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The Impact of Social Responsibility and Innovation Ecosystem of Chinese Pharmaceutical Enterprises on Innovation Performance

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Abstract

This article studies how corporate social responsibility affects the innovation performance of pharmaceutical companies from the perspective of the innovation ecosystem. Based on a large amount of theoretical evidence, we have proposed hypotheses about the constituent dimensions of key factors and their impact on relationships. We constructed a measurement scale for corporate social responsibility, resource acquisition, synergy, and innovation performance from measurement projects, expert interviews, interviewee interviews, and pre surveys. Large scale formal research provided data, and regression analysis confirmed the hypothesis. Out of 11 research hypotheses, 9 were validated by data, 1 was not validated, and 1 was partially supported. And its effectiveness and ineffectiveness were tested. Summarized the document and provided suggestions to the management. Pharmaceutical companies can improve innovation performance by fulfilling social responsibility, and the support of the innovation ecosystem mediates the causal relationship between corporate social responsibility and innovation performance. Innovation ecosystem support mainly includes resource acquisition and collaborative symbiosis. The focus of innovation ecosystem support is on synergy and resource acquisition. Corporate social responsibility and innovation performance are linked through resource acquisition and synergy.

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Introduction

As one of the important industries supporting national economic development and people's health, the pharmaceutical industry has always attracted much attention. In 2024, with the changes in medical technology and pharmaceutical market, the pharmaceutical industry will present some new status quo and development trends. First, the status of the pharmaceutical industry shows a trend of expansion. As the aging of the population intensifies and living standards improve, medical needs continue to increase, and the scale of the pharmaceutical market has also expanded rapidly. According to statistics, the global healthcare market will exceed US$1.5 trillion in 2024, and China's pharmaceutical market will reach 3.2 trillion-yuan, surpassing Europe and Japan and becoming the world's second largest pharmaceutical market. Secondly, the pharmaceutical industry is developing rapidly, and technological innovation has become an important driving force. With the continuous advancement of science and technology, medical technology continues to innovate, and new drug research and development results continue to emerge, providing a strong driving force for the development of the pharmaceutical industry. In 2024, the number of new drugs launched globally reached a new high, including a few innovative drugs that can treat major diseases such as cancer and cardiovascular diseases. China's innovative drug research and development has also made breakthroughs. Not only have multiple new drugs obtained marketing approval, but many more have entered the clinical trial stage (Kolar & Janke, 2019, Frerichs & Teichert2021).

Thirdly, the transformation and upgrading of the pharmaceutical industry is accelerating. The traditional pharmaceutical industry is mainly based on generic drugs and is relatively small in scale. However, driven by the new medical reform policy, the pharmaceutical industry is undergoing important transformation and upgrading. On the one hand, the government has increased its support for the R&D and production of innovative drugs and encouraged companies to increase investment in R&D and R&D of innovative drugs. On the other hand, the government has strengthened the supervision and rectification of generic drugs, requiring companies to improve quality and reduce price wars. Therefore, the pharmaceutical industry is transforming from traditional scale expansion and low-end generic drug production to innovative drug research and development and high-end manufacturing, and the pace of industrial upgrading is accelerating (Kolar & Janke, 2019, Frerichs & Teichert2021). Finally, the internationalization of the pharmaceutical industry continues to increase. With the advancement of globalization, the internationalization of the pharmaceutical industry has become a trend. Domestic companies are going abroad one after another to seek international cooperation and development opportunities. At the same time, foreign companies have also entered the Chinese market and increased investment and cooperation in the Chinese pharmaceutical market. In 2024, pharmaceutical cooperation between China and the world will continue to increase, including cooperation in new drug research and development, medical research exchanges, and technology introduction.

To sum up, the pharmaceutical industry in 2024 will show the development trend of scale expansion, technological innovation, transformation and upgrading, and internationalization. The healthy development of the pharmaceutical industry is of great significance to the country's economic growth and people's health and well-being. In the future, the pharmaceutical industry will face more opportunities and challenges, which requires the joint efforts of the government, enterprises and all sectors of society to push the pharmaceutical industry to a new level.

Problem statement

With the improvement of people's living standards and the increasing emphasis on their health, as well as the increase in medical and health expenditures year by year, the scale of China's pharmaceutical market has maintained rapid growth and has become the second largest pharmaceutical market in the world after the United States. At the same time, pharmaceutical companies are also springing up and developing (Kolar & Janke, 2019, Frerichs & Teichert, 2021). After entering the 21st century, the development of pharmaceutical companies has become slower and slower due to reasons such as the increase in research costs, the extension of the R&D cycle, and the expiration of previous patents. details as follows:

1. There are many pharmaceutical companies, but their economic scale is small.
2. Lack of corporate social responsibility
3. Innovation is the first driving force for the development of pharmaceutical companies.

At present, more and more scholars are paying more attention to the transmission mechanism of corporate social responsibility affecting corporate performance on the basis that corporate social responsibility affects corporate performance, which is more conducive to a thorough explanation of how corporate social responsibility affects corporate performance. After sorting out the relevant literature, we found that from the perspective of research content, there are many studies on the internal interaction mechanism of corporate social responsibility into performance using corporate reputation, intangible resources, social capital, etc. as the starting point (Kolar & Janke, 2019, Frerichs & Teichert2021). Regarding the research on innovation ecosystem and innovation performance, most use ecological methods to explain the innovation activities of enterprises, and little attention is paid to the research on the paths and mechanisms to improve enterprise innovation performance from the perspective of innovation ecosystem. There is a lack of innovation ecology. Explicit study variables of the system at the system level (Blowfield & Murray 2019, Lund-Thomsen 2022).

Research Questions

Based on the above problem statement, this paper takes pharmaceutical companies as the research object and analyses the impact of corporate social responsibility on the innovation performance of pharmaceutical companies from the perspective of the innovation ecosystem. The details are as follows:

1. How does corporate social responsibility affect the innovation performance of pharmaceutical companies?
2. Will pharmaceutical companies receiving support from the innovation ecosystem help improve their innovation performance?
3. Does access to resources within the innovation ecosystem play a mediating role in corporate social responsibility and innovation performance?
4. Does synergy within the innovation ecosystem play a mediating role in corporate social responsibility and innovation performance?

Research Objectives

The main research goal of this paper is to study how corporate social responsibility affects the innovation performance of pharmaceutical companies from the perspective of the innovation ecosystem. The details are as follows:

1. To explore the relationship between corporate social responsibility and the innovation performance of pharmaceutical companies.
2. To verify that pharmaceutical companies receiving support from the innovation ecosystem can help improve their innovation performance.

3. To analyse the mediating effect of resource acquisition within the innovation ecosystem on corporate social responsibility and innovation performance.
4. To analyse whether synergy within the innovation ecosystem plays a mediating effect on corporate social responsibility and innovation performance.

Scope of study

This paper takes pharmaceutical companies as the research object. Based on literature research and social surveys, it analyses the current situation and existing problems of innovation in Chinese pharmaceutical companies; from the perspective of "ecology", it analyses, summarizes, and summarizes the innovation ecology of pharmaceutical companies. Based on the core elements of the system, a structural model of the innovation ecosystem of pharmaceutical enterprises was constructed; from the perspective of the innovation ecosystem, the transmission mechanism of corporate social responsibility to innovation performance was analysed, in which resource acquisition and collaborative symbiosis were the transmission mediators; ultimately, for the effective improvement of medicine Provide policy and management recommendations on corporate innovation performance.

Literature Review

Preliminary research on corporate social responsibility

Carroll (2021) is currently recognized by the academic community as the earliest systematic and organized explanation of corporate social responsibility. He believes: ''Enterprises have obligations to formulate policies, make decisions and take desirable concrete actions by the goals and values of our society." Since then, due to the different research perspectives and theoretical understandings of scholars, the definition of corporate social responsibility has also been diversified, and a unified and standardized understanding has not yet been formed. Matten et al, (2008) believe that this is because maximizing the interests of shareholders or stakeholders has always been a significant point of controversy in corporate social responsibility; the scope of corporate social responsibility is related to ecology and ethics. Multiple disciplines such as science and sociology intersect and overlap, and the implementation rules are relatively open; the dynamic nature of the corporate social responsibility process is also the reason why it is difficult to reach a consensus on its definition. The globalization of social responsibility (for example Ali et al. (2021)), the implementation of corporate social responsibility in emerging markets (for example He & Harris (2020)), and the failure of corporate social responsibility (for example: Sánchez-Torné et al., 2020) and other aspects.

Review of research on the innovation ecosystem

The British plant ecologist Tansley (2014) first proposed the concept of ecosystem in 1935. Since then, many ecologists have given various explanations and definitions of the concept of ecosystem based on their respective research directions and contents. The two famous American ecologists, the Odum brothers, have made outstanding contributions to the development of the concept of ecosystems. They have always emphasized the importance of ecosystem research and created a model that combines ecology and social sciences. An ecosystem is a unified whole formed through the process of continuous material circulation and energy flow between all living things (i.e., biological communities) and the environment that live together in a certain space (Lyulyuchenko, 2020). Kludacz-Alessandri & Cygańska (2021) further proposed that the business ecosystem of an organization is an economic union based on the interaction between organizations and individuals, which can better produce high-value products and services for consumers. Serve. Bhatia & Dhawan (2021) proposed the concept of platform-based innovation ecosystem. This illustrates the flexibility of the concept

of the innovation ecosystem. Different perspectives and uses have different definitions, but it also causes different conceptual definitions to overlap, even contradict and compete. For example: Think of business ecosystem as a synonym for innovation ecosystem. The innovation ecosystem and business ecosystem are different. After conducting in-depth research on the relevant literature on the innovation ecosystem, no literature has given a clear definition of the innovation ecosystem so far.

Preliminary research on innovation performance

Hagedoorn et al. (2003) explain innovation performance as the result of firms introducing inventions and innovations to the market. Innovation performance according to Ernst (2001) refers to the entire process of coming up with new ideas or concepts, developing new products based on these ideas, and bringing them to the market. Jantunen (2005) believes that innovation performance refers to a company's performance and is the result of improvements to processes or products. According to the research results of Sosik et al. (2012), a company's innovation performance is directly proportional to the company's innovation value, which is the result of the company's pioneering innovation and additional product innovation. Huggins (2012) believes that innovation performance is the corporate value generated by the combination of a company's internal resources and external resource sources. Guan et al. (1990) believe that the innovation performance of an organization is the value obtained by the organization adopting a series of creative behaviors. Zhou et al. (2014) define innovation performance as: from the perspective of collaborative innovation, all parties involved in collaborative innovation are satisfied. In addition, the authors add strategic collaboration and organizational communication among all stakeholders to the innovation process. Wang Rui (2017) pointed out that the innovation performance of the system is a holographic description of the internal innovation status of the entire system. Xiao Yanhong (2018) believes that innovation performance refers to the improvement of products, technologies, processes, and market value brought about by the open innovation process of enterprises.

Related theories

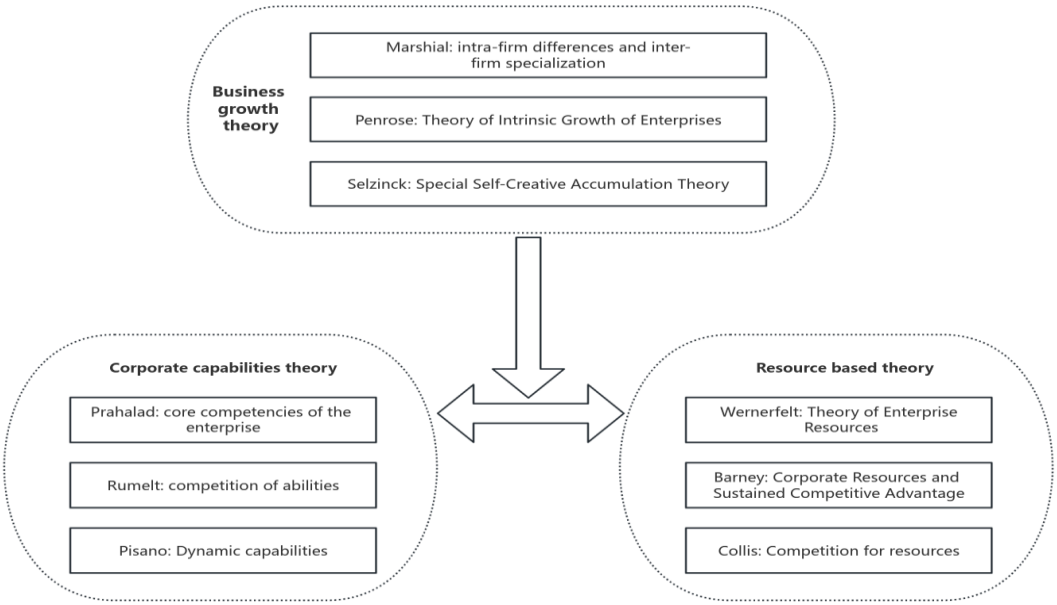
Ecology and Ecosystem Theory

The word ecology first came from Greece, which means residence or place of residence. Ecology is the science of the living environment. Ecology as a subject term was first proposed by the German naturalist Haeckel in his book "Generelle Morphologie der Organismen". Ecology as he understood it is the science that studies the relationship between organisms and the environment in the life process of organisms, especially the relationship between organisms and the environment. Hostile or mutually beneficial relationships between other animals and plants (Kharouba & Wolkovich, 2020) After the 1950s, ecology broke the boundaries between animals and plants, went beyond the field of biology, and entered the ecosystem period. At this time, American ecologist Odum defined ecology as "the science that studies the functions and structures of ecosystems" and "the science that comprehensively studies organisms, the physical environment, and human society", and began to emphasize the role of humans in the ecological process (Navarro & Tudge, 2022). On this basis, Ma Shijun, founder of the Ecological Society of China, defined ecology as ''the science of studying the rules and mechanisms of interactions between living systems and environmental systems''(Márton, 2021, Ogbu & Simons 2022). As the research content becomes more and more extensive, the concept of ecology has entered the fields of economic management and sociology, and living systems not only include plants, animals, microorganisms, and humans themselves but also extend to industries. the system, business system, regional system, organizational system, and enterprise system; the environmental system has also expanded from the inorganic and organic factors

on which living things depend, biological factors, and human society accordingly to include the social environment of all human activities (Carlucci et al., 2020)

Resource-based theory

In the 1980s, as the business environment changed and competition among enterprises became increasingly fierce, the focus of research on enterprise strategic management theory gradually shifted from the market positioning of enterprises to the competitive advantages of enterprises, especially how enterprises obtain and maintain competitive advantages. On research. In this context, the theory of corporate competitive strategy has been developed and improved, and two different theoretical schools have gradually emerged. One believes that corporate capabilities are the source of corporate competitive advantage, which is the corporate capability theory. The other holds that special resources are the key for enterprises to gain competitive advantage, that is, resource-based theory. These two theoretical schools are both independent and complementary to each other (D'Oria et al., 2021).



Research Framework

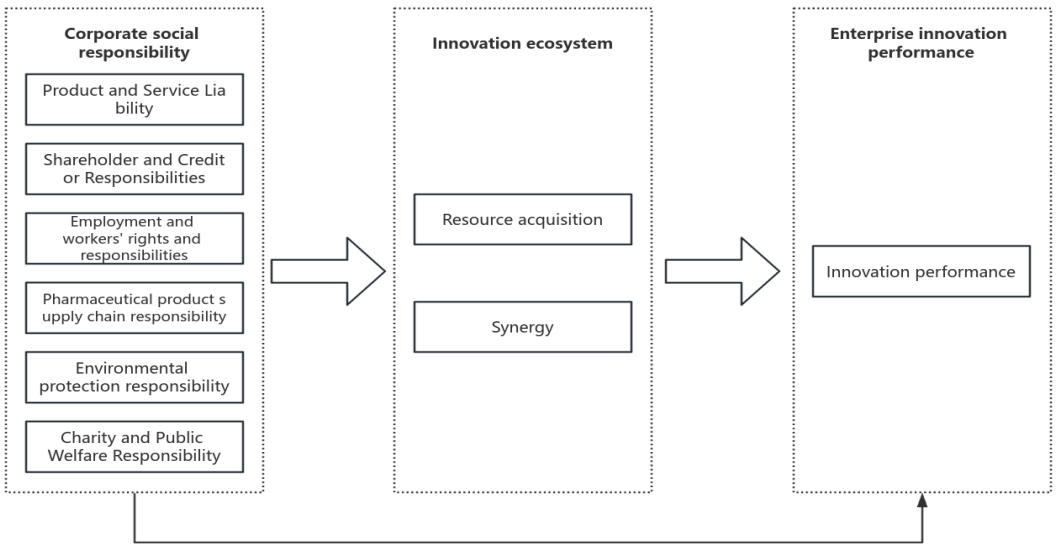


Figure2 Theoretical model of the impact of corporate social responsibility on the innovation performance of pharmaceutical companies

Research Hypotheses

H1: Pharmaceutical corporate social responsibility positively affects innovation performance.
H1a: The social responsibility of pharmaceutical companies' products and services positively affects innovation performance.
H1b: The social responsibility of shareholders and creditors of pharmaceutical companies positively affects innovation performance.
H1c: Pharmaceutical companies' social responsibility for employment and workers' rights positively affects innovation performance.
H1d: The social responsibility of the pharmaceutical product supply chain of pharmaceutical companies positively affects innovation performance.
H1e: The social responsibility of pharmaceutical companies for environmental protection positively affects innovation performance.
H1f: The social responsibility of pharmaceutical companies for charity and public welfare positively affects innovation performance.
H2: Pharmaceutical companies' resource acquisition in the innovation ecosystem positively affects innovation performance.
H3: The synergy and symbiosis of pharmaceutical companies in the innovation ecosystem positively affect innovation performance.
H4: Pharmaceutical corporate social responsibility indirectly affects innovation performance through resource acquisition as an intermediary.
H5: Pharmaceutical corporate social responsibility indirectly affects innovation performance through collaborative symbiosis as a mediator.

Research Method

1. Literature analysis method. Search, consult and collect literature related to research issues, and sort out and summarize the literature, mainly through the Chinese and foreign language databases of the school's electronic library, including Web of Science, Wiley Online Library, Elsevier SD, Springer Link, Emerald, CNKI, Superstar Digital Library, as well as Internet resources such as Google Academic, Baidu Academic and books in the library collection. Understand the latest progress and research results on ecology, corporate innovation ecosystem, corporate social responsibility, and corporate innovation performance both domestically and internationally. This has laid a solid foundation for the formation of the research topic, determination of research ideas, definition of relevant concepts, and construction of theoretical models for this paper.
2. Field investigation method. In the process of determining research topics, constructing research models, sorting out variable relationships, and designing research scales, this paper not only relied on existing literature, but also conducted field investigations of multiple pharmaceutical companies, as well as visits and exchanges with experts, scholars, and enterprise managers in this field, which improved the practicality of the research question.
3. Questionnaire survey method. This paper data is sourced from a survey questionnaire. From October 2023 to December 2023, a questionnaire survey was conducted on the relationship between corporate social responsibility, innovation ecosystem support, and innovation performance of pharmaceutical companies. The questionnaire survey includes the following steps: The first step is to design a questionnaire. By consulting a large amount of literature at home and abroad, combined with the opinions of experts and scholars, and selecting a scale with high recognition and maturity, a scale that fits the research theme of this paper is developed, forming a survey questionnaire for this paper. Select 50 pharmaceutical companies within Shanxi Province and those with branches within Shanxi Province for preliminary research. The pre survey adopts a combination of questionnaire filling and face-to-face interviews, and further improves the questionnaire based on the questions and suggestions

raised by the survey subjects. Thirdly, determine the research objectives. To avoid errors caused by a single survey area, this study conducted questionnaire surveys on multiple pharmaceutical companies in four regions: East China, Central China, North China, and Northwest China, and selected pharmaceutical companies of different industries and sizes. Fourthly, after obtaining data and determining the research subjects, conduct a large-scale questionnaire survey to obtain valid questionnaires, and use the obtained sample data for empirical testing.

Variable measurement

1. Corporate Social Responsibility Scale

Table1 Corporate Social Responsibility Variables

Variable	No	Measurement items
Product and Service Responsibility(Yang & Stoh,2019)	CSR1.1	Your company values the quality of the products provided
	CSR1.2	Your company would like to know about the quality supervision measures issued by the government
	CSR1.3	Your company values the safe use of the products provided
	CSR1.4	Your company hopes for faster updates and upgrades of its products
	CSR1.5	Your company focuses on providing high-quality services
Responsibilities of shareholders and creditors	CSR2.1	The dividends of your company's shareholders increase with the increase of enterprise value
	CSR2.2	Your company's shareholders play a decisive role in making decisions on major corporate issues
	CSR2.3	Your company strictly discloses information to shareholders in accordance with legal provisions, and the truthfulness of the information reported or disclosed
	CSR2.4	Your company is able to abide by the contract and has good commercial credit
Employment and Workers' Rights and Responsibilities (Rettab et al., 2021)	CSR3.1	Your company pays attention to the signing of labor contracts between employees and enterprises
	CSR3.2	Your company focuses on employees being able to work with dignity
	CSR3.3	Your company provides employees with a healthy and safe working environment
	CSR3.4	Your company is concerned about the organization and role of trade union rights and interests in the company
	CSR3.5	Your company is concerned about equal pay for equal work within the company
Responsibility for the pharmaceutical product supply chain (Carroll, 2016)	CSR4.1	Your company has established long-term and stable cooperative relationships with suppliers and sellers
	CSR4.2	Your company has a high proportion of on-time payment for goods in the same industry
Pharmaceutical Product Supply Chain Responsibility (Carroll, 2016)	CSR4.3	Your company treats suppliers fairly and equally in the procurement process
	CSR4.4	Your company has a high proportion of deliveries to distributors in the same industry
	CSR4.5	Your company has provided strong technical support and a good brand reputation to distributors
Environmental protection responsibility Carroll, 2016	CSR5.1	Your company focuses on strengthening employees' environmental awareness
	CSR5.2	Your company focuses on adopting new environmentally friendly technologies
	CSR5.3	Your company emphasizes the use of environmentally friendly products
	CSR5.4	Your company focuses on improving the environmental assessment standards in this industry
Charity and Public Responsibility Carroll, 2016	CSR6.1	If there is a disaster, your company can actively make donations
	CSR6.2	Your company actively invests in educational and cultural public welfare projects
	CSR6.3	Your company assists the community in meeting the needs of residents in various aspects such as life, employment, and elderly care
	CSR6.4	Your company can invest the funds obtained from commercial operations into charitable projects
	CSR6.5	Your company is able to provide various volunteer services to socially disadvantaged groups

2. Resource acquisition measurement

Table 2 Measurement items for resource acquisition

Variable	No	Measurement items
Resource acquisition	RA1	Your company can obtain knowledge resources of the innovation ecosystem through various channels
	RA2	Your company can obtain a large amount of knowledge resources needed from the innovation ecosystem
	RA3	Your company can obtain knowledge-based resources from the innovation ecosystem at a lower cost
	RA4	Your company can obtain capital resources for the innovation ecosystem through various channels
	RA5	Your company can obtain a large amount of capital resources needed from the innovation ecosystem
	RA6	Your company can obtain capital resources from the innovation ecosystem at a lower cost

Data source: Author's organized design

3. Measurement of collaborative symbiosis

Table3 Measurement items for collaborative symbiosis

Variable	No.	Measurement items
Collaborative symbiosis	CS1	Your company has established diversified cooperative relationships with members of the innovation ecosystem
	CS2	Your company aligns with the strategic development direction of members of the innovation ecosystem
	CS3	Your company and members of the innovation ecosystem can achieve collaborative evolution
	CS4	Your company has smooth communication channels with members of the innovation ecosystem
	CS5	The innovation ecosystem can provide knowledge complementarity and compatibility for your company

Data source: Author's organized design

4. Measurement of Innovation Performance

Table 3 Measurement items for innovative performance

Variable	No.	Measurement items
Innovation performance	IP1	Your company actively develops various new technologies, including products, processes, services, etc
	IP2	Your company's sales of new products account for a relatively high proportion of total sales
	IP3	Your company emphasizes innovative management
	IP4	The new products developed by your company have high technological content
	IP5	Your company has a high success rate in innovative projects
	IP6	Your company has a large number of patent applications
	IP7	Your company's GMP is highly aligned with international standards

Data source: Author's organized design

5. Control variables

This study selected enterprise age, enterprise size, industry to which the enterprise belongs, and the level of the enterprise's technology center as control variables. The main basis is that Nieto et al. (2010) argue that firm size significantly affects its innovation performance. Henderson et al. (1994) also proposed that compared to small businesses, the size of large enterprises has a significant impact on their innovation performance. Therefore, this paper uses the number of employees to represent the size of the enterprise, and the years of establishment to represent the age of the enterprise, using them as control variables. Veugelers (1997) found that different industries mean different external environments faced by enterprises, which can also affect their innovation performance. Therefore, control was exercised over the industry to which the enterprise belongs. Tsai (2009) believes that the level of technology centers established by a company will have a positive impact on its innovation

performance, so the level of technology centers has also become a control variable. The above variables were virtually encoded separately.

Questionnaire Collection

This paper takes pharmaceutical companies as the research object and collects data through a questionnaire survey. The research topic of this paper is the impact of corporate social responsibility on innovation performance from the perspective of innovation ecosystem. It is necessary to measure the social responsibility of pharmaceutical companies, the support obtained from the innovation ecosystem during the innovation process, and the innovation performance of enterprises. Therefore, it is necessary to select pharmaceutical companies with more active innovation activities and a more complete innovation ecosystem as samples for the questionnaire survey as much as possible. At the same time, to avoid errors caused by a single survey area, this study conducted surveys on multiple industries and pharmaceutical enterprises of varying scales in four regions: East China, Central China, North China, and Northwest China. The survey is distributed to middle and senior management personnel such as CEOs, directors, general managers, and deputy general managers of pharmaceutical companies. This is because these personnel have a better understanding of the operating conditions, innovation activities, corporate social responsibility, and the concept of the innovation ecosystem of their respective companies. The entire process of conducting and collecting this paper questionnaire lasted for three months (October 2023 to December 2023). A total of 430 questionnaires were distributed and 283 were collected, with a response rate of 65.8%. There were 228 valid questionnaires, with an effective rate of 80.6%.

Finding

Table 4-1: Regression analysis results of the impact of corporate social responsibility on innovation performance

variable	Innovation performance			Multicollinearity diagnosis	
	M1	M2	M3	Tolerance	VIF
Corporate Social Responsibility		0.686^{***}			
Product and Service Responsibility			0.018^{*}	0.647	1.545
Responsibilities of shareholders and creditors			0.374^{***}	0.424	2.360
Employment and Workers' Rights and Responsibilities			0.170^{**}	0.511	1.957
Responsibility for the pharmaceutical product supply chain			0.140^{*}	0.540	1.852
Environmental protection responsibility			0.060	0.272	3.683
Charity and Public Responsibility			0.289^{***}	0.286	3.500
Model metrics					
R^2	0.114	0.672	0.751		
Adjusted R^2	0.100	0.663	0.738		
F	9.645^{***}	70.624^{***}	58.043^{***}		

Further analysis of Table 4-1 shows that the M1 regression analysis results show that the size of the enterprise and the level of technology centers owned by the enterprise have a significant positive impact on the innovation performance of the enterprise, while the industry to which the enterprise belongs has no significant impact on the innovation performance. The regression results of M2 indicate that the regression coefficient of corporate social responsibility on innovation performance is β= 0.686 ($p<0.001$), the regression effect is significant, that is, the hypothesis that H1 pharmaceutical corporate social responsibility has a positive impact on innovation performance has been validated by data, and hypothesis H1 is

supported. From the M3 regression results, the regression coefficient of product and service responsibility on innovation performance is β= 0.018 (p<0.05) showed significant regression effect, indicating that the hypothesis H1a pharmaceutical company's fulfilment of product and service social responsibility has a positive impact on innovation performance, which has been validated by data. Hypothesis H1a is supported; The regression coefficient between shareholder and creditor responsibilities and innovation performance is β= 0.374 (p<0.001), the regression effect is significant, indicating that the hypothesis H1b pharmaceutical company's fulfilment of shareholder and creditor responsibilities has a positive impact on innovation performance, which has been validated by data. The hypothesis H1b is supported; The regression coefficient between employment and employee rights and responsibilities on innovation performance is β= 0.170 (p<0.01), the regression effect is significant, that is, the hypothesis that H1c pharmaceutical companies fulfill their social responsibility for products and services and have a positive impact on innovation performance has been verified by data, and H1c is supported; The regression coefficient of pharmaceutical product supply chain responsibility on innovation performance is β= 0.140 (p<0.05), significant regression effect, i.e. assuming that H1d pharmaceutical companies fulfil their pharmaceutical product supply chain responsibilities and have a positive impact on innovation performance has been verified by data, H1d is supported; The regression coefficient of environmental responsibility for innovation performance is β= 0.060 (p>0.05), the regression effect is not significant, that is, assuming that H1e pharmaceutical companies fulfils their social responsibility for environmental protection and have a positive impact on innovation performance has not been verified by data, H1e does not support this hypothesis; The regression coefficient of charity and public welfare responsibility on innovation performance is β= 0.289 (p<0.001), the regression effect is significant, indicating that the hypothesis H1f that pharmaceutical companies fulfill their social responsibilities for charity and public welfare has a positive impact on innovation performance has been validated by data, and the hypothesis H1f is supported.

Table 4- 1 Regression analysis results on the impact of resource acquisition on innovation performance

variable	Innovation performance		Multicollinearity diagnosis	
	M1	M4	Tolerance	VIF
Resource acquisition		0.589^{***}	0.292	3.420
Collaborative symbiosis		0.134^{*}	0.358	2.793
Model metrics				
R^2	0.114	0.659		
Adjusted R^2	0.100	0.649		
F	9.645^{***}	63.136^{***}		

Further analysis of Tables 4-2 reveals that the regression coefficient of resource acquisition on innovation performance is β= 0.589 (p<0.001), significant regression effect, hypothesis that H2 resource acquisition has a positive impact on innovation performance has been validated by data, and hypothesis H2 is supported. The regression coefficient of collaborative symbiosis on innovation performance is β= 0.134 (p<0.05), significant regression effect, hypothesis H3 synergistic symbiosis has a positive impact on innovation performance verified by data, and hypothesis H3 is supported.

Table 4- 2 Regression analysis results

variable	Resource acquisition		Collaborative symbiosis		Innovation performance	
	M5	M6	M7	M8	M2	M9
Corporate Social Responsibility		0.690***		0.646***	0.686***	0.416***
Mediating variables						
Resource acquisition						0.322***
Collaborative symbiosis						0.075*
Model metrics						
R^2	0.112	0.673	0.157	0.474	0.672	0.720
Adjusted R^2	0.098	0.665	0.140	0.461	0.663	0.710
F	9.412***	61.137***	9.277***	35.498***	70.624***	71.682***

variable	Resource acquisition		Collaborative symbiosis		Innovation performance	
	M5	M10	M7	M11	M3	M12
Product and Service Responsibility		0.056*		0.150*	0.018*	0.010
Responsibilities of shareholders and creditors		0.563***		0.633***	0.374***	0.282***
Employment and Workers' Rights and Responsibilities		0.186***		0.284***	0.170**	0.134*
Responsibility for the pharmaceutical product supply chain		0.150*		0.144*	0.140*	0.117*
Environmental protection responsibility		0.015		0.002	0.060	0.061
Charity and Public Responsibility		0.324***		0.130	0.289***	0.254***
Resource acquisition						0.075*
Collaborative symbiosis						0.078*
Model metrics						
R^2	0.112	0.709	0.157	0.621	0.751	0.756
Adjusted R^2	0.098	0.699	0.140	0.601	0.738	0.741
F	9.412***	61.486***	9.277***	31.499***	58.043***	49.148***

From the regression analysis results of M4 in the previous text, the regression coefficient of resource acquisition on innovation performance reaches a significant level β= 0.589 (p<0.001). Analysing Table 6-15, it can be seen from the regression analysis results of M10 that the regression coefficients of product and service responsibility, shareholder and creditor responsibility, employment and labor rights responsibility, pharmaceutical product supply chain responsibility, environmental protection responsibility, charity and public welfare responsibility on resource acquisition are as follows: β= 0.056 (p<0.05) β= 0.563 (p<0.001) β= 0.186 (p<0.001) β= 0.150 (p<0.05) β= 0.015 (p>0.05) β= 0.324 (p<0.001) indicates that except for the regression coefficient of environmental protection responsibility on resource acquisition which did not reach a significant level, the regression coefficients of all other variables on resource acquisition reached a significant level. From the regression analysis results of M12, it can be seen that in the presence of control variables and independent variables (product and service responsibility, shareholder and creditor responsibility, employment and labor rights responsibility, pharmaceutical product supply chain responsibility, environmental protection responsibility, charity and public welfare

responsibility), the regression coefficient of the intermediate variable resource acquisition on innovation performance is β= 0.075 (p<0.05), with a significant regression coefficient. Furthermore, from the regression analysis results of M12 and the comparison with the regression analysis results of M3, it can be seen that in the presence of control variables and independent variables (product and service responsibility, shareholder and creditor responsibility, employment and worker rights responsibility, pharmaceutical product supply chain responsibility, environmental protection responsibility, charity and public welfare responsibility), after adding intermediary variables, the regression coefficients of product and service responsibility, shareholder and creditor responsibility, employment and worker rights responsibility, pharmaceutical product supply chain responsibility, environmental protection responsibility, charity and public welfare responsibility on innovation performance are: β= 0.010 (p>0.05) β= 0.282 (p<0.001) β= 0.134 (p<0.05) β= 0.117 (p<0.05) β= 0.061 (p>0.05) β= 0.254 (p<0.001) indicates that after adding the mediating variable, the regression coefficient between product and service responsibility and innovation performance did not reach a significant level. Therefore, resource acquisition plays a complete mediating role in the impact of product and service responsibility on innovation performance. Hypothesis H4 is validated by data; If the regression coefficient between shareholder and creditor responsibilities and innovation performance decreases and reaches a significant level, resource acquisition partially mediates the impact of shareholder and creditor responsibilities on innovation performance; Assuming H5 receives data validation.

5.1 Conclusion

This study focuses on practical issues and theoretical deficiencies in the innovation ecosystem, pharmaceutical corporate social responsibility, and innovation performance. Based on relevant theoretical research results such as ecology and ecosystem theory, stakeholder theory, resource-based theory, and self-organization theory, the study establishes a research theme on the impact of corporate social responsibility on pharmaceutical corporate innovation performance from the perspective of the innovation ecosystem. A profound and detailed study is conducted on the relationship between corporate social responsibility, innovation ecosystem support, and innovation performance. Using various data obtained from research on pharmaceutical companies, data testing and analysis discussions are conducted, and the following research conclusions are ultimately drawn:

(1) The establishment of an innovation ecosystem plays a positive role in the innovative development of pharmaceutical enterprises. The innovation ecosystem of pharmaceutical enterprises, based on talent, funds, and information, with pharmaceutical core enterprises, supplier enterprises, seller enterprises, and affiliated enterprises that are supportive, complementary, and competitive with the core enterprises as the core, and supported by universities, research institutions, governments, demanders, and intermediary institutions, can promote the rational utilization and coordinated allocation of resources in all aspects, and ensure the stability and sustainable development of the innovation ecosystem through the self-organization of collaborative symbiosis among various entities, thereby improving the innovation ability and level of pharmaceutical enterprises. As RDPAC has stated, creating a sustainable innovation ecosystem in the pharmaceutical industry is of utmost importance in the next 10 to 20 years, as it promotes social development.

(2) The support for innovative ecosystems includes resource acquisition and collaborative symbiosis. In order to specifically measure the impact of the innovation ecosystem on the overall innovation of pharmaceutical enterprises, this paper introduces the concept of innovation ecosystem support, defining innovation ecosystem support as various supports obtained from the innovation ecosystem that have a driving effect on enterprise innovation activities, with important aspects being resource acquisition and collaborative symbiosis.

Resource acquisition is a key aspect of innovation ecosystem support for pharmaceutical enterprises, which refers to the fundamental resources for pharmaceutical enterprises to carry out various innovative behaviors, obtain synergy and symbiosis with other innovative entities, and the innovation ecosystem. Collaborative symbiosis is the process of interaction and coordinated development among the various entities of the pharmaceutical enterprise co creation ecosystem. It is a manifestation of harmonious symbiosis, collaborative optimization, and value-added realization among the various entities of the innovation ecosystem, as well as between the entities and the innovation environment.

(3) Corporate social responsibility has a positive impact on the innovation performance of pharmaceutical companies. Pharmaceutical companies assume social responsibility and promote innovation to meet the needs of stakeholders. The research results of this paper indicate that fulfilling social responsibility in pharmaceutical companies promotes their innovation performance. Due to the particularity of pharmaceutical products, the social responsibility of pharmaceutical enterprises is divided into six dimensions: products and services, pharmaceutical product supply chain, shareholders and creditors, employment and labor rights, environmental protection, and charity and public welfare responsibility. Product and service responsibility is the primary social responsibility of pharmaceutical enterprises. Empirical evidence shows that, except for the insignificant impact of environmental protection responsibility on the innovation performance of pharmaceutical enterprises, all other factors have a positive impact on improving enterprise innovation performance. Among them, the social responsibility of shareholders and creditors has the greatest impact, the product and service responsibility has the smallest impact, and the impact of labor rights responsibility and pharmaceutical product supply chain responsibility is not significantly different.

(4) The resource acquisition and collaborative symbiosis in the innovation ecosystem have a positive impact on innovation performance. Because resources are an important factor leading to gaps in innovation performance among pharmaceutical companies, they obtain new resources from the innovation ecosystem, integrate internal resource stocks, update existing systems in a timely manner, and achieve synergy among various aspects of the enterprise to improve its innovation performance. It is obvious that pharmaceutical companies can achieve positive development in their innovation performance after obtaining resources from the innovation ecosystem and supporting collaborative symbiosis. The results of this study also indicate that resource acquisition and collaborative symbiosis both promote the innovation performance of enterprises.

(5) There is a mediating effect between resource acquisition and collaborative symbiosis in the impact of corporate social responsibility on innovation performance. When improving the innovation performance of enterprises, corporate social responsibility plays a promoting role, while resource acquisition and collaborative symbiosis mediate this causal relationship. The research results of this paper indicate that the two play a mediating role in the transmission mechanism of corporate social responsibility on innovation performance, and their effects are relatively similar. Specifically, in terms of various dimensions of social responsibility of pharmaceutical companies, resource acquisition and collaborative symbiosis have not played a mediating role in the impact of environmental protection responsibility on corporate innovation performance. The other dimensions indirectly affect the innovation performance of enterprises through resource acquisition and collaborative symbiosis.

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