

Game Analysis of Parent Company and Resident Startups in Contractual Pharmaceutical Corporate Incubator

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Abstract

Contract pharmaceutical corporate incubators are favored by large pharmaceutical companies and startups by virtue of their flexible organizational style. However, in this way of organization, as the most important stakeholder of the system, the interaction between parent company and resident startups and the choice of action strategy is not clear. Therefore, with the help of game theory, this paper analyzes the game process, cooperative relationship and corresponding income of the two, and concludes that the game subject should attach importance to the technology spillover between them while paying attention to the income of incubation items, so as to improve the innovation capacity of enterprises and promote the sustainable development of enterprises. At the same time, the parent company should strive to cooperate with the "good enterprise" and balance the income distribution ratio between the two, so as to ensure the sustainable development of the contractual pharmaceutical corporate incubation system.

Keywords

Contractual pharmaceutical corporate incubator, decision tree, game theory.

1. Introduction

As an important carrier to promote industrial innovation and development, enterprise incubators have received high attention and support from governments. In recent years, large pharmaceutical companies have emerged the upsurge of establishing pharmaceutical corporate incubators, which has contributed to promoting industrial innovation and development. In addition, the State Council clearly expressed support for conditional leading enterprises and other subjects to build professional incubators in <opinions on vigorously promoting some policies and measures of "widespread entrepreneurship and innovation">, so as to realize the coordinated development between large and small enterprises[1]. From the practice of pharmaceutical corporate incubators, large pharmaceutical companies provide incubation services for startups, which are mostly conditional on obtaining a small number of shares of the latter or priority negotiation rights, so it reduces the willingness of startups to enter the incubator; At the same time, the incubation service of contractual pharmaceutical corporate incubators adhering to the "no additional conditions" ((i.e., not requiring shares or priority negotiation rights to resident startups) has to some extent dispelled the concerns of startups and will be more likely to attract startups. The connotation, composition and operation mechanism of equity corporate incubator have been analyzed, and the performance of enterprise incubator has been affirmed. However, there are few studies on contractual corporate incubator, and the interaction relationship between relevant subjects in the system has not been analyzed. Therefore, this paper will deeply analyze the action strategy and interaction relationship between large pharmaceutical companies and startups in the contractual pharmaceutical corporate incubator system, and open the "black box" of system operation.

2. Literature Review and Connotation Definition

Contractual pharmaceutical corporate incubators refer to the organizational institutions established and operated by large pharmaceutical companies (hereinafter referred to as parent companies) to provide tangible space, instruments and equipment, experts, commercial services and intangible resources and services for the startups through the parent companies and their network resources, without requiring the shares or priority negotiation rights to resident startups. The fundamental purpose of the parent company to establish the contractual pharmaceutical corporate incubator is to enrich the product pipeline of parent company and activate its innovative entrepreneurial spirit through in-depth cooperation with the startups.

Corporate incubator emerged at the beginning of the 21st century, and corporate incubators in the real sense of China appeared after 2010[2]. Hansen's innovation case study of Ford opened up the research of corporate incubator in the academic community, and believed that the startups and parent company had a synergistic effect through the flow of technology and talents to achieve[3]. Similar to service-oriented enterprises, corporate incubators indirectly create value while providing resources, network relationships, and innovation environments for innovation players such as startups[4], and the value creation approaches can be summarized as spatial agglomeration effects, value-added services[5], and promoting the cooperation between startups and external heterogeneous resource players[6]. In this process, the parent company can obtain the incubation service fee and instrument and equipment leasing fee, and may also obtain the equity income of startups. However, compared with the return of tangible resources and profits, the parent company pays more attention to the feedback of explicit knowledge and tacit knowledge[7]. Compared with traditional acquisition, equity investment and equity pharmaceutical corporate incubator, contractual pharmaceutical corporate incubator has the characteristics of small investment and flexible operation[8], but it also has the common problem of corporate incubator, that is, insufficient control of incubation results[9].

Internal innovation capacity and external information spillover are two main aspects to enhance company own technological innovation capacity. Based on the perspective of knowledge evolution, Wang Changlin believes that the technology spillover effect will affect the motivation of company innovation and realize the improvement of enterprise innovation capacity through the ability of company knowledge absorption, innovation, sharing and integration[10]. The information spillage among companies within the technology business incubator and the information provided by the incubation platform are of great significance for small and medium-sized companies and can effectively make up for the shortcoming of their information acquisition[11]. In addition, some scholars use game theory to study the cooperation relationship between incubators and startups, and believe that the moral hazard of the game plays may occur at the beginning of incubation due to information asymmetry, and in addition, the difference between the return of cooperative innovation and the value of transferring equity is an important factor affecting the decision-making of game subjects.

Previous studies has fully affirmed the value of pharmaceutical corporate incubator, and deeply explored its connotation, value creation approach, operation mechanism and other issues, but the relevant subject decision-making and interaction process is still a "black box", so this paper will try benefit evolution game theory to study the decision-making and interaction relationship of parent companies and resident startups in the process of collaborative innovation.

3. Construction and Analysis of Game Model between Parent Company and Resident Startups

3.1. Game Process Analysis of Parent Company and Resident Startups

The characteristics of high risk, high investment, long cycle and multidisciplinary intersection of pharmaceutical innovation and entrepreneurship activities as well as the complexity of policy requirements represented by review and approval policies set a higher threshold for startups and also increase the difficulty of entrepreneurial success. Therefore, it is of great significance for startups to enter pharmaceutical corporate incubators. Parent company provide the resident startups with office space, instruments and equipment, professional incubation services, but also indirectly use its brand reputation to endorse resident startups, and expect to benefit from the cooperation with them; resident startups will attach great importance to the protection of their intellectual property rights and interests while accepting various tangible and intangible services provided by their parent companies. Contractual pharmaceutical corporate incubators are designed on the basis of fully considering the concerns of both parent companies and resident startups, providing incubation services first and then conducting in-depth cooperation based on the wishes of both parties.

The cooperation process between parent company and resident startups can be regarded as a multi-stage game process, including the initial incubation stage, the re-evaluation stage of the qualification of both game players and the deepening cooperation stage. In the initial incubation stage, the pharmaceutical corporate incubator provides office space, instruments and equipment, professional tutor services for the resident startups and makes full use of network resources to provide them with opportunities for cooperation with external capital and other subjects, and may also provide a small amount of financial support. Parent and its affiliates will not work in depth with the resident startups in the initial stages. In the re-evaluation stage of the qualification of both game players, game players re-judge the qualification of the other side based on the investigation before incubation and the in-depth understanding in the initial incubation stage. At this stage, the parent company will have a further understanding of the degree of effort of the start-up team and market development prospects, and at the same time, the resident startups will also have a deep understanding of the parent company's resource endowment, strategic intention and cooperation attitude. In the stage of deepening cooperation, the parties shall carry out cooperation focusing on their advantageous technologies or products based on the results of qualification re-evaluation. This stage not only helps to improve the income of the start-up project, but also promotes the level of technical spillover during the cooperation process, which can be regarded as an important income period for pharmaceutical corporate incubators.

3.2. Construction of Evolutionary Game Model between Parent Company and Resident Startups

Hypothesis 1: In the initial incubation stage, the unit cost of parent company in providing office space, instruments and equipment, incubation service, etc. for the start-up is n , and the incubation cost m ($n < m$) is charged to the start-up; it is assumed that the proportion of good and bad resident startups is x and $(1-x)$, respectively; the proportion of good enterprises in coordination with the development strategy of parent company and meeting the requirements of parent company is y ; the proportion of such enterprises willing to have in-depth cooperation with parent company is p . It is assumed that the fundamental purpose of parent company is to obtain technology spillover and incubation project income through cooperation with the resident startups, so parent company always has a positive cooperation attitude;

Hypothesis 2: Parent company tends to cooperate with good enterprises that cooperate with their development strategies and carry out activities such as cooperative development or

venture capital, without in-depth cooperation with resident startups that have unsatisfactory market development prospects and team performance or do not cooperate with parent company development strategies. After the in-depth cooperation agreement is reached, the parent company will provide financial support for the resident startups for product development and/or market promotion and other activities (in order to avoid too complex research model, learn from Zhang Han's research ideas, assume that the scale of the company's internal venture capital fund can completely bear the fund vacancy of the resident enterprise, and directly invest in cash[12]);

Hypothesis 3: When startups independently carry out entrepreneurial activities, the market income is R , the market income of good or bad resident startups is R_1 and R_2 , respectively, and the cost of innovation and entrepreneurship is I_1 and I_2 , respectively; when resident startups and parent companies cooperate deeply, they can produce synergistic effect, with a coefficient of k (generally speaking, the enterprise synergistic effect multiplier k meets $1 < k < 2$); parent companies will also enjoy the income distribution right of resident startups, with the income distribution ratio of parent companies and resident startups being α and $(1-\alpha)$, respectively, but parent companies also need to invest the corresponding funds I_0 ;

Hypothesis 4: Parent company and resident startups will inevitably produce technology spillover in the process of cooperation, and the level of technology spillover is affected by the depth of cooperation between the two sides and the technical strength of the company itself. With the parent company as the case, the technical spillover level in the cooperation stage is $M_0 >$ the technical spillover level in the non-cooperation stage is M'_0 ; the technical spillover level in the bad enterprise is N_1 ; the technical spillover level in the good enterprise cooperation stage is $N_2 >$ the technical spillover level in the non-cooperation stage is N'_2 ; in addition, the relevant subjects cannot completely absorb the spillover knowledge, and it is assumed that the absorption systems of the parent company, the bad company and the good company are γ_0, γ_1 and γ_2 , respectively.

Based on the above assumptions, the game process and corresponding benefits between the parent company and the resident startups in the contract pharmaceutical corporate incubator system are as follows.

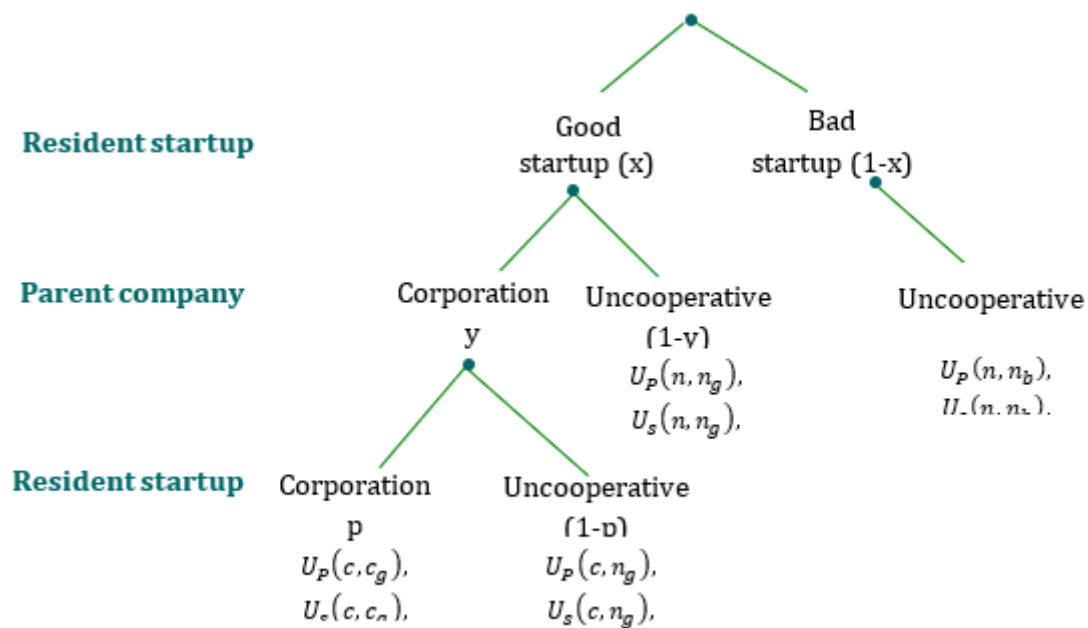


Figure 1: Decision tree for deepening cooperation between parent company and resident startups

3.3. Analysis of Evolutionary Game Model between Parent Company of Contract Pharmaceutical Incubator and Resident Startups

According to the assumptions in the previous section, the respective benefits of parent company and resident startups under different scenarios are summarized in Table 1.

Table 1: Payoffs of parent company and resident startups under different scenarios

	payoffs of parent company, U_p	payoffs of resident startups, U_s
(c, c_g)	$\alpha kR_2 + m - n + \gamma_0 N_2 - M_0 - I_0$	$(1 - \alpha)kR_2 + \gamma_2 M_0 - N_2 - m - I_2$
(c, n_g)	$m - n + \gamma_0 N'_2 - M'_0$	$R_2 + \gamma_2 M'_0 - N'_2 - m - I_2$
(n, n_g)	$m - n + \gamma_0 N'_2 - M'_0$	$R_2 + \gamma_2 M'_0 - N'_2 - m - I_2$
(n, n_b)	$m - n + \gamma_0 N_1 - M'_0$	$R_1 + \gamma_1 M'_0 - N_1 - m - I_1$

Based on game process analysis and game hypothesis, the expected income of parent company and start-up enterprise can be obtained:

$$E_p = x \cdot \{y[p \cdot U_p(c, c_g) + (1 - p)U_p(c, n_g)] + (1 - y)U_p(n, n_g)\} + (1 - x)U_p(n, n_b) \quad (1)$$

$$E_s = x \cdot \{y[p \cdot U_s(c, c_g) + (1 - p)U_s(c, n_g)] + (1 - y)U_s(n, n_g)\} + (1 - x)U_s(n, n_b) \quad (2)$$

From the perspective of long-term system development, only when $E_p > 0$ and $E_s > 0$, that is, the expected benefits of both parent company and resident startups are greater than 0, the system may exist for a long time and realize healthy development. Judging from the expected return results of the two, except for the return of the game subject under different circumstances, the proportion of good or bad resident startups, the proportion of good resident startups in strategic coordination with the parent company, and the proportion of good resident startups in in-depth cooperation with the parent company will have an impact on the expected return of both game players.

4. Conclusions and Implications

(1) Compared with the income of incubation projects, the parent company shall pay more attention to the income of technology spillover. Incubation project income is similar to investment income, reflected as capital appreciation; and inter-enterprise technology spillover is ultimately reflected as promoting enterprise innovation capacity, thereby increasing enterprise innovation income on the one hand, but also promoting the sustainable development of enterprises. In addition, the parent company fully considers the game income and corresponding proportion of the two sides in the system design, so as to improve the long-term income of the enterprise as much as possible.

(2) When entering the pharmaceutical corporate incubator, the resident startups shall fully investigate the resource status and cooperation intention of the parent company, and also form an objective evaluation of its own advantages and disadvantages, so as to make favorable strategies in the cooperation process, and then promote the successful incubation of the project and its own rapid development.

References

- [1] Information on: http://www.gov.cn/gongbao/content/2019/content_5380370.htm.
- [2] G. Hua: Exploratory research on operation model of corporate incubator from the perspective of open innovation, *Science & Technology Progress and Policy*, vol. 34 (2017) No.18, p.80-87.
- [3] Hansen M T, Chesbrough H W, Nohria N, et al. Networked incubators. Hothouses of the new economy, *Harvard Business Review*, vol.78 (2000) No.5, p.74-84, 199.
- [4] S. Chen: Business incubators and technology innovations (Ph.D., Xiamen University, China 2006), p.52-56.
- [5] J. F. Yuan, Z. Xu: A system review on business incubator international research: status and future development direction, *Science of Science and Management of S.&T*, vol. 39 (2018) No.08, p.82-99.
- [6] Pauwels C , Clarysse B , Wright M , et al. Understanding a new generation incubation model: The accelerator, *Technovation*, 2015:S0166497215000644.
- [7] Gassmann O , Becker B: Towards a resource-based view of corporate incubators, *International Journal of Innovation Management*, vol. 10 (2006) No.1, p.19-45.
- [8] Tobias, Weiblen, Henry, et al. Engaging with Startups to Enhance Corporate Innovation, *California Management Review*, 2015.
- [9] Y. Wang: Model of pharma R&D organizations under open innovation framework, *forum on Science and Technology in China*, (2014) No.08, p.11-15+54.
- [10] C. L. Wang: Technology Spillover Effect and Enterprise Independent Innovation, *science and technology management research*, (2007) No.04, p.21-23.
- [11] Y. L. Liu: Research on system operation mechanism and performance evaluation of scientific and technological business incubator in China, (Ph.d., Harbin Engineering University, China 2009), p.79-81.
- [12] H. Zhang, L. M. Zhao: Analysis of business incubator network stability based on game theory, *Scientific management research*, vol. 31 (2013) No.3, p.57-61.