of industrial clusters, Chen et al. studied the layout

of animal husbandry industrial clusters in Gansu Province. The systematic pattern of factor agglomeration in the animal husbandry industry was formed through the gravitational measurement across regions [45]. In summary, this study found that the literature on element clustering in the innovation system was mostly performed in the nonsynchronous state, whereas the agglomeration in the local synchronous state was ignored.

### 3. Model Construction

*3.1. Restoration Description Model of Discipline Pyramid.* Previous studies have shown that many disciplines emerged over time. There are hierarchical differences among these disciplines, which are arranged in a pyramid [46]. Among them, physics is at the bottom, and chemistry is the next, as arranged in turn, which explains the formation of the pyramid with philosophy at the top. There are hierarchical differences among disciplines. According to reductionism [47], the given element data can be processed by simpler or more basic element data. High-level complex data objects are decomposed into low-level simple data objects [48]. Therefore, innovation in economics and institutional governance in sociology are supposed to be in the upper half of the pyramid. Electromagnetism in basic physics is at the bottom of the pyramid. The upper part can be simplified by the lower part. In addition, the field theory was first proposed by Bourdieu [13] and then expanded by the scholars. This study draws lessons from Zhang's innovation field theory [49]. The agglomeration of similar innovation element generates data set under the action of universal gravity, which is regarded as the innovation field in the innovation ecosystem. Similarly, this study was inspired by Wang et al. [50]. A series of institutional elements will be used to manage and control innovation activities within the innovation ecosystem. The formation of systematic governance space should be considered a part in the field of institutional governance. The studies by Zou et al. [51], Zhang et al. [52], and He et al. [53] further demonstrated the existence of institutional governance field. In summary, according to the reduction theory and field theory, the innovation field and institutional governance field can be described by the electromagnetic field at the bottom of the pyramid. However, the description is only one-way restoration of the described behavior. The reverse is not necessarily true. The specific restoration process model is shown in Figure 1.

*3.2. Analogy between Electromagnetic Waveguide and Innovation Ecosystem Form.* Electricity and magnetism are common energy waves in physics, which can be converted into energy forms. It can be said that electricity and magnetism promote and influence each other. Waveguide is a place where electric energy elements and magnetic energy elements are clustered at the same frequency or phase. Besides, it is a medium space with coupled waves in accordance with a certain law [54]. In the field of management, innovation and institutional governance are common activities. The innovation behavior of enterprises has the

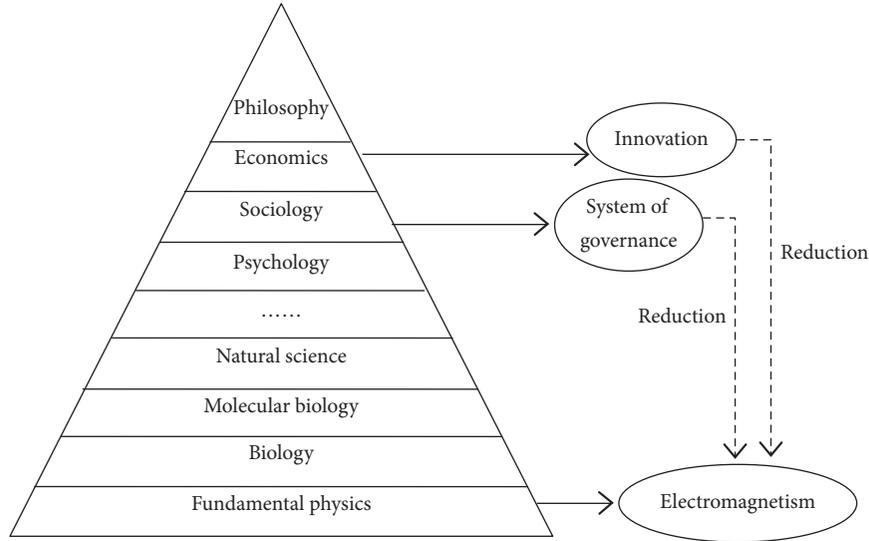


FIGURE 1: Electromagnetic description of innovation and governance by the discipline pyramid.

function of network extension and radiation [55]. Institutional governance behavior is also an independent organization. Governance behavior could further spread to mutual interaction partners or potential cooperative relationships [56]. As a result, the agglomeration of innovation elements and institutional governance elements forms their respective fields with radiation function. Therefore, innovation ecosystem is a space that contains the field agglomeration of innovation elements and the field agglomeration of institutional governance elements. It is the carrier of innovation field and institutional governance field. Although waveguide and innovation ecosystem belong to different fields, there still exist many similarities in morphology. This study will further explore whether the carrier of electromagnetic wave, innovation, and institutional governance space exist the approximation. It mainly explores the characteristics and mode of transmission. The specific analysis is shown in Table 1.

In addition, the elements cluster in the innovation ecosystem and form a subsystem of innovation and institutional governance from the form of communication. This process can also be regarded as the fluctuation, reflection, and radiation of energy in the field theory of innovation and institution. Similar to electromagnetic waves, there is wave conduction. Briefly, electromagnetic waveguide and innovation ecosystem are similar in form.

### 3.3. Deduction of the Local Synchronous Agglomeration Model.

Innovation field and institutional governance field can produce coupling state in the fluctuation process of innovation ecosystem [57]. Out of sync (chimera state) is a universal phenomenon in nature, regional economy, and social development. In accordance with coupled wave theory, out of sync is the norm in the innovation ecosystem [58]. If there is coupling fluctuation, there is a synchronous state in a local area [59]. The Kuramoto oscillator model is the most extensively applied local

synchronization research by scholars [60]. Learning from Wang's synchronous enhancement theory [61], if there is synchronous vibration fluctuation on the local agglomeration behavior of innovation and institutional governance in the innovation ecosystem, it can generate energy superposition effect [62, 63]. The generated energy can promote the organization to produce breakthrough innovation and disruptive innovation. In this study, the innovation ecosystem is approximately regarded as a waveguide. Then, the local agglomeration model will be deduced in combination with universal gravitation. Existing studies have demonstrated that universal gravitation is everywhere [64]. There exists mutual attraction between any two particles, which is not affected by any physical and media properties. Therefore, this work applies universal gravitation to deal with the problem of local synchronous agglomeration within the innovation ecosystem. Let  $x$  be a data object of the data set  $X$  in the innovation ecosystem.  $x_i$  represents the changing phase of the position of object element  $x$  in the  $i$ th dimension.  $F$  refers to the gravitational attraction between the two elements.  $m$  indicates the quality of the element. To facilitate the derivation, the quality of each element is set equally in this study.  $G$  is the constant of gravity, and  $r_{ij}$  is the Euclidean distance between elements  $i$  and  $j$ .

The formula of universal gravitation can be obtained from the known conditions. Therefore,

$$F = G \cdot \frac{m_i \cdot m_j}{r_{ij}^2}. \quad (1)$$

The direction of the force is supposed as  $d_r$ , and then,

$$d_r = \frac{x_j - x_i}{r_{ij}}. \quad (2)$$

According to Newton's second law, the acceleration expression is as follows:

TABLE 1: Common characteristics of electromagnetic waveguide and innovation ecosystem.

Common features	Electromagnetic waveguide	Innovation ecosystem
Boundary	Waveguides have sizes and shapes.	Each ecosystem has boundaries and sizes.
Stability	Stable conduction structure.	Institutional governance makes the system tend to be stable.
Complexity	There are synchronous and chimera state electromagnetic waves in the cavity.	A multitarget, multilevel, and variable quantum system.
Energy interaction	Electromagnetic wave conduction.	Sharing of innovative information and resources.
Subject independence	There are several independent waves in the cavity.	Several independent innovation subjects in the system.
Open	Electromagnetic waves also exist on the outer surface of the waveguide.	Cooperation with the external environment.

$$a = \frac{F}{m}d_r. \quad (3)$$

It can be further obtained from equations (1)–(3):

$$ma = F = G \cdot \frac{m_i \cdot m_j}{r_{ij}^2} \cdot \frac{x_j - x_i}{r_{ij}}. \quad (4)$$

In this study, formula (4) of universal gravitation is further transformed. It constructs a local synchronous agglomeration model of innovation ecosystem. This study assumes that there are  $n$  data sets  $x$  in the innovation ecosystem. Then,  $x_i = \{x_i^1, x_i^2, \dots, x_i^k, \dots, x_i^m\}$ ,  $i \leq n$ , where  $x_i^k$  represents the position of element  $i$  in the  $k$ th dimension. Therefore, at a certain time  $t$ , the gravitational attraction of the element  $x_i$  in the data set from the element  $x_j$  is as follows:

$$F_{ij}^k = G \frac{m_i m_j}{r_{ij}^2} \times \frac{x_j^k(t) - x_i^k(t)}{r_{ij}}. \quad (5)$$

At this time, it is not difficult to obtain the resultant force equation of element  $X_i$ . Therefore, it is easy to obtain

$$F_i^k(t) = \sum_{j=1, i \neq j}^n G \frac{m_i m_j}{r_{ij}^2} \times \frac{x_j^k(t) - x_i^k(t)}{r_{ij}}. \quad (6)$$

According to (3), the moving acceleration equation is shown as follows at time  $t$ :

$$a_i^k(t) = \frac{F_i^k(t)}{m_i}. \quad (7)$$

According to the dynamic equation,  $v_i^k(t+1) = v_i^k(t) + a_i^k(t)$ . The change in position of the element is equal to the original position plus velocity times time. For the convenience of derivation, the dynamic acceleration coefficient is 0.5. In addition, it is easy to obtain the equation of position change of elements.

$$x_i^k(t+1) = x_i^k(t) + \frac{1}{2} \cdot a_i^k(t). \quad (8)$$

To apply the universal gravitational dynamic model to synchronous agglomeration,  $N_\varepsilon(X)$  is set as the nearest adjacent domain of sample  $x$  in the innovation ecosystem. It is the distance to  $x \leq \varepsilon$  that all the elements are clustered into

a field function. The synchronization model can be obtained by combining equations (6)–(8):

$$x_i(t+1) = x_i(t) + \frac{1}{2} \sum_{y \in N_\varepsilon(x)} G \cdot \frac{m_x m_y}{r_{m_x m_y}^2} \cdot \frac{y_i(t) - x_i(t)}{r_{m_x m_y}} \cdot \frac{1}{m_x}. \quad (9)$$

Since the sample quality has been assumed to be equal in size, it exerts no effect on the agglomeration results within the innovation ecosystem. Therefore, to facilitate calculation,  $m$  is set as 1 in the current work. After the dynamic evolution of  $t = (1, 2, \dots, T)$ , new position of the sample  $x_i(t+1)$  can be obtained. The gravity equation after dynamic evolution of each component of the sample is expressed as follows:

$$x_i(t+1) = x_i(t) + \frac{1}{2} \sum_{y \in N_\varepsilon(x)} G \cdot \frac{y_i(t) - x_i(t)}{r_{m_x m_y}^3}. \quad (10)$$

This study describes the degree of inter-field synchronization of local factor groups by measuring the consistency in the innovation ecosystem. Based on the global sequence parameter formula [65], an agglomeration order parameter  $r_c$  is introduced. This can determine whether the local synchronization process is completed. The specific formula is as follows:

$$r_c = \frac{1}{n} \sum_{i=1}^n \left( \frac{1}{N_\varepsilon(x_i)} \sum_{y \in N_\varepsilon(x_i)} e^{\|x_i - y\|} \right). \quad (11)$$

Due to the influence of gravity, a large number of innovation elements gather in the innovation field. In addition, the same phenomenon occurs in the institutional governance field with the development of time.  $r_c$  is constantly changing. When  $r_c \approx 1$  or  $r_c = 1$ , innovation field and institutional governance field are close to synchronized. In the range of neighborhood  $\varepsilon$ , it can be judged as synchronous agglomeration.

#### 4. Evolution Analysis of Local Agglomeration Game of Innovation Ecosystem

**4.1. Game Hypothesis and Model Analysis.** To explore the gravitational agglomeration of local synchronous data set of innovation ecosystem, this study made further analysis by adopting evolutionary game method. The main body of innovation ecosystem is divided into enterprises, university and scientific research institute, and government. From the

perspective of innovation, the reason is that enterprises and university and scientific research institute have high innovation radiation efficiency. Based on the perspective of institutional governance, the government is the main designated party of the system. Additionally, enterprises and university and scientific research institute also have the situation of institutional governance. From the perspective of institutional governance, the government is the main institution maker. Enterprises and university and scientific research institute also have institutional governance. The specific game relationship hypothesis is presented as follows:

- (1) Subject selection strategy: the strategies of government include high-intensity support and low-intensity support in the development of innovation and institutional governance. The enterprise strategy contains synchronous state development and chimera state development. The strategy of university and scientific research institute consists of high coupling strength and low coupling strength.
- (2) The government strongly supports technological innovation and innovation system governance, which can achieve social benefits  $Q_1$ . The support cost is  $C_1$  (it does not cover the funds to support enterprises and universities). With low-intensity support for technological innovation and innovation system governance development, the social benefits can be  $Q_2$ . The support cost is  $C_2$  (it does not cover the funds to support enterprises and universities).
- (3) The synchronous development probability of innovation and governance in enterprises is  $\beta$ . Break-through innovation revenue  $G_1$  can be obtained. Besides, it requires an innovation input for  $C_3$  (this does not cover funding for university and scientific research institute).

The probability of chimera state of enterprise innovation and institutional governance is  $1 - \beta$ . The probability of enterprise innovation intensity > institutional governance intensity is  $\alpha$ . In addition, there is an innovation cost  $C_4$ . Then, the payoff is  $G_2$ . The state probability of institutional governance > innovation is  $1 - \alpha$ . The enterprise can obtain innovation income  $G_5$  with the cost being set as  $C_5$ . In addition, enterprises obtain government

funding support  $J_1$ . Enterprises funded university and scientific research institute can obtain additional technical income  $L_1$ .

- (4) If the innovation and institutional governance of university and scientific research institute are highly coupled, the technical benefit is  $R_1$  with the cost being  $C_6$ . If low-intensity coupling is carried out, technical benefits can be obtained  $R_2$  ( $R_1 > R_2$ ). The cost is  $C_7$  ( $C_6 > C_7$ ). The nontechnical income includes the income  $J_2$  obtained from enterprise subsidy and  $J_3$  obtained from government fund.
- (5) If the probability of high-intensity government support is  $x$ , the probability of low-intensity government support is  $1 - x$ . If the synchronous state development probability of the enterprise is  $y$ , the chimera state development probability is  $1 - y$ . The strong coupling probability of innovation and governance of university and scientific research institute is  $z$  with the weak coupling strength probability being  $1 - z$ .  $0 < x < 1$ ,  $0 < y < 1$ , and  $0 < z < 1$ .

Through the above game relationship, a game tree is constructed, as illustrated in Figure 2. The benefit matrix is shown in Table 2. The agglomeration of innovation and institutional governance elements is set  $W_i$  as the final state in the innovation ecosystem, where  $i$  is 1, 2, ..., 8.

**4.2. Replicator Dynamic Equation.** Replication dynamics can be regarded as an adjustment mechanism. It is the ability of simple imitation of dominant strategies. Therefore, the number of successful strategies adopted by individuals will gradually increase. The replicator dynamic equation is the basis of the whole evolution theoretical model, which can be adopted for finding the evolutionary stability strategy [66]. Therefore, according to the three-party benefits in Table 2, the following replication dynamic equation function can be obtained:

- (1) *Government's Replication Dynamic Equation.* The government chooses  $H_{x1}$  for expected return high-intensity support strategy and  $H_{x2}$  for expected return for low-intensity support strategy. Hence, the expected return of the government is  $HX$ . The specific equation is expressed as follows:

$$\begin{aligned}
 H_{x1} &= yz(Q_1 - C_1 - \beta J_1 - J_3) + y(1 - z)(Q_1 - C_1 - \beta J_1 - J_3) + (1 - y)z(Q_1 - C_1 - (1 - \beta)J_1 - J_3) \\
 &\quad + (1 - y)(1 - z)(Q_1 - C_1 - (1 - \beta)J_1 - J_3) \\
 &= y(Q_1 - C_1 - \beta J_1 - J_3) + (1 - z)(Q_1 - C_1 - (1 - \beta)J_1 - J_3), \\
 H_{x2} &= (Q_2 - C_2 - J_1 - J_4)yz + (Q_2 - C_2 - J_1)y(1 - z) + (Q_2 - C_2 - J_2 - J_4)(1 - y)z \\
 &\quad + (Q_2 - C_2 - J_2)(1 - y)(1 - z) = Q_2 - C_2, \\
 H_x &= xH_{x1} + (1 - x)H_{x2}.
 \end{aligned} \tag{12}$$

The replication dynamic equation of the government is constructed from equation (14):

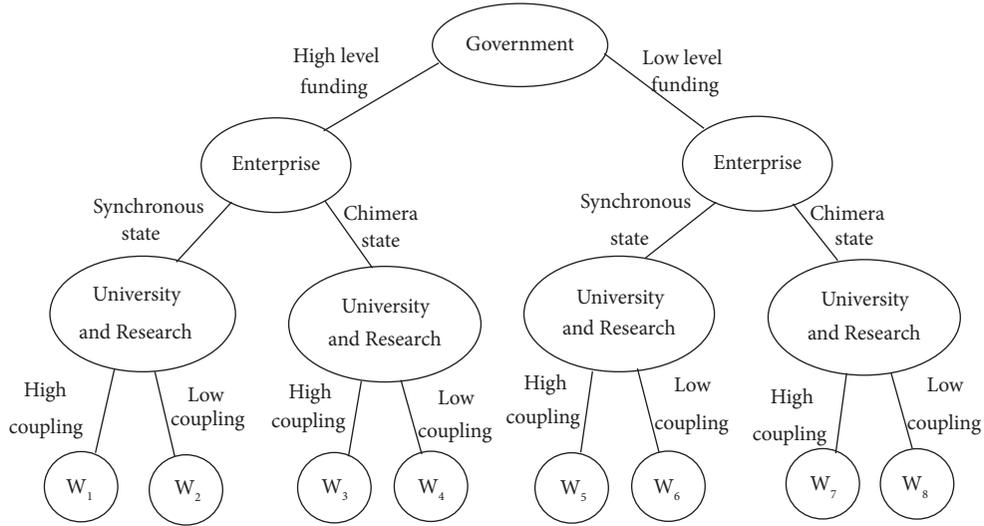


FIGURE 2: Game evolution tree.

TABLE 2: Income matrix of the game.

Strategy	Gravitational agglomeration state	Profit
\$W_1\$	(High-intensity support, synchronous state, high coupling strength)	$(Q_1 - C_1 - \beta J_1 - J_3, \beta(G_1 + J_1 + L_1 - C_3 - J_2), R_1 + \beta J_2 + J_3 - C_6)$
\$W_2\$	(High-intensity support, synchronous state, low coupling strength)	$(Q_1 - C_1 - \beta J_1 - J_3, \beta(G_1 + J_1 + L_1 - C_3 - J_2), \beta J_2 + J_3 + R_2 - C_7)$
\$W_3\$	(High-intensity support, chimera state, high-intensity support)	$(Q_1 - C_1 - (1 - \beta)J_1 - J_3, (1 - \beta)[\alpha(G_2 - C_4) + (1 - \alpha)(G_3 - C_5) + J_1 + L_1 - J_2], R_1 + (1 - \beta)J_2 + J_3 - C_6)$
\$W_4\$	(High-intensity support, chimera state, low coupling strength)	$(Q_1 - C_1 - (1 - \beta)J_1 - J_3, (1 - \beta)[\alpha(G_2 - C_4) + (1 - \alpha)(G_3 - C_5) + J_1 + L_1 - J_2], (1 - \beta)J_2 + J_3 + R_2 - C_7)$
\$W_5\$	(Low-intensity support, synchronous state, high-intensity support)	$(Q_2 - C_2, \beta(G_1 + L_1 - C_3 - J_2), R_1 + \beta J_2 - C_6)$
\$W_6\$	(Low-intensity support, synchronous state, low coupling strength)	$(Q_2 - C_2, \beta(G_1 + L_1 - C_3 - J_2), R_2 + \beta J_2 - C_7)$
\$W_7\$	(Low-intensity support, chimera state, high-intensity support)	$(Q_2 - C_2, (1 - \beta)[\alpha(G_2 - C_4) + (1 - \alpha)(G_3 - C_5) + L_1 - J_2], R_1 + (1 - \beta)J_2 - C_6)$
\$W_8\$	(Low-intensity support, chimera state, low coupling strength)	$(Q_2 - C_2, (1 - \beta)[\alpha(G_2 - C_4) + (1 - \alpha)(G_3 - C_5) + L_1 - J_2], R_2 + (1 - \beta)J_2 - C_7)$

$$F(x) = \frac{dx}{dt} = x(H_{x1} - H_x) = x(1-x)[y(Q_1 - \beta J_1 - C_1 - J_3) + (1-z)(Q_1 - C_1 - (1-\beta)J_1 - J_3) - Q_2 + C_2]. \quad (13)$$

It can be observed from the replication of the stability principle of dynamic differential equations and the evolutionary stability strategy.  $F(x) = 0, F'(x) < 0$ . When  $x$  is a strict Nash equilibrium, its value is the evolutionary stability strategy ESS. This makes the evolutionary game tend to remain stable.

When  $y = (z-1)(Q_1 - C_1 - (1-\beta)J_1 - J_3) + Q_2 - C_2 / (Q_1 - C_1 - \beta J_1 - J_3)$ , then  $f(x) \equiv 0$ . It is stable for all variables  $x$ . When  $y \neq (z-1)(Q_1 - C_1 - (1-\beta)J_1 - J_3) + Q_2 - C_2 / (Q_1 - C_1 - \beta J_1 - J_3)$ , let  $f(x) \equiv 0$ , and it is easy to obtain two stable states of  $x = 0$  and  $x = 1$ . Derivation of  $f(x)$  is  $dF(x)/dx = (1-2x)[y(Q_1 - C_1 - \beta J_1 - J_3) + (1-z)(Q_1 - C_1 - (1-\beta)J_1 - J_3) - Q_2 + C_2]$ . If  $y < (z-1)(Q_1 - C_1 - (1-\beta)J_1 - J_3) + Q_2 - C_2 / (Q_1 - C_1 - \beta J_1 - J_3)$ ,  $dF(x)/dx|_{x=0} < 0$ , and  $dF(x)/dx|_{x=1} > 0$ ,  $x=0$  is the equilibrium point. If  $y > (z-1)(Q_1 - C_1 - (1-\beta)J_1 - J_3) + Q_2 - C_2 / (Q_1 - C_1 - \beta J_1 - J_3)$ ,  $dF(x)/dx|_{x=0} > 0$ , and

$dF(x)/dx|_{x=1} < 0$ ,  $x = 1$  is the equilibrium point. The specific process is shown in Figure 3 where  $S_1$  is the section formed.

$$y = \frac{(z-1)(Q_1 - C_1 - (1-\beta)J_1 - J_3) + Q_2 - C_2}{Q_1 - C_1 - \beta J_1 - J_3},$$

$$y < \frac{(z-1)(Q_1 - C_1 - (1-\beta)J_1 - J_3) + Q_2 - C_2}{Q_1 - C_1 - \beta J_1 - J_3}, \quad (14)$$

$$y > \frac{(z-1)(Q_1 - C_1 - (1-\beta)J_1 - J_3) + Q_2 - C_2}{Q_1 - C_1 - \beta J_1 - J_3}.$$

(2) *Replication Dynamic Equation of Enterprise*. In the innovation ecosystem, enterprises perform innovation and institutional governance activities. The expected payoff of synchronous state is  $H_{y1}$ . The expected payoff of chimera state is  $H_{y2}$ . The expected return of the enterprise is  $H_y$ . The specific equation is expressed as follows:

$$H_{y1} = xz\beta(G_1 + J_1 + L_1 - C_3 - J_2) + x(1-z)\beta(G_1 + J_1 + L_1 - C_3 - J_2) + (1-x)z\beta(G_1 + L_1 - C_3 - J_2) + (1-x)(1-z)\beta(G_1 + L_1 - C_3 - J_2) = x\beta(G_1 + J_1 + L_1 - C_3 - J_2) + (1-z)\beta(G_1 + L_1 - C_3 - J_2),$$

$$H_{y2} = xz(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + J_1 + L_1 - J_2] + x(1-z)(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + J_1 + L_1 - J_2] + (1-x)z(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + L_1 - J_2] + (1-x)(1-z)(1-\beta), \quad (15)$$

$$[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + L_1 - J_2] = x(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + J_1 + L_1 - J_2] + (1-z)(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + L_1 - J_2],$$

$$H_y = yH_{y1} + (1-y)H_{y2}.$$

The replication dynamic equation of enterprise game is constructed from equation (18):

$$F(y) = \frac{dy}{dt} = y(1-y)[x\beta(G_1 + J_1 + L_1 - C_3 - J_2) + (1-z)\beta(G_1 + L_1 - C_3 - J_2) - x(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + J_1 + L_1 - J_2] - (1-z)(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + L_1 - J_2]]. \quad (16)$$

If  $x = (1-z)[(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + L_1 - J_2] - \beta(G_1 + L_1 - C_3 - J_2)] / [\beta(G_1 + J_1 + L_1 - C_3 - J_2) - (1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + J_1 + L_1 - J_2]] = M$ ,  $F(y) \equiv 0$ . When  $M = 0$ , then it is stable for all variables  $y$ . When  $x \neq M$  and  $F(y) = 0$ , it is easy to

get the stable states of  $y = 0$  and  $y = 1$ . Derivation of  $F(y)$  is  $dF(y)/dy = (1-2y)[x\beta(G_1 + J_1 + L_1 - C_3 - J_2) + (1-z)\beta(G_1 + L_1 - C_3 - J_2) - x(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + J_1 + L_1 - J_2] - (1-z)(1-\beta)[\alpha(G_2 - C_4) + (1-\alpha)(G_3 - C_5) + L_1 - J_2]]$ . If  $x < M$ ,

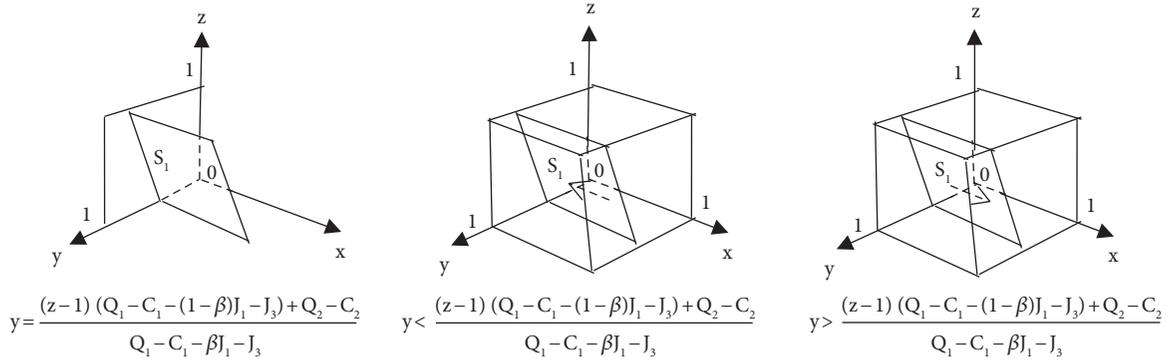


FIGURE 3: Stability change process of government ESS.

$dF(y)/dy|_{y=0} < 0$ , and  $dF(y)/dy|_{y=1} > 0$ ,  $y=0$  is the equilibrium point. If  $x > M$ ,  $dF(y)/dy|_{y=0} > 0$ , and  $dF(y)/dy|_{y=1} < 0$ ,  $y=1$  is the equilibrium point. The specific process is displayed in Figure 4, where  $S_2$  is the section formed.

(3) *Replication Dynamic Equations of University and Research Institute.* The university and scientific

research institute chooses  $H_{x1}$  for expected return of high coupling strategy, and the expected return of low coupling strength is  $H_{x2}$ . Then, the expected income of university and scientific research institute is  $H_z$ .

$$\begin{aligned}
 H_{z1} &= xy(R_1 + \beta J_2 + J_3 - C_6) + x(1-y)(R_1 + (1-\beta)J_2 + J_3 - C_6) \\
 &\quad + (1-x)y(R_1 + \beta J_2 - C_6) + [R_1 + (1-\beta)J_2 - C_6](1-x)(1-y) \\
 &= 2y\beta J_2 + J_2 y + x J_3 + R_1 + (1-\beta)J_2 - C_6, \\
 H_{z2} &= xy(\beta J_2 + J_3 + R_2 - C_7) + x(1-y)[(1-\beta)J_2 + J_3 + R_2 - C_7] \\
 &\quad + (1-x)y(R_2 + \beta J_2 - C_7) + (R_2 + (1-\beta)J_2 - C_7)(1-x)(1-y) \\
 &= 2y\beta J_2 - J_2 y + x J_3 + R_2 + (1-\beta)J_2 - C_7, \\
 H_z &= zH_{z1} + (1-z)H_{z2}.
 \end{aligned} \tag{17}$$

The replication dynamic equations of university and scientific research institute are constructed from equation (17):

$$\begin{aligned}
 F(z) &= \frac{dz}{dt} = z(H_{z1} - H_z) \\
 &= z(1-z)[2J_2 y + R_1 - C_6 - R_2 + C_7].
 \end{aligned} \tag{18}$$

It can be observed from the replication of the stability principle of dynamic differential equations and the evolutionary stability strategy. If  $y = R_2 - C_7 - R_1 + C_6/2J_2$ , then  $F(z) \equiv 0$ . It is stable for all variables  $z$ . When  $y \neq R_2 - C_7 - R_1 + C_6/2J_2$ , let us make  $F(y) = 0$ . It is easy to obtain the stable states of  $z=0$  and  $z=1$ . Derivation of  $F(z)$  is  $dF(z)F/dt = (1-2z)[2J_2 y + R_1 - C_6 - R_2 + C_7]$ . If  $y > R_2 - C_7 - R_1 + C_6/2J_2$ ,  $dF(z)F/dt|_{z=0} < 0$ , and  $dF(z)F/dt|_{z=1} > 0$ , then  $z=0$  is the equilibrium point. If  $y < R_2 - C_7 - R_1 + C_6/2J_2$ ,  $dF(z)F/dt|_{z=0} > 0$ , and  $dF(z)F/dt|_{z=1} < 0$ , then  $z=1$  is the equilibrium point. The specific process is displayed in Figure 5, where  $S_3$  is the section formed.

$$\begin{aligned}
 y &= \frac{R_2 - C_7 - R_1 + C_6}{2J_2}, \\
 y &> \frac{R_2 - C_7 - R_1 + C_6}{2J_2}, \\
 y &< \frac{R_2 - C_7 - R_1 + C_6}{2J_2}.
 \end{aligned} \tag{19}$$

**4.3. ESS Stability Determination.** According to the Jacobian matrix, the stable state of 8 points  $(0, 0, 0)$ ,  $(1, 0, 0)$ ,  $(0, 1, 0)$ ,  $(0, 0, 1)$ ,  $(1, 1, 0)$ ,  $(1, 0, 1)$ ,  $(0, 1, 1)$ , and  $(1, 1, 1)$  is judged. As shown in Table 3, if the characteristic root is less than 0, it can be regarded as progressive stability.

It can be found from Table 3 that there are two policy points with unknown states. The common feature of two unknowns refers to that the government adopts high-intensity support and university and scientific research institute chooses high coupling decision-making. Then, this study discusses the unknown points to judge the stability. If  $\beta \times (G_1 + J_1 + L_1 - C_3 - J_2) > (1-\beta) \times [\alpha(G_2 - C_4)$

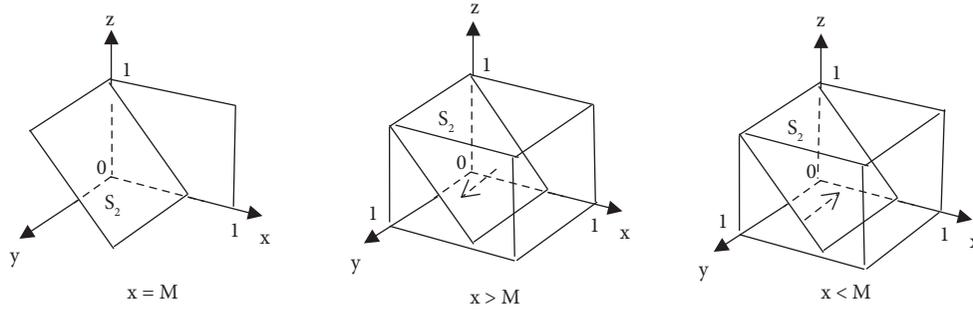


FIGURE 4: Change process of enterprise ESS stability.

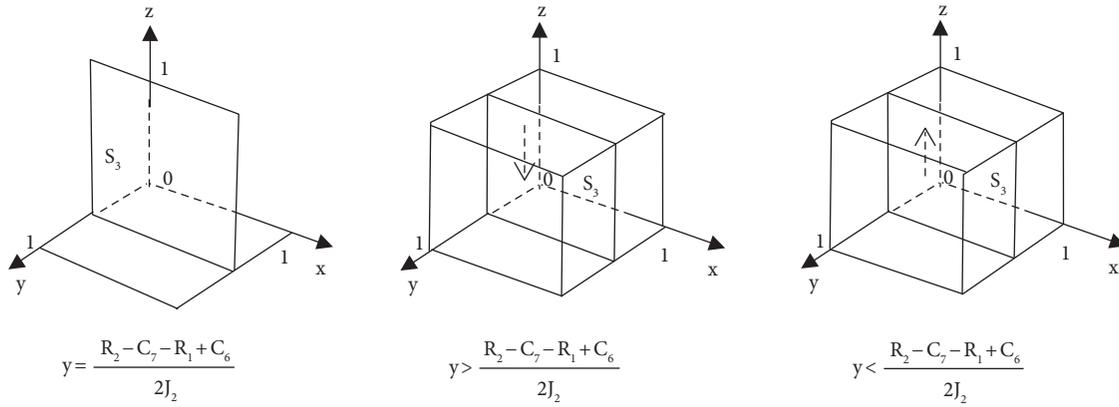


FIGURE 5: Changes in ESS stability in university and scientific research institutes.

TABLE 3: ESS stability judgment.

Equilibrium strategy point	Characteristic root of Jacobian	Strategy trend	ESS status
(0, 0, 0)	$Q_1 - C_1 - (1 - \beta) \times J_1 - J_3, \beta \times (G_1 + L_1 - C_3 - J_2), R_1 - C_6 - R_2 - C_7$	(+, ?, +)	Saddle point
(1, 0, 0)	$Q_2 - C_2, 2\beta(G_1 + J_1 + L_1 - C_3 - J_2) - 2(1 - \beta) \times [\alpha \times (G_2 - C_4) + (1 - \alpha) \times (G_3 - C_5) + J_1 + L_1 - J_2], R_1 - C_6 - R_2 + C_7$	(+, ?, +)	Saddle point
(0, 1, 0)	$Q_2 - C_2 + J_2, -\beta(G_1 + J_1 + L_1 - C_3 - J_2) - (1 - \beta) \times [\alpha \times (G_2 - C_4) + (1 - \alpha) \times (G_3 - C_5) + J_1 + L_1 - J_2], R_1 - C_6 - R_2 + C_7 + 2J_2$	(+, ?, +)	Saddle point
(0, 0, 1)	$-Q_2 + C_2, 0, -R_1 + C_6 + R_2 - C_7$	(-, 0, -)	Instability point
(1, 1, 0)	$Q_2 - C_2, -2\beta \times (G_1 + J_1 + L_1 - C_3 - J_2) - 2(1 - \beta) \times [\alpha \times (G_2 - C_4) + (1 - \alpha) \times (G_3 - C_5) + J_1 + L_1 - J_2], R_1 - C_6 - R_2 + C_7 + 2J_2$	(+, ?, +)	Saddle point
(1, 0, 1)	$-Q_2 + C_2, \beta \times (G_1 + J_1 + L_1 - C_3 - J_2) - (1 - \beta) \times [\alpha \times (G_2 - C_4) + (1 - \alpha) \times (G_3 - C_5) + J_1 + L_1 - J_2], -R_1 - C_6 + R_2 - C_7$	(-, ?, -)	Unknown
(0, 1, 1)	$Q_1 - C_1 - \beta J_1 - J_3 - Q_2 + C_2, 0, -R_1 + C_6 + R_2 - C_7 - 2J_2$	(?, 0, -)	Instability point
(1, 1, 1)	$-Q_2 + C_2 - Q_1 + C_1 + \beta J_1 + J_3, -\beta \times (G_1 + J_1 + L_1 - C_3 - J_2) + (1 - \beta) \times [\alpha \times (G_2 - C_4) + (1 - \alpha) \times (G_3 - C_5) + J_1 + L_1 - J_2], -R_1 + C_6 + R_2 - C_7 - 2J_2$	(-, ?, -)	Unknown

$+ (1 - \alpha)(G_3 - C_5) + J_1 + L_1 - J_2]$ , (1, 1, 1) is the only ESS stable equilibrium point and Nash equilibrium solution, namely  $\beta > 0.5$ . In the agglomeration of innovation and institutional governance elements, enterprise adopts the strategy of synchronization. High-intensity support by the government and strong coupling between university and scientific research institute have laid the development foundation for the emergence of synchronous state. If  $\beta \times (G_1 + J_1 + L_1 - C_3 - J_2) < (1 - \beta) \times [\alpha(G_2 - C_4) + (1 - \alpha)$

$(G_3 - C_5) + J_1 + L_1 - J_2]$ , (1, 0, 1) becomes the only ESS stable equilibrium and Nash equilibrium solution. At this point,  $\beta < 0.5$ . The data set agglomeration of innovation and institutional governance elements presents a chimera state. Through the game analysis, it is found that university and scientific research institute can obtain the maximum benefit from the high-intensity coupling of innovation and institutional governance, whether in the chimera state or in the synchronous state. In addition, government can also get the

maximum benefit by choosing high-intensity support. However, the maximum profit of the enterprise is dependent on the situation. Therefore, this study will further explore how to cluster the elements of enterprise innovation and institutional governance and how to achieve the optimal.

## 5. Model Simulation and Discussion

Simulation is a common way for numerous scholars to explore the research of innovation ecosystem. This study focuses on whether the agglomeration of local synchronous data can achieve its optimal revenue solution in the innovation ecosystem, that is, whether enterprises in the system can generate the superposition effect of efficiency through local synchronization. Therefore, the current work further discusses this problem through model simulation.

**5.1. Parameter Settings.** This study sets the  $x$ -axis as the data collection trend of government innovation and institutional governance elements. The  $y$ -axis is set as the data collection trend of enterprise innovation and institutional governance elements. Similarly, the  $z$ -axis is set as the agglomeration trend of innovation and institutional governance data of university and scientific research institute.  $\beta$ ,  $\alpha$ , and  $Q_i$ ,  $G_i$ , and  $R_i$  are set as high, middle, and low standards respectively. Among them,  $Q_i, G_i, R_i \in (2, 5, 8)$ ,  $\beta \in (0.2, 0.5, 0.8)$ , and  $\alpha \in (0.2, 0.4, 0.9)$ . The synchronization state probability and chimera state probability of enterprise innovation and institutional governance factor data sets are taken as the basic reference. Based on the interest relationship of innovation ecosystem, it forms an innovation ecosystem, which is based on the interests of all parties. According to the actual situation to formulate the basic relationship parameters, the details are as follows:  $C_1 = 5, C_2 = 3, C_3 = 2, C_4 = 3, C_5 = 1, C_6 = 2, C_7 = 1, Q_1 = 8, Q_2 = 2, G_1 = 10, G_2 = 5, G_3 = 4, J_1 = 4, J_2 = 3, J_3 = 2, L_1 = 2, R_1 = 5, R_2 = 2, \beta = 0.2$ , and  $\alpha = 0.2$ .

### 5.2. Simulation Analysis and Discussion

- (1) *The Influence of Innovation and Institutional Governance Factors on Data Set Agglomeration Strategy in Synchronous State.* At this point,  $\beta \in (0.2, 0.5, 0.8)$  is the enterprise synchronous low, medium, and high standards. Due to synchronization, this state sets  $a = 0.5$ . After simulation, the behavioral evolution trends of governments, enterprises, and university and research institute are illustrated in Figure 6.

When the probability of synchronization between innovation and institutional governance factor data sets is 20%, the trend of government, enterprises, and university and scientific research institute shows an increase and then presents a decrease. The optimal synchronization probability is approximately 50%. It presents an increasing upward trend. When the synchronization probability is 80%, the trend of government, enterprises, and university and scientific research institute is gradually decreasing in Figure 6.

This demonstrates that too low or too high synchronization will not produce good benefits in innovation and institutional governance element data set. It needs moderate synchronous development. Simulations found that this modest threshold fluctuated around 50%. Therefore, this is a good reflection of the development of the principle of moderation.

- (2) *The Influence of Innovation and Institutional Governance Factor Data Cluster Strategy in Chimera State.* This part needs to apply the previous simulation results, and thus,  $\beta = 0.5$ . Since it is a singular state,  $\alpha = 0.5$  needs to be modified.  $\alpha \in (0.2, 0.4, 0.9)$  is set to low, medium, and high standards, making the development environment out of sync. After simulation, the behavior evolution trend of government, enterprise, and university and scientific research institute is presented in Figure 7.

The evolution trend of chimera state is  $\alpha = 0.9 > a = 0.4 > a = 0.2$ . When  $a = 0.9$ , the status is innovation investment > institutional governance investment. At this time, innovation leads to governance development, which is the current development state of most enterprises. Therefore, the government, enterprise, and university and scientific research institute can benefit from the evolution trend by increasing the investment in innovation. When  $\alpha = 0.2$  and  $\alpha = 0.4$ , it is the state of institutional governance input > innovation input. If the intensity of institutional governance increases, it will restrict the emergence of innovation. Then, the government, enterprise, and university and research institute will have diminishing returns. According to the obtained results, the greater the intensity of institutional governance, the more obvious the decline trend. However, it can be found from Figure 7 that both innovation and institutional governance do not increase infinitely to generate better results. Both of them achieve incremental benefit within a certain range. When it is beyond this threshold range, it will be counterproductive.

- (3) *Influence of Government Input on  $Q_i$  Strategy.*  $Q_i \in (2, 5, 8)$  is set as the low, medium, and high ranges of changes in government input. When  $Q_i = 2$ , it indicates the strategy with low government support intensity. When  $Q_i = 8$ , it suggests the strategy with high government support intensity. After simulation, the evolution trend of government behavior is shown in Figure 8.

$Q_i$  presents an increasing trend. It indicates the higher the value of  $i$ , the better the government will obtain. This suggests that the benefits of high-intensity government support are greater than low-intensity government support. According to Figure 8, the higher the intensity of government investment, the better the income trend of enterprise and university and scientific research institute.

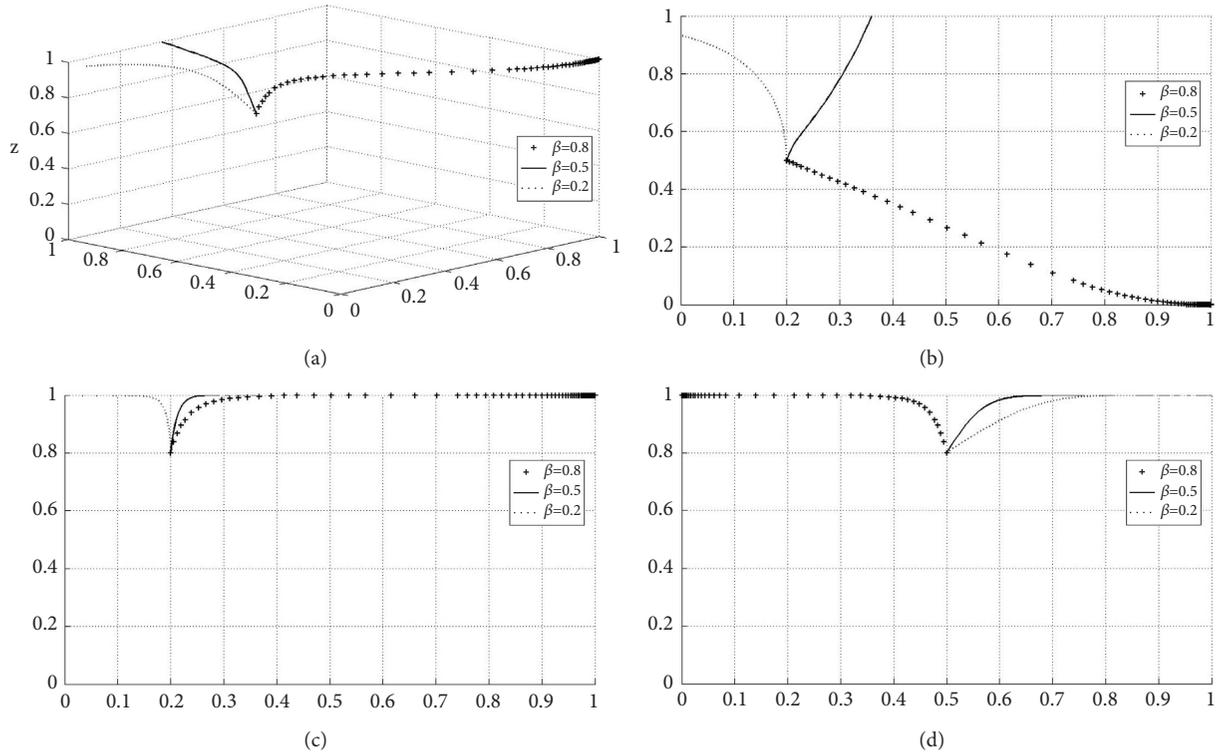


FIGURE 6: Influence of innovation and institutional governance factors on data set agglomeration strategy in synchronous state. (a) Description of the  $\beta$ -trend in main view. (b) Description of the  $\beta$ -trend in  $x$ - $y$  view. (c) Description of the  $\beta$ -trend in  $x$ - $z$  view. (d) Description of the  $\beta$ -trend in  $y$ - $z$  view.

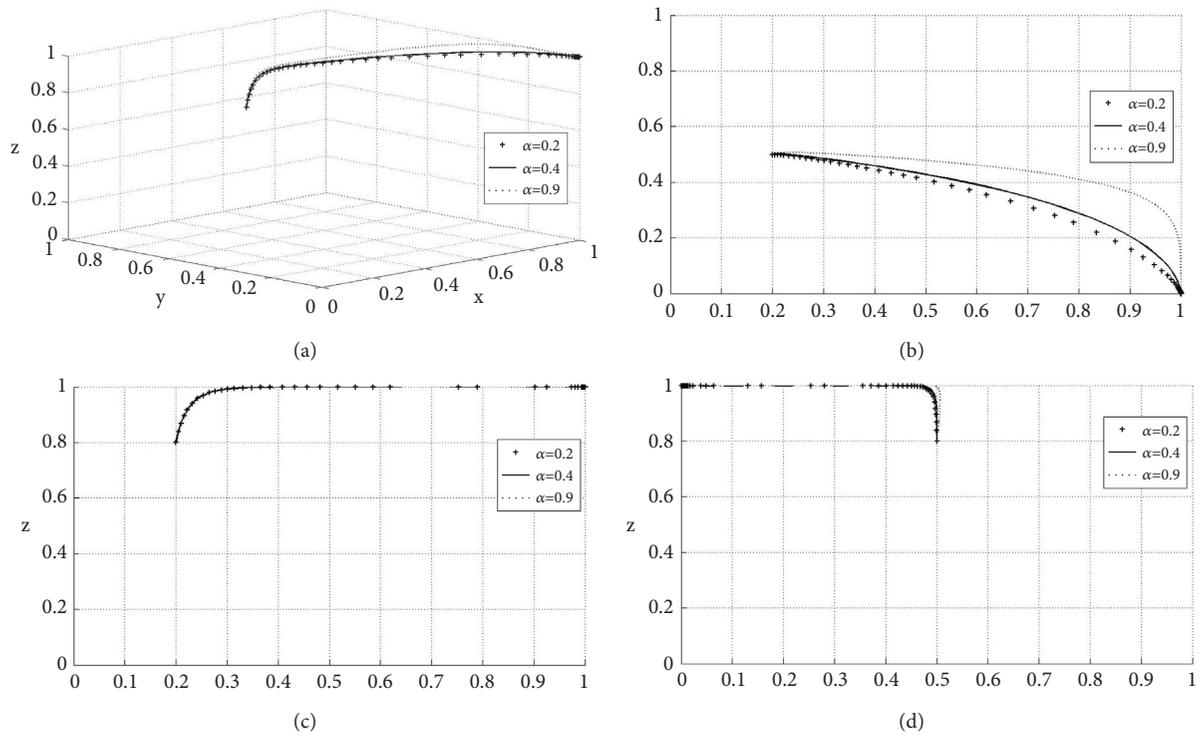


FIGURE 7: Influence of innovation and institutional governance factor data cluster strategy in chimera state. (a) Description of the  $\alpha$ -trend in main view. (b) Description of the  $\alpha$ -trend in  $x$ - $y$  view. (c) Description of the  $\alpha$ -trend in  $x$ - $z$  view. (d) Description of the  $\alpha$ -trend in  $y$ - $z$  view.

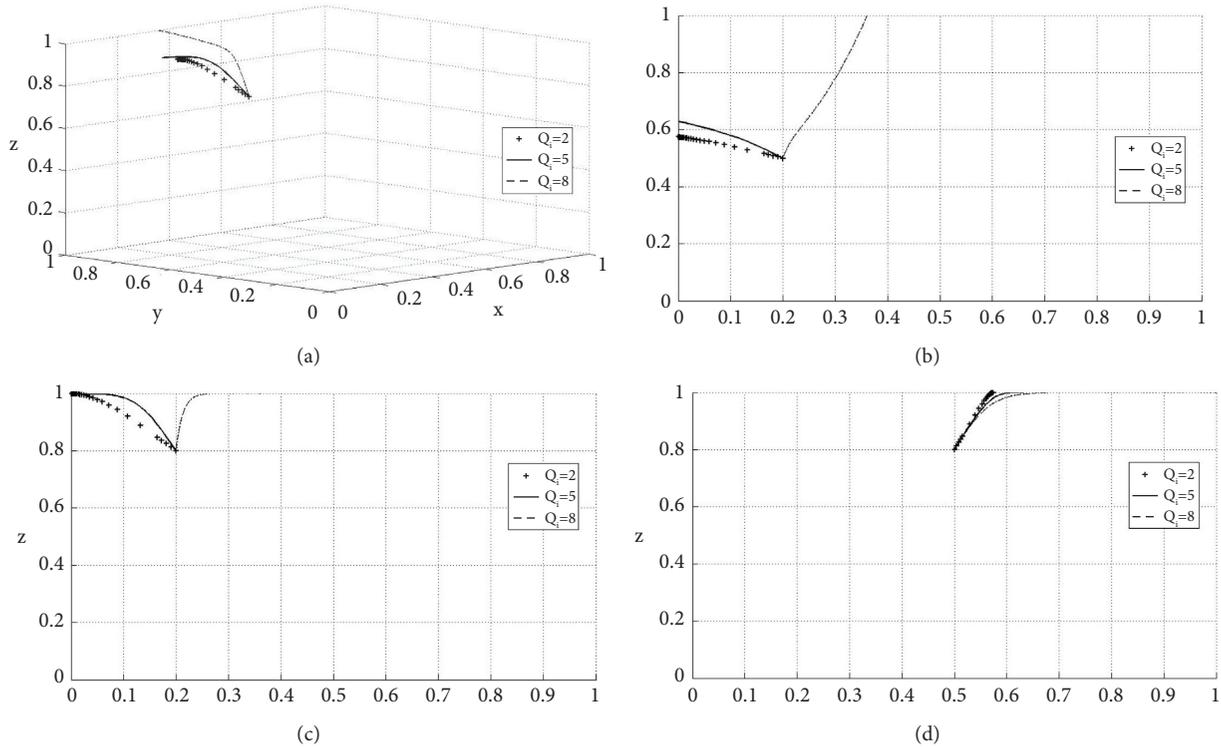


FIGURE 8: Impact of  $Q_i$  in government investment on innovation and institutional governance. (a) Description of the  $Q_i$  trend in the main view. (b) Description of the  $Q_i$  trend in  $x$ - $y$  view. (c) Description of the  $Q_i$  trend in  $x$ - $z$  view. (d) Description of the  $Q_i$  trend in  $y$ - $z$  view.

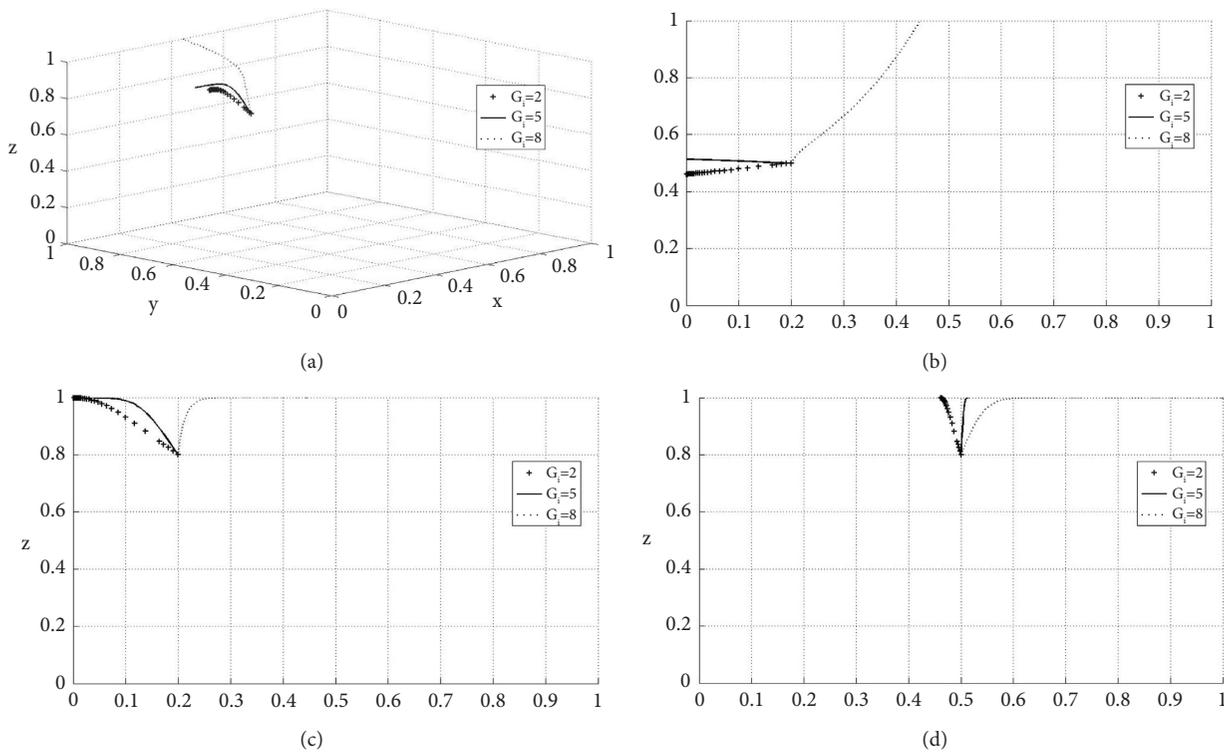


FIGURE 9: Influence of enterprise investment on innovation and institutional governance. (a) Description of the  $G_i$  trend in the main view. (b) Description of the  $G_i$  trend in  $x$ - $y$  view. (c) Description of the  $G_i$  trend in  $x$ - $z$  view. (d) Description of the  $G_i$  trend in  $y$ - $z$  view.

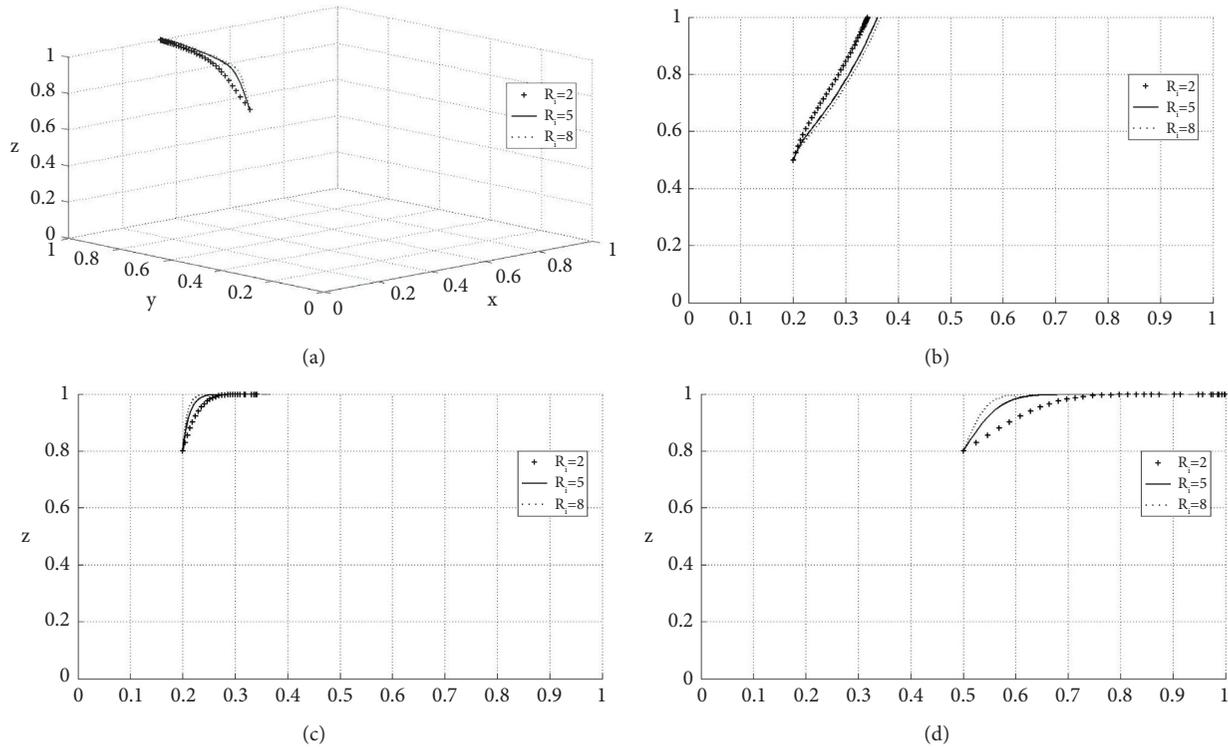


FIGURE 10: Influence of the coupling strength between innovation and institutional governance in university and scientific research institutes. (a) Description of the  $R_i$  trend in the main view. (b) Description of the  $R_i$  trend in  $x$ - $y$  view. (c) Description of the  $R_i$  trend in  $x$ - $z$  view. (d) Description of the  $R_i$  trend in  $y$ - $z$  view.

- (4) *Influence of  $G_i$  Strategy Invested by Enterprises.*  $G_i \in (2, 5, 8)$  is set as the low, medium, and high ranges of changes in enterprise input. When  $G_i = 2$ , it signifies the strategy with low investment in enterprise innovation and institutional governance. When  $G_i = 8$ , it represents the strategy with high investment in enterprise innovation and institutional governance. After simulation, the behavior evolution trend of enterprise is illustrated in Figure 9.

It can be seen from Figure 9 that  $G_i$  presents an increasing trend and the higher the value of  $i$ , the higher the trend of the enterprise. This reveals that the investment of enterprises is directly proportional to the growth of enterprises. As a result, with the increase in investment in enterprise innovation elements and institutional governance elements, more benefits can be created. The increase in enterprise investment can produce qualitative improvement after reaching a certain threshold. It is observed in Figure 9 that the threshold range is  $G_i > 5$ . This indicates that enterprise needs progressive input of innovation elements and institutional governance elements to achieve high-quality development. Therefore, the elements are transformed from quantitative change to qualitative change after agglomeration.

- (5) *The Impact of  $R_i$  Strategy on the Investment of University and Scientific Research Institute.*

$R_i \in (2, 5, 8)$  is set as the low, medium, and high ranges of changes in university and scientific research institute input. When  $R_i = 2$ , it suggests that the coupling between innovation and institutional governance of university and scientific research institute is low. When  $R_i = 8$ , it indicates the coupling high time investment strategy of innovation and institutional governance of university and scientific research institute. After the simulation, the behavior evolution trend of university and scientific research institute is obtained, as shown in Figure 10.

With the increasing of  $R_i$  support for innovation and institutional governance, the income of universities and research institutes has shown an increasing trend. It indicates the bigger the investment is, the bigger the return. It can be seen from Figure 10 that the larger the investment is, the shorter the time is needed to achieve the same benefit. Therefore, in the coupling of innovation and institutional governance elements, university and scientific research institute can save time and cost of R&D by increasing the investment.

## 6. Conclusion and Enlightenment

To conclude, this study uses universal gravitation algorithm and coupled wave to deduce the local synchronous agglomeration of the data sets of innovation and institutional governance elements in innovation ecosystem. The game

relationship between innovation and governance is simulated and explored in the innovation ecosystem. The following conclusions can be drawn:

- (1) University and scientific research institute has laid the foundation for local synchronous agglomeration of enterprise innovation factor data set and system factor data set. In the innovation ecosystem, it indicates the higher the degree of coupling, the higher the income. In line with the field theory, the strong coupling state of university and scientific research institute can shape a good innovation atmosphere. In addition, it attracts the convergence of many innovation elements and forms the basic innovation field of university and research institute. With the increase in investment, some problems will occur in the innovation ecosystem, such as fragmented information, fragmentation of technology, and lack of rapid response. The orderly organizational arrangements are established through institutional governance. A common governance institutional space for industry-university-research cooperation is built to satisfy the growing needs of university and research institute. The simulation in Figure 10 shows that the increase in coupled investment can help university and research institute save the cost of research time. Therefore, the strong coupling between innovation and institutional governance is the premise of cooperation in university and scientific research institute. Moreover, it lays a foundation for enterprises to realize local synchronous development of innovation and institutional governance in the innovation ecosystem.
- (2) The synchronous agglomeration of enterprise innovation and institutional governance elements is an important way to achieve high-quality development of enterprise. The premise of synchronous generation refers to the existence of a high-intensity trigger environment in the innovation ecosystem. The agglomeration of innovation factor data sets and institutional governance factor data sets often exists by a chimera state in innovation ecosystem. As shown in Figure 7, increasing innovation input can enhance enterprise income. However, the innovation risk will increase, and thus, improving the intensity of institutional governance can provide an environment for local synchronous development of enterprise innovation and institutional governance element data sets. It can be found from Figure 6 that moderate growth is appropriate. The probability of the synchronous state is not the greater the better while there exists a certain threshold range. As shown in Figure 9, this range fluctuates around  $\beta=0.5$  to achieve the transformation from quantitative to qualitative. Hence, synchronous state promotes the efficiency accumulation and superposition of innovation field and institutional governance field and accelerates the emergence of breakthrough innovation or disruptive innovation. However, it is

discovered that the generation of the same gait requires a certain trigger environment. In addition, the synchronization of high probability or low probability makes the data agglomeration of innovation and institutional governance factors unable to reach the optimal solution.

- (3) The intensity of government investment is directly proportional to the trend of benefits in the data set of innovation and institutional governance factors. The simulation experiment in Figure 10 demonstrates that the benefits obtained by high-intensity government support are greater than those obtained by low-intensity government support. Government behavior will directly influence the data agglomeration status of innovation and institutional governance elements in enterprise and university and scientific research institute. High-intensity government support will accelerate the flow and convergence of innovation factors. The field of innovation factor data set and innovation institutional governance factor data set is formed in innovation ecosystem. Besides, it exerts the role of radiation in the surrounding areas and brings considerable social benefits to the government.

There are still some deficiencies in this study, which will be enhanced in the future research. There are many reasons to emerge the agglomeration of elements in the innovation ecosystem. For example, it can be expanded from the perspectives of space overflow and regional coordination. Apart from that, the game hypothesis and simulation analysis of this study are only for a specific environment, and the scenario application also still has some limitations. Certainly, element agglomeration requires more iterations, which trigger conditions. In comparison with the chimera state, synchronous state is an accidental event with low probability in this study. As a result, the element aggregation of innovation ecosystem in chimera state is a subject that needs to be tackled in the future.

## Data Availability

This study adopts the game without data.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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