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## SHARED FUNDING OF R&D IN SMALL AND MEDIUM-SIZED INNOVATIVE ENTERPRISES: THE CASE OF CHINESE BIOMEDICAL INDUSTRY

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**Abstract.** This study delves into the corporate governance challenges confronted by small and medium-sized innovative biomedical enterprises in the context of equity financing. Its objective is to provide valuable recommendations for the successful implementation of such financing. In order to address issues such as imperfect equity structure, inadequate financial audit systems, and low stability of the core team during equity financing, a range of improvement measures are proposed. These measures comprise optimizing internal management mechanisms, establishing an efficient R&D organizational structure, implementing practical incentive mechanisms for R&D enterprises focused on benefits, and enabling technical experts to actively engage in company ownership structures. Equity financing plays a vital role in resolving the difficulties faced by small and medium-sized innovative biomedical enterprises, particularly in fostering the development of innovative pharmaceutical products within the biomedical R&D field. Thus, it has a positive impact on effectively advancing China's biomedical industry."

**Keywords:** small and medium-sized enterprises, SME, biomedical company, venture capital, VC, equity financing, corporate governance, R&D

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ФИНАНСИРОВАНИЕ, ФОНДЫ И КАДРЫ НАУКИ

ОРИГИНАЛЬНАЯ ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

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## ДОЛЕВОЕ ФИНАНСИРОВАНИЕ НИОКР НА МАЛЫХ И СРЕДНИХ ИННОВАЦИОННЫХ ПРЕДПРИЯТИЯХ: ПРИМЕР КИТАЙСКОЙ БИОМЕДИЦИНСКОЙ ПРОМЫШЛЕННОСТИ

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**Аннотация.** Данное исследование рассматривает вопросы корпоративного управления, стоящие перед малыми и средними инновационными биомедицинскими предприятиями в процессе выпуска акций. Статья ставит своей целью предложить рекомендации для успешного осуществления этого процесса. Для решения таких проблем, как неполная структуризация капитала, недостаточно эффективные финансовые системы контроля и невысокая устойчивость основного коллектива в процессе эмиссии, предлагаются меры для улучшения ситуации. В их числе: оптимизация внутренней системы управления, формирование эффективной структуры научно-исследовательских и опытно-конструкторских работ (НИОКР), внедрение практических механизмов стимулирования для прибыльно-ориентированных НИОКР и обеспечение присутствия технических экспертов в структуре управления компании. Выпуск акций играет значительную роль в решении вопросов, с которыми сталкиваются малые и средние инновационные биомедицинские компании, особенно в отношении развития инновационных фармацевтических продуктов и биомедицинских исследований. Таким образом, данная практика положительно влияет на активное развитие биомедицинского сектора Китая.

**Ключевые слова:** малые и средние предприятия, МСП, биомедицинская компания, венчурный капитал, акционерное финансирование, корпоративное управление, НИОКР

**Информация о финансировании:** Данное исследование выполнено без внешнего финансирования.

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## INTRODUCTION

In accordance with the latest medical reform policy, the State Food and Drug Administration of China has promulgated a series of novel policies to accelerate the growth of the innovative biomedical industry (Lin, 2018). These policies explicitly incentivize Chinese biomedical companies to engage in groundbreaking R&D efforts while expediting the introduction of internationally advanced pharmaceuticals into the domestic market. This strategic initiative aims to propel Chinese biopharmaceutical enterprises towards innovation and globalization, nurturing a global biopharmaceutical industry ecosystem and competitive landscape. Consequently, the robust development of innovative drugs has emerged as a pivotal national-level strategy.

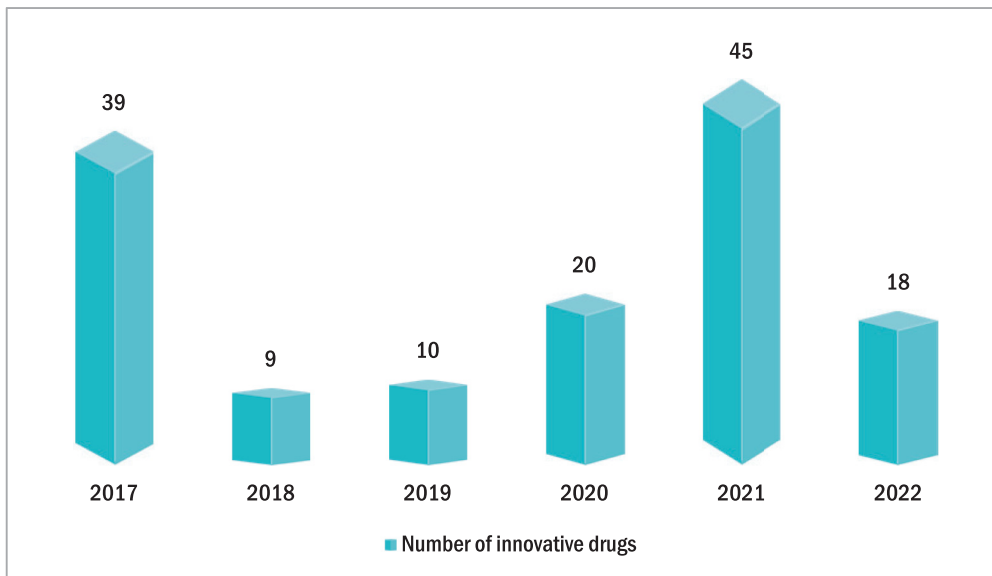
The capacity to undertake innovative drug R&D serves as a vital indicator of a nation's pharmaceutical industry advancement (Ding Jinxi, Ma Yilin, 2012). In 2021, the comprehensive acceleration of the review and approval policies for various new drugs in China resulted in a record high number of approved new drugs. The NMPA approved 45 innovative drugs, among which 18 were launched in the market in 2022, including seven chemical drugs, seven biological drugs, and four traditional Chinese drugs (Fig. 1). The process of R&D for novel medications is typified by substantial investment, considerable risk, and

extended cycles. However, small and medium-sized innovative biomedical enterprises frequently encounter persistent challenges in securing financing. Notably, companies such as BeiGene and Shenzhen Microchip play indispensable roles in propelling China's biomedical industry forward (Gao, 2016). This study aims to scrutinize the financing circumstances of these enterprises (referred to as "financing enterprises") while addressing one of the existing issues – corporate governance. Additionally, it proposes countermeasures and suggestions to aid in successful equity financing for small and medium-sized innovative biomedical enterprises.

## CHALLENGES FACED BY SMALL AND MEDIUM-SIZED INNOVATIVE BIOMEDICAL ENTERPRISES IN EQUITY FINANCING

During the process of survival and growth, small and medium-sized enterprises worldwide frequently encounter significant constraints in accessing financing (Wu, Xu, 2020). The scarcity of corporate funds impinges upon their capacity for innovative drug R&D. From a micro-enterprise perspective: on one hand, although large pharmaceutical companies allocate an average of 7% to 10% of their annual sales revenue, the majority of their R&D investments are channeled towards generic drugs, with only a limited

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**Figure 1.** The number of innovative drugs approved for marketing in China from 2017 to 2022.

**Рисунок 1.** Количество инновационных препаратов, одобренных для реализации в Китае с 2017 по 2022 год.

Data extracted from National Medical Products Administration (NMPA, <https://www.nmpa.gov.cn/>)

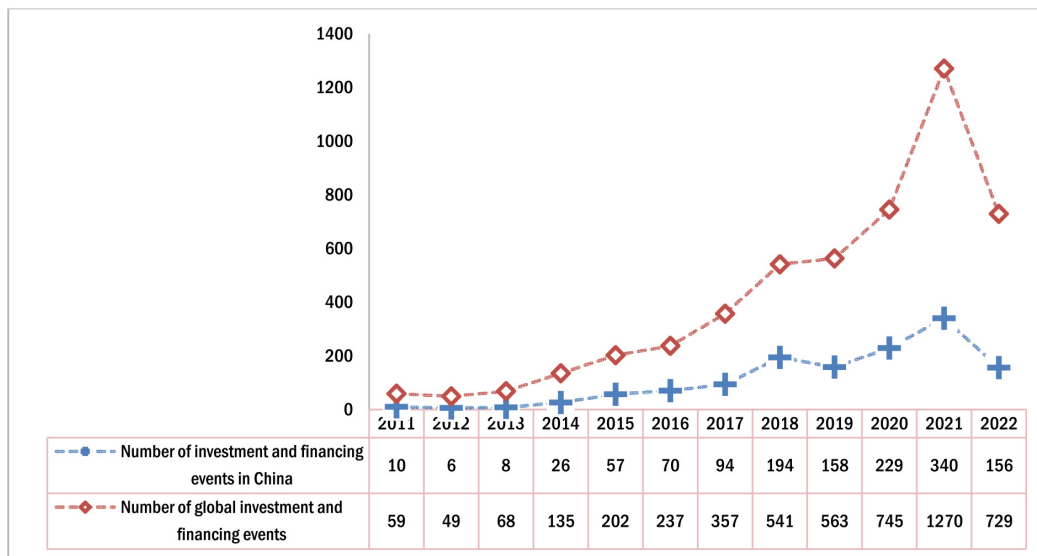
number truly dedicated to innovative drug R&D (Guo Dandan, Feng Guozhong, 2015). On the other hand, despite small and medium-sized innovative biomedical enterprises utilizing all available funds for the R&D of innovative drug projects, they grapple with severe limitations in capital availability. Consequently, they find themselves ensnared in a situation where the chain of R&D funding is disrupted, thus necessitating an urgent need for additional financial resources.

The primary financing channels for Chinese pharmaceutical R&D enterprises currently include internal funding, government support through scientific research funds, loans from commercial banks, and listing financing (Cao, 2005). However, these options may not be optimal for small and medium-sized innovative biomedical enterprises. Venture capital serves as a vital equity financing channel that plays a significant role in promoting the industrialization of scientific and technological achievements within a market economy context. It involves investing funds in high-tech research and development efforts and their corresponding products while assuming the risk of potential failure. The ultimate objective is

to accelerate the commercialization of novel technological breakthroughs and achieve substantial capital returns (Huang, Luo, Chen, 2000). The biomedical health field has progressively evolved into a pivotal domain of global competition. As illustrated in *Fig. 2*, investments and financing in the global and Chinese biomedical health industries from 2011 to 2022 demonstrate a consistent upward trend. Nonetheless, due to the impact of macroeconomic factors, the financing activities of the biomedical health sector in both regions are anticipated to decline to some extent in 2022.

## QUESTIONNAIRE AND RESULTS

Based on an extensive review of the literature concerning innovative biomedicine R&D and equity financing within the biomedical sector, a tailored questionnaire was developed incorporating selected candidate questions. Subsequently, a survey was conducted among private equity and venture capital institutions and small and medium-sized innovative biomedicine enterprises, aiming to identify the financing bottlenecks and key issues prevalent in the equity financing practice of these enterprises.

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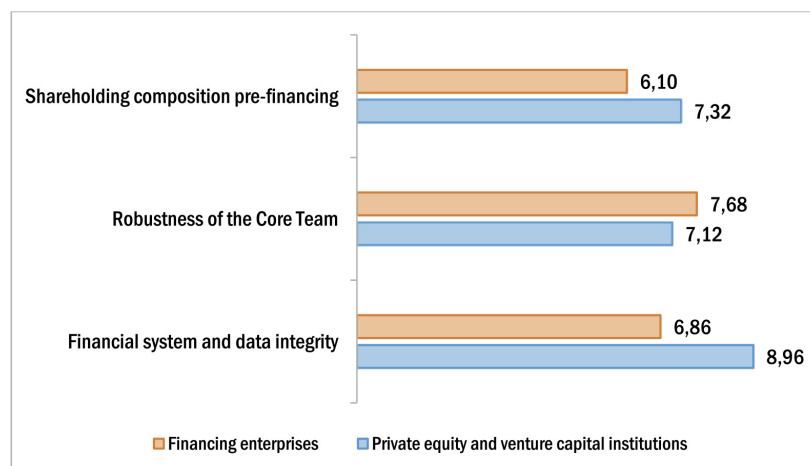
**Figure 2.** Trends of investment and financing in global and Chinese biomedical health industry from 2011 to 2022.

**Рисунок 2.** Тренды инвестиций и финансирования в мировой и китайской биомедицинской индустрии здравоохранения с 2011 по 2022 год.

*Data extracted from VBDATA.CN.*

The present study primarily employs a multi-modal approach, including email distribution, WeChat group dissemination, phone interviews, and in-person visits. A total of 400 questionnaires were distributed to venture capital firms (cohort-A) and small medium-sized innovative biomedical enterprises (cohort-B). A total of 187

valid questionnaires were collected from cohort-A, yielding a calculated response rate of 93.5%. Similarly, a total of 196 valid questionnaires were obtained from cohort-B, corresponding to a response rate of 98%. The data gathered from the questionnaires were primarily analyzed using Microsoft Excel, an application software.

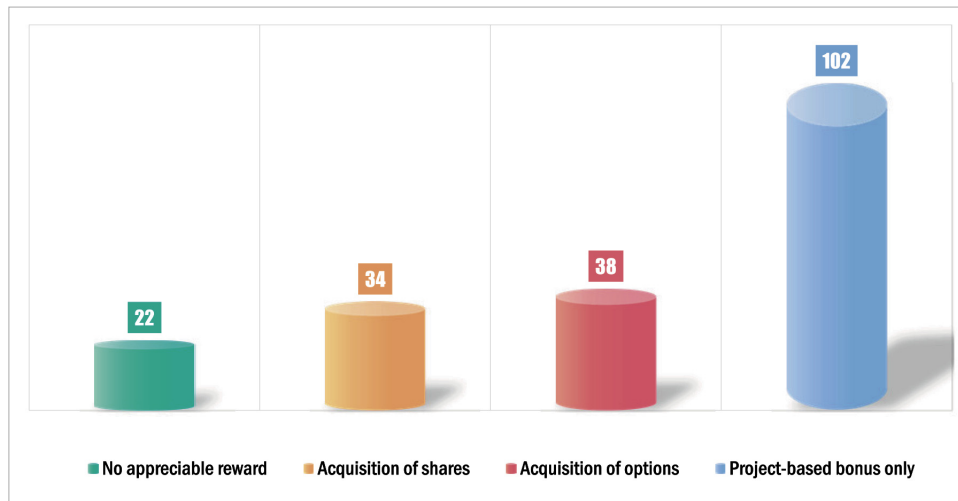


**Figure 3.** The results of analysis on corporate governance issues.

**Рисунок 3.** Результаты анализа по вопросам корпоративного управления.

*The data are derived from the results of this questionnaire.*

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**Figure 4.** Incentive mechanisms of financing enterprises.

**Рисунок 4.** Стимулирующие механизмы финансирования предприятий.

*The data are derived from the results of this questionnaire.*

According to the outcomes of the survey, a statistical analysis was conducted, which revealed that the primary factors influencing the equity financing of small and medium-sized innovative biomedical enterprises were related to the corporate governance issues of these financing entities. These issues, inter alia, encompassed the following aspects: (a) Imperfect equity structure pre-financing; (b) Inadequate financial audit system within the company; (c) Subpar stability of the core team.

### CORPORATE GOVERNANCE PROBLEMS AND ANALYSIS OF FINANCING ENTERPRISES

*The equity structure is not perfect before financing*

The equity structure serves as the foundation for the corporate governance framework, with the specific operational manifestation being the corporate governance organization. Variations in ownership structure dictate distinct corporate governance structures and, consequently, indirectly influence the behavior and performance of enterprises. A robust equity structure not only mirrors the current state but also prognosticates the future prospects of a startup.

As illustrated in Fig. 3, private equity and venture capital institutions exhibit a significant emphasis on the pre-financing equity structure of small and medium-sized innovative biomedical

enterprises, rating it 7.32 on the importance scale. In instances where an innovative R&D enterprise possesses a relatively comprehensive team, the capital stakeholders tend to prioritize the team's ownership structure.

For small and medium-sized innovative biomedical enterprises, the imperfect distribution of shareholders' rights and interests at present and the unreasonable design of equity structure significantly influence the ease and success of financing to a certain extent. The root of this issue lies in the fact that the entrepreneurial team did not recognize the paramount importance of equitable allocation during the startup phase, and the founding partners did not fully realize the so-called equity benefit maximization. Consequently, this has led to a lack of cohesion and competitiveness among small and medium-sized innovative biomedical enterprises. Furthermore, the independence of the board of directors in these enterprises is insufficient, and the functionality of the board of supervisors is limited.

*The company's financial audit system is not standardized*

Financial data and analysis serve as crucial indicators that are challenging to overlook during the initial assessment of capital investors. As depicted in Fig. 3, private equity and venture capital institutions exhibit significant concern regarding the "authenticity of financial audit

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systems and financial data” of small and medium-sized innovative biomedical enterprises, assigning a high importance degree of 8.96. Concurrently, these enterprises scored 6.86 in the questionnaire survey, suggesting that financing companies face considerable challenges in this area, which necessitate prompt resolution.

The financial challenges faced by small and medium-sized innovative biomedical enterprises are multifaceted. These enterprises are predominantly in their startup phase, with most being small-scale and possessing opaque financial information. Furthermore, these companies have yet to establish a robust financial accounting system, resulting in chaotic auditing and accounting practices. To secure equity financing, some enterprises may engage in window dressing their annual financial statements, and even commit fraud, leading to a significant disconnect between financial data and the actual situation of innovative and R&D-focused companies. Additionally, certain enterprises erroneously assume that a project company’s operational success should facilitate easier financing and are reluctant to invest time and resources into developing a standardized financial management system tailored to their specific needs (Pu, 2008). Until these crucial internal financial issues are resolved, it will remain challenging for small and medium-sized innovative biomedical enterprises to secure investment from capital parties.

*Low stability of core team*

The importance of “core team stability” for small and medium-sized innovative biomedical enterprises is assessed by private equity and venture capital institutions with a score of 7.12, as illustrated in Fig. 3. Concurrently, these enterprises self-evaluated their performance in this regard, scoring 7.68 in the questionnaire survey. The results indicate that financing enterprises face significant challenges in maintaining a stable core team, necessitating immediate attention and resolution.

The stability of the core team in small and medium-sized innovative biomedical enterprises can be attributed to the presence of a weak board problem and an imperfect incentive mechanism (Gao Jian, Cheng Ming, 2002). For instance: (1) The number of senior managers receiving remuneration is

relatively small, with many instances of “zero remuneration”. (2) The structure and design of the salary system in the field of human resources are often unreasonable or overly simplistic. Most small and medium-sized companies employ a “salary + bonus” remuneration model for managers, while the adoption of an annual salary system for managers is relatively rare. (3) Small and medium-sized innovative biomedical enterprises possess a limited number of total personnel shareholdings, a low average shareholding ratio, and a small number of shareholders. The phenomenon of “zero shareholding and non-shareholders” is prevalent, making it challenging to retain key personnel for extended periods (Tang, Song, 2011). Furthermore, (4) The incentives for innovative biomedical core technical personnel are dynamic yet insufficient. There is a lack of normative correlation between the personal income of core technology and the performance of the company’s project R&D. Additionally, there is no significant positive correlation between the shareholding ratio of innovative biomedical R&D core technical personnel and their contribution (or performance) to the company. These findings were similarly corroborated in the questionnaire, as illustrated in Fig. 4.

The findings from Fig. 4 reveal that among the small and medium-sized R&D enterprises surveyed in this study, 102 questionnaires indicate the presence of only project bonuses as incentives, with no additional methods such as shares or options. Meanwhile, 22 questionnaires revealed the absence of any incentive methods or have no appreciate reward. Thus, it is evident that the majority of small and medium-sized innovative drug R&D enterprises lack long-term incentive mechanisms.

**STRATEGIC  
COUNTERMEASURES  
AND RECOMMENDATIONS  
FOR ADDRESSING THE  
GOVERNANCE CHALLENGES  
FACED BY FINANCING  
COMPANIES**

*Enhance the corporate internal governance framework*

Although small and medium-sized innovative biomedical enterprises secure venture capital

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due to their high-potential, value-added innovative products and patented technological inventions, the internal management shortcomings of these entrepreneurial enterprises often go unnoticed by financing entities.

Efficient collaboration among all departments is crucial for the growth of small and medium-sized innovative biomedical enterprises. The development of these enterprises hinges on the technological advancements of their products and novel drugs, which require multiple R&D pipelines to mitigate risks and seize market opportunities. It is recommended that financing enterprises should not only continuously refine their novel drug development technology but also fortify their technical team with a strong market acumen, enabling a seamless integration of technology, novel drugs, and the market. This will facilitate active and productive cooperation among the company and its various functional departments.

Improve the company's internal financial and audit systems. Financial data and analysis serve as crucial indicators that are challenging to overlook during the preliminary assessment of small and medium-sized innovative biomedical enterprises. The financial management status of an enterprise is directly correlated with its future healthy development. Generally, capital investors primarily evaluate an enterprise from the following perspectives: current liabilities, changes in equity, post-investment liabilities and equity, investment exit-related matters, and future planning. It is recommended that financing enterprises prioritize the authenticity of their corporate financial systems and data, establish a modern corporate financial and audit system, and ensure the authenticity, compliance, and rationality of financial data to gain the favor of funds.

*Construct an efficient organizational framework for innovative R&D companies*

The organizational structure of small and medium-sized innovative biomedical enterprises is congruent with their development strategy of biomedical innovative R&D, serving as the organizational guarantee for their sustainable growth and high-growth potential. Enterprises with innovative biomedical R&D as their core business possess robust R&D capabilities and swift

progress, necessitating an adaptable, sensitive, and flexible management-level organizational structure for small and medium-sized innovative biomedical enterprises to a certain extent, in order to cater to the objective needs of the rapid growth of small and medium-sized enterprises (Zhao Fang, 2001). It is recommended that in terms of organizational structure design for enterprise founders and managers, a flat structure should predominate, with the establishment of various departments kept to a minimum to establish an innovative organizational structure that fosters efficient work productivity.

*Implement a practical motivation system for R&D organizations*

From the perspective of management theory, the implementation of incentive mechanisms by enterprises not only enhances employee enthusiasm but also fosters the healthy and orderly development of enterprises. The term "incentive mechanism" refers to the process of optimizing employee commitment to the organization through the integration of specific modern enterprise management systems and human resource management techniques (Qiang Fu, 2012). These "specific management methods" encompass fixed and tailored approaches that serve as incentives, including equity rewards, bonus incentives, and promotional opportunities (Yang, Ji, 2010).

Capital investors exhibit a greater focus on the professionalism and high-caliber abilities of an innovative enterprise's team, rather than on the enterprise's current performance reports. The biomedical R&D technology team serves as the linchpin of the entire R&D enterprise; accordingly, the quality and strength of this team directly correspond to the future development potential of innovative R&D enterprises. Furthermore, the execution of innovation projects by biomedical R&D enterprises is fully reflected in the makeup and capabilities of their R&D technology teams.

It is proposed that small to medium-sized innovative biomedical enterprises establish a scientific incentive evaluation system that embodies fairness, fostering enthusiasm, innovation, and creativity among R&D team members. This system should also include a practical incentive management mechanism, such as rewards

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for taking on new drug project development responsibilities. Recognizing and rewarding exceptional employees who significantly contribute to technological innovation and the growth of the R&D enterprise is crucial. The integration of actual income, personal value representation, and a medium to long-term tenure system for R&D enterprise employees will serve as essential components of the incentive mechanism for the R&D enterprise.

*Technical experts are permitted to obtain equity stakes in accordance with the company's equity structure*

The crux of competition in the biomedical market hinges on the rivalry for innovative pharmaceutical high-tech talent and R&D wisdom, as well as the strategic marketing acumen and responsiveness of biomedical enterprise teams (Li, 2008). The entrepreneurial process of high-tech enterprises, epitomized by innovative drug R&D, necessitates a mutual synergy and close collaboration between biomedical venture capitalists, technical experts associated with new drug creation, and enterprise management specialists (Chen, 2004).

In high-tech companies primarily engaged in innovative biomedical R&D, the international/domestic technological innovations generated by the technical experts in innovative biomedical R&D can contribute a certain proportion to the "technical backbone shares" following objective assessment. It is proposed that the project party facilitate and motivate the relevant R&D personnel of the company, particularly the technical experts, to become shareholders with patented

technology, thereby enhancing the equity structure of the enterprise in accordance with the agreement between both parties. Upon the project party's achievement of a specified financing stage, the repurchase of shares from the technical personnel can be executed as agreed.

## CONCLUSION

To summarize, being the world's second largest unilateral drug consumption market, the Chinese market is poised to present significant growth opportunities for the innovative biomedical industry (Ge Dongsheng, 2012). Venture capital plays a crucial role in the field of innovative biomedical R&D, aiding companies in creating new drugs more efficiently, thus fostering the rapid advancement of innovative drugs in China and further propelling the entire biomedical industry's upgrading. Venture capital can address the financing constraints faced by small and medium-sized innovative biomedical enterprises, i.e., it serves as the optimal equity financing channel for them. As a small and medium-sized innovative biomedical enterprise, it constitutes a lasting research topic for the pharmaceutical science and technology industry, finance industry, pharmaceutical industry, and government departments when collaborating with venture capital institutions and investors (Jin, 2007). For instance, the project evaluation of biotechnology innovative drugs in equity financing enterprises, the allocation of interests during the financing process, and the valuation of intellectual property in the financing process require further exploration and research.

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