Research Article

Evolutionary Game Analysis on Impacts of Organization Distance on Open Innovation Mode Selection of High-Tech Industrial Clusters

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Received 28 March 2022; Revised 25 June 2022; Accepted 13 July 2022; Published 9 August 2022

Academic Editor: Miladin Stefanović

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Based on the evolutionary game theory, this study aimed to explore the decision-making behavior of the enterprise when it adopted the open innovation model from the perspective of organizational distance. The evolutionary game theory is an important method to study the enterprise' decision-making under bounded rationality. It applies to describe the trend of decision-making based on the enterprises' open innovation choices in industrial clusters. This paper employs open innovation and institutional theory, utilizes industrial clusters as the research object, and measures the geographical proximity of enterprises in high-tech industrial clusters employing organizational distance. Within the analytical framework of the duopoly model, the impact of organizational distance and patent licensing fees on the innovative performance of a high-tech industrial cluster is studied. The findings indicate that the export-oriented open innovation model is more appropriate for the innovation of high-tech industry clusters. There is a significant relationship between organizational distance and the R&D spillovers of businesses. Increased patent fees can encourage industry clusters to adopt an open innovation model with an outward orientation if they are located in close proximity to each other. Further research analyzed the effect of organizational distance on the selection of an open innovation mode employing an evolutionary game model and indicated that geographical proximity would encourage enterprises to adopt open innovation export strategies. The conclusion of this study has both theoretical and practical ramifications for the independent innovation of high-tech industry clusters.

1. Introduction

Since the turn of the 21st century, the rapid development of the global cluster economy has produced a major radiation effect, and industrial clusters have constituted a crucial growth stage in regional economic development [1]. A high concentration of industries is the defining characteristic of industrial clusters. This high concentration is beneficial to the enhancement of economies of scale and scope of enterprises. Moreover, the agglomeration of enterprises produces innovation spillovers and fosters the advancement of the innovation capability of the entire cluster. Research into technological innovation has recently risen to the forefront of the field of industrial cluster research; however, the innovation of contemporary enterprises is increasingly dependent on external innovation resources rather than internal resource integration and R&D investment. Consequently, the traditional theory of technological innovation is no longer applicable to Chinese enterprises in practice. In 2003, Professor Chesbrough introduced the conception of open innovation. Open innovation refers to a new innovation paradigm in which an enterprise’s innovation activities transcend existing organizational boundaries and engage in dynamic multiangle cooperation with other enterprises, consumers, and scientific research institutions in the knowledge network [2]. In the past, technological monopoly offered large businesses a competitive advantage due to their strong internal innovative
capabilities. The current wave of global economic globalization, however, is refining the division of labor in the industrial chain, making it harder for the conventional model to rely on innovations from within. Currently, the growth of China’s high-tech industry relies increasingly on horizontal cooperation between enterprises and scientific research institutions. However, the current status of high-tech SMEs participating in industry-university research cooperation is not satisfactory due to factors such as scale and policies. In contrast to state-owned enterprises and listed companies, it is challenging for technology-based SMEs to acquire technology from scientific research institutions. Therefore, for technology-based SMEs, acquiring innovation resources from outside sources has become a vital consideration. Open innovation has become a popular research concept in China, serving as a guide for the innovation strategies of enterprises, particularly SMEs [3–5].

Chesbrough and Crowther classify open innovation models into two categories: inward and outward, based on whether the innovative activities of an enterprise flow from the outside in or from the inside out. Inbound open innovation entails enterprises utilizing external knowledge sources to uncover ideas and technologies outside the enterprise to integrate them into the enterprise and commercialize external innovation results. While outbound open innovation refers to the process by which an enterprise considers itself as the source of knowledge for other enterprises and aggressively exports its internal research and development findings to the external community for the commercialization of other organizations or enterprises [6]. Traditional industries typically absorb knowledge from high-tech industries, and technological spillovers from high-tech industries can be advantageous to traditional industries; hence, traditional industries seek to adopt inbound open innovation [7]. Due to the fast pace of technological advancement in the high-tech industry, businesses are increasingly willing to embrace outbound open innovation [8]. Torkkeli et al. analyzed the relationship between the open innovation model and the scale of enterprises, noting that large enterprises tend to sell their noncore technology as they have more innovation resources; however, they have an incentive to accelerate research and development, and consequently, external patent expertise is frequently purchased [9].

Research performed by Henkel on the open innovation model of small enterprises found that smaller companies are more inclined to choose outbound open innovation [10]. The impact of absorptive capacity on an organization’s preference for an open innovation model was studied by Gao and Zhang [11]. Through a qualitative study, Guo et al. evaluated the open innovation strategies of China’s strategic emerging industries and proposed policy recommendations to enhance the innovation capacities of strategic emerging industries [12]. Existing research focuses primarily on inbound open innovation, with few studies examining outbound open innovation [13]. Academic institutions need to devote greater priority to outbound open innovation in order to advance the theory and practice of open innovation in areas where the government is vigorously developing strategic emerging industries.

Measuring the innovation capability of an industrial cluster is contingent on the interaction between upstream and downstream businesses within the cluster. The most significant manifestation of an industrial cluster’s innovative capabilities is its spatial advantage. From a geographical perspective, industrial cluster innovation highlights the significance of geographic concentration or proximity in the intensive interchange of knowledge. Ibrahim and Fallah argued that the spatial proximity of scientific research institutions typically accompanies the concentration of high-tech businesses [14]. Hans-Dieter noted that spatial proximity is a crucial component in the creation of knowledge clusters; the importance of distance variables in cluster innovation activities is beyond doubt [15]. Wang et al. introduced the idea of organizational distance in their study of the industrial cluster growth mechanism. He dissected the variables of organizational distance into three aspects: resource elements, organizational culture, and trust, which collectively represent a significant source of innovative performance in industrial clusters [16]. Yuan and Lei discovered that the closer the organizational distance, the greater the innovative capacity of enterprise inside a virtual industrial cluster [17].

Several studies have focused on the impact of geographic proximity on the innovation of industrial clusters, yet most of the research focuses on the empirical field. Few theoretical analyses describe the role of distance in the decision-making of an open innovation in industrial clusters from a microperspective. The purpose of this paper is to use the damping coefficient to describe the organizational distance of industrial clusters to analyze the impact of organizational distance on corporate profits under different open innovation decisions, and to analyze the role of organizational distance in the open innovation model of enterprises.

The selection of an open innovation mode refers to the choice of two open innovation modes, external and inward. Based on the internal and external resources and innovation environment, the enterprise achieves sustainable development strategies and competitive advantages so as to achieve the purpose of enhancing innovation performance and market competitiveness. We hope that this paper will explore two aspects. Firstly, by using the duopoly model [18] to construct the profit function of enterprises, we hope to explore which open innovation model is more efficient for enterprises in industrial clusters to select. Secondly, we hope to analyze the role of organizational distance in the selection strategy of enterprise open innovation mode through the evolutionary game theory. The selection of the open innovation cooperation model is a dynamic process, so it is more practical to use the evolutionary game theory to study this problem in a dynamically changing group environment.

Compared to earlier research, this paper may contain the following innovations. First, this paper employs organizational distance to characterize the effectiveness of industrial cluster collaboration, considering that geographic proximity is a key determinant in the competitive advantage of industrial clusters. Second, evolutionary games have become an essential research tool in innovation research [19–22], rendering them ideally suited for the study of open innovation mode selection. Finally, the model is strengthened in
this paper by nesting a duopoly mode within the conventional evolutionary game model.

2. The Profit Analysis of the Open Innovation Model of Enterprises

2.1. Basic Assumptions. Based on the duopoly model, this section introduces the attenuation coefficient reflecting organizational distance between clusters and the patent licensing fee of open innovation and conducts a game analysis on the innovation decision-making of enterprises in industrial clusters.

Consider an industrial cluster in which the maximum distance between two firms is \( L \). The organizational distance here can be regarded as both spatial proximity and institutional legitimacy distance [23]. Suppose the inverse demand function of duopoly firms in the cluster is \( P(Q) = a - bQ \), where \( P \) is the market price of the commodity, \( a \) is the maximum potential demand in the market, \( b \) is the elasticity coefficient of demand, and \( Q \) is the total market demand for the products of the two companies in the industrial cluster, \( Q = q_1 + q_2 \), \( q_i (i = 1, 2) \) is output for the firm \( i \). Both firms start with the same unit cost of \( c \), and the innovation output is \( x \) and indicates that firm \( i \) innovates to reduce its unit cost by \( x_i \).

Li [24] proposed a cooperative R&D model based on absorptive capacity and knowledge spillover, arguing that the knowledge spillover generated in cooperative R&D was transformed into the R&D benefits of cooperative enterprises, and different absorptive capacities had different absorption effects on spillover knowledge. Tang [25] used empirical research to find a correlation between knowledge spillovers and corporate R&D benefits. He proposed that knowledge spillovers were converted into R&D benefits after being absorbed by companies (revision 4). He [26], based on the relationship between knowledge spillovers and corporate R&D benefits, assumed that the spillover and absorption of knowledge acquired by an enterprise leads to a decrease in its cost numerically obeying a damping coefficient. Attenuation coefficient \( \lambda = (1 - (S/L)) \), \( S \in (0, 1) \), and \( S \) is the organizational distance \( (S \leq L) \). When the organizational distance is large and close to \( L \), the attenuation coefficient is small, that is, other companies obtain less cost reduction. On the contrary, when the organizational distance is small, other companies obtain a larger cost reduction. The unit cost of firm 1 is \( c_1 = c - \lambda x \); the unit cost of firm 2 is \( c_2 = c - \lambda x \). Suppose firm 1’s R&D investment is \( I = (\eta x^2 / 2) \), \( \eta \) is the innovation effort coefficient of firm 1.

Profit function for two firms are as follows:

The profit of firm 1 is: \( \pi_1 = (P - c + x_1 + \lambda x_2)q_1 - I_1 \).
The profit of firm 2 is: \( \pi_2 = (P - c + x_2 + \lambda x_1)q_2 - I_2 \).

In the process of open innovation, without loss of generality, enterprise 1 is assumed to be a large enterprise and enterprise 2 is a small enterprise; afterward, only company 1 is assumed to entrust some products to company 2 for innovation, and company 1 offers company 2 a patent license fee \( M \). Suppose that the innovation output of firm 2 for this part of the product is \( x^* \). Simultaneously, it is assumed that the innovation resources obtained by enterprises from outside the industrial cluster are negligible, so it is reasonable to assume that the income function of innovation of enterprise 2 is as follows:

\[
\pi_2 = M - \frac{\eta x^*}{2} \tag{2}
\]

2.2. Both Companies Opt for Inbound Open Innovation. Suppose that both enterprises 1 and 2 rely on external knowledge sources to innovate only through external technologies. Currently, neither business is receiving any external innovation benefits despite paying for patent licenses. The situation is as follows.

The total profit of firms 1 and 2 is as follows:

\[
\pi_c = (P - c + x_1 + \lambda x_2)q_1 - I_1 + (P - c + x_2 + \lambda x_1)q_2 - I_2 - 2M,
\]

\[
x_{c1} = x_{c2} = \frac{(\lambda + 1)(a - c)}{4b\eta - \lambda^2 - 2\lambda - 1},
\]

\[
q_2 = \frac{\eta (a - c)}{4b\eta - \lambda^2 - 2\lambda - 1},
\]

\[
q_1 = \frac{\eta (a - c)}{4b\eta - \lambda^2 - 2\lambda - 1},
\]

\[
\pi_{cc} = \frac{\eta (a - c)^2}{4b\eta - \eta^2 - 2\lambda - 1} - 2M.
\]

2.3. Both Companies Opt for Outbound Open Innovation. Suppose that both firm 1 and firm 2 engage in R&D for external R&D activities, but neither firm receives patent license fees. The total profit of firms 1 and 2 is as follows:

\[
\pi_{\infty} = (P - c + x_1 + \lambda x_2 + x^*)q_1 - I_1 + (P - c + x_2 + \lambda x_1 + x^*)q_2 - I_2 - \eta x^*^2
\]

\[
x_{\infty 1} = x_{\infty 2}
\]

\[
x^* = \frac{2(a - c)}{4b\eta - \lambda^2 - 2\lambda - 3},
\]

\[
q_2 = \frac{\eta (a - c)}{4b\eta - \eta^2 - 2\lambda - 3},
\]

\[
q_1 = \frac{\eta (a - c)}{4b\eta - \eta^2 - 2\lambda - 3},
\]

\[
\pi_{\infty} = \frac{\eta (a - c)^2}{4b\eta - \eta^2 - 2\lambda - 3}.
\]
2.4. Enterprise 1 and Enterprise 2 Choose Different Open Innovation Models. Suppose firm 1 chooses inbound open innovation, while firm 2 chooses outbound open innovation.

At this time, the profit function of the two companies is as follows.

The profit of firm 1 is
\[
\pi_1 = (P - c + \eta x_1 + \lambda x_2)q_1 - I_1 - M. \tag{5}
\]

The profit of firm 2 is
\[
\pi_2 = (P - c + \eta x_1 + \lambda x_2 + x^*)q_2 - I_2 - \eta x^2. \tag{6}
\]

Suppose firm 1 chooses outbound open innovation, while firm 2 chooses inbound open innovation. Enterprise 2, being a smaller business at the moment, is unable to pay royalties for the R&D of Enterprise 1 and commercialize it. At this time, the profit function of the two companies is as follows.

The profit of firm 1 is
\[
\pi_1 = (P - c + \eta x_1 + \lambda x_2)q_1 - I_1. \tag{7}
\]

The profit of firm 2 is
\[
\pi_2 = (P - c + \eta x_1 + \lambda x_2)q_2 - I_2, \tag{8}
\]

2.5. Conclusion and Numerical Simulation

**Conclusion 1.** The total social welfare under outbound open innovation is greater than under inbound open innovation, while the innovation output level of high-tech enterprises is greater under inbound open innovation.

Proof: \(\pi_2 > \pi_1\), under the outward open innovation model, enterprises can maximize their innovation advantages.

**Conclusion 2.** The correlation between the attenuation coefficient and total social welfare and innovation output is positive, indicating that the greater the attenuation coefficient is, the lesser the organizational distance is and the greater the spillover effect is.

**Conclusion 3.** The correlation between the attenuation coefficient and the innovation output of scientific research institutions is positive. The innovation output of outbound open innovation is greater as the attenuation coefficient increases and organizational distance decreases.

**Conclusion 4.** When \(M > (\eta (a - c)^2/(4b\eta - \eta^2 - 2\lambda - 3)^2)\), companies were motivated to adopt an outbound open innovation model.

Without a sizable profit margin from patent licensing fees, enterprises will be disinclined to invest in R&D. When the patent licensing fee is insufficient to maintain the cost of innovation for enterprises, the innovation momentum will be eroded due to a lack of capital for high-tech SMEs.

The following results can be obtained from the numerical simulation of total social welfare and innovation output by MATLAB software.

Figures 1 and 2 substantiate the aforementioned findings. Organizational distance variables contribute significantly to both innovation models. Industrial clusters are formed by organizational distance, which serves as both a driving force and an intrinsic link.

In industrial clusters, outbound open innovation is a superior innovation model to inbound open innovation; since, under the outbound open innovation model, enterprises can determine the optimal R&D strategy through long-term and stable collaboration with other enterprises in the cluster. The proximity of industry clusters and the support of research and technology policy are the foundations upon which the Silicon Valley mythos rests. In order to attract high-density enterprises, Stanford University sells land near schools at a rather low rate. College gradss are launching businesses to accomplish their patent sales to large corporations owing to the Baidoo Act, federal financing, and the presence of industry leaders and a significant number of highly concentrated startups in the area, rather than looking to the R&D departments of large corporations as their first choice. This outbound open innovation model has enabled the spread of various "magical technologies" throughout Silicon Valley, thereby establishing its own legendary status.

3. Evolutionary Game Analysis of Enterprise Innovation Mode Selection

Through the analysis of the AJ model, it is possible to conclude that the patent license fee plays a significant role in the selection of the enterprise innovation model, and the evolutionary game model can be utilized to examine how the
3.1. Model Solution. Traditional game theory is based on the assumption of complete rationality, while the evolutionary game theory has something in common with the principle of biological evolution, and it believes that the players of the game are bounded rationality. The game parties have the ability to optimize strategies, to learn, and to imitate. They learn and obtain decision-making basis by observing the behavior of other game parties in similar environments. After continuous games, when the benefits of any new strategy cannot be greater than the benefits of the existing strategies, the entire game group has reached an evolutionary stable state. Industrial clusters are the spatial agglomeration of a large number of enterprises with bounded rationality, which is very suitable for a research to use the evolutionary game methods. Now consider a random pairing game between enterprises in an industrial cluster under the condition of bounded rationality. The proportion of outbound open innovation is $1 - x$, a function of time $t$. The proportion of small business groups who choose inward-oriented open innovation is $y$. The proportion of outbound open innovation is $1 - y$, where $y$ is a function of time $t$. According to the description in Table 1, it can be observed that the expected benefits of large enterprises that choose inbound open innovation are as follows:

$$U_{IC} = y(\pi_{c11} - \pi_{o1}) + (1 - y)(\pi_{o1} - \pi_{o01}).$$

The expected benefits of large enterprises that choose outbound open innovation are as follows:

$$U_{IO} = y(\pi_{o11} - \pi_{c2}) + (1 - y)(\pi_{c2} - \pi_{c2}).$$

The average return of a large enterprise is $U_1 = xU_{IC} + (1 - x)U_{IO}$. According to the Malthusian equation (27), the replication dynamics equation of large enterprises that choose inbound open innovation can be obtained as follows:

$$\frac{dx}{dt} = x(U_{IC} - \overline{U}),$$

$$= x(1 - x)[y(\pi_{c11} - \pi_{o1}) + (1 - y)(\pi_{o1} - \pi_{o01})].$$

Similarly, the replication dynamic equation of small enterprises that choose inbound open innovation is

$$\frac{dy}{dt} = y(U_{IC} - \overline{U}),$$

$$= y(1 - y)[x(\pi_{c21} - \pi_{o2}) + (1 - x)(\pi_{o2} - \pi_{o02})].$$

From the above two equations, a two-dimensional dynamical system can be obtained as follows:

$$\begin{align*}
\frac{dx}{dt} &= x(1 - x)[y(\pi_{c11} - \pi_{o1}) + (1 - y)(\pi_{o1} - \pi_{o01})], \\
\frac{dy}{dt} &= y(1 - y)[x(\pi_{c21} - \pi_{o2}) + (1 - x)(\pi_{o2} - \pi_{o02})].
\end{align*}$$

### Table 1: The benefits of different strategic choices of enterprises in industrial clusters.

|                  | Small enterprise | Large enterprise |
|------------------|------------------|------------------|
|                  | Inbound open innovation | Outbound open innovation |
| Inbound open innovation | $(\pi_{o11}, \pi_{c2})$ | $(\pi_{o11}, \pi_{c2})$ |
| Outbound open innovation | $(\pi_{c11}, \pi_{o2})$ | $(\pi_{c11}, \pi_{o2})$ |

Innovation output under different open innovation models.

Organizational distance factor influences the enterprise’s open innovation decision-making. Table 1 depicts the income function of enterprises 1 and 2 when they choose inward open innovation and outward open innovation.
**Proposition 1.** The equilibrium point of the system is \((0, 0), (0, 1), (1, 0),\) and \((1, 1)\).

**Proof:** make \((dx/dt) = 0, (dx/dt) = 0\) and the above proposition can be obtained.

The method proposed by Friedman [28] deduces the stability of the evolutionary equilibrium point from the local stability analysis of the Jacobian matrix (denoted as \(J\)) of the system:

\[
J = \begin{bmatrix}
\frac{\partial x}{\partial x} & \frac{\partial x}{\partial y} \\
\frac{\partial y}{\partial x} & \frac{\partial y}{\partial y}
\end{bmatrix}
\]

\[
\begin{bmatrix}
(1 - 2x)(\pi_{o1} - \pi_{o1} + y\Delta P) & x(1 - x)\Delta P \\
y(1 - y)\Delta Q & (1 - 2y)(\pi_{o2} - \pi_{o2} + x\Delta Q)
\end{bmatrix},
\]

\[
\Delta P = \pi_{o1} + \pi_{o1} - \pi_{o1} + \pi_{o1},
\]

\[
\Delta Q = \pi_{o2} + \pi_{o2} - \pi_{o2} - \pi_{o2}.
\]

(15)

The determinant and trace of the Jacobian matrix \(J\) can be expressed as follows:

\[
\text{Det}\ (J) = a_{11}a_{22} - a_{12}a_{21},
\]

\[
\text{Tr}\ (J) = a_{11} + a_{22}.
\]

(16)

In conjunction with calculation and analysis, the local stability of the aforementioned equilibrium point can be categorized as follows.

**Case 1.** When \(\lambda > (a^2\eta^2/M - b\eta^3)\), in this case, the organizational distance is shorter. According to Table 2, the evolutionary stability strategy has a value of \((0, 0)\), indicating that neither large nor small enterprises tend to employ inbound open innovation strategies. Currently, large enterprises outsource some product research and development to small enterprises and pay patent license fees.

**Case 2.** When \((b\eta^2/2M - a^2\eta^3) < \lambda < (a^2\eta^3/M - b\eta^3)\), according to Table 3, it can be identified that the evolutionary stability strategy is \((1,0)\), i.e., large enterprises tend to choose inbound open innovation, and small enterprises tend to choose outbound open innovation.

**Case 3.** When \(\lambda < (b\eta^2/2M - a^2\eta^3)\), in this case, the organizational distance is longer. According to Table 4, it can be identified that the evolutionary stability strategy is \((0, 0)\), that is, neither large enterprises nor small enterprises tend to choose outbound open innovation strategies.

3.2. Simulation Analysis. This paper employs numerical comparative analysis to further analyze the effect of organizational distance on the evolution of open innovation decision-making in industrial clusters. The relevant parameters is set as \(a = 1, b = 0.8, M = 3,\) and \(\eta = 1.\) Figures 3–5 show the evolution trajectories of the two companies, respectively, when \(\lambda = 0.5, 0.25, 0.1.\)

**Conclusion 5.** The MATLAB simulation results indicate that when the organizational distance is short; industrial cluster enterprises will choose the outbound open innovation strategy. When the organizational distance is moderate, large enterprises tend to choose inbound open innovation, whereas small enterprises prefer outbound open innovation. This demonstrates that SMEs with limited funds and resources are more likely to choose an outbound open innovation strategy.
innovation strategy and are more willing to sell patents to large enterprises for short-term profits. When organizational distance is great, enterprises within an industrial cluster will opt for inbound open innovation. This makes it simpler for businesses within the industrial cluster to tap into knowledge from the external environment to enhance their capacity for innovation. The innovation strategy of the cluster is presently well-suited to outbound open innovation.

4. Conclusion and Implications

4.1. Analysis Conclusion. Employing the data on organizational distance and patent license fees, this paper develops an AJ model and an evolutionary game model to examine enterprise strategy across a spectrum of innovation environments. Organizational proximity has been shown to improve innovation performance within an industrial cluster. Conversely, the industrial cluster is better suited for the outbound open innovation mode owing to the efficiency of patent cooperation. This paper investigates the impact of distance between organizations on the open innovation strategies adopted by enterprises in clusters, uncovering that proximity encourages technology-based SMEs to pursue outbound open innovation strategies. This demonstrates that industrial concentration and the lenient institutional framework are essential to the growth of China’s high-tech industry. The findings of this study offer a theoretical basis for the selection of innovation modes by China’s high-tech enterprises.

4.2. Theoretical and Practical Inspiration. The theoretical contribution of this paper mainly lies in the following. Firstly, we assume that the spillover and absorption of knowledge acquired by the enterprise leads to the reduction of its cost, the numerical value obeys the damping coefficient, and the damping coefficient is used to describe the organizational distance, so as to establish the duopoly model under different strategies of the enterprise. Secondly, we nest a duopoly model in the evolutionary game model, and the model is more credible.

The practical contribution of this paper mainly lies in the following. Firstly, export-oriented open innovation in industrial clusters is a better model, and its innovation output and total social welfare are better, which is consistent with the findings of Henkel [10]. This may be due to the high proportion of small- and medium-sized enterprises in Chinese enterprises; secondly, the proximity of organizational distance will prompt enterprises to choose the open innovation model, which is consistent with the study of Peng [28]. Peng found that institutional legitimacy distance has a negative effect on the relationship between introverted and extroverted open models and innovation performance.

4.3. Limitations and Future Directions. Although this study has obtained some important conclusions and inspirations that are beneficial to the theoretical research of open innovation and enterprise management practice, this paper still has the following shortcomings: (1) in the duopoly model, only the cooperative R&D within the industrial cluster is considered, and the factors outside the cluster are not considered; (2) the setting of organizational distance is too simple and the different roles of geographic proximity and institutional legitimacy distance in knowledge spillover and absorption are not been taken into account; (3) in real life, there is often a core enterprise in an industrial cluster. The similarities and differences between the open innovation model of a core enterprise and other enterprises are not been discussed. On subsequent research, we will use a combination of dynamic game and empirical research to further explore open innovation model decision-making in specific industrial clusters.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.
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