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The Impact of Corporate Social Responsibility (CSR) on Corporate Innovation Performance - The Case of Chinese Pharmaceutical Companies

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Master in Business Administration

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BUSINESS
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Department of Marketing, Strategy and Operations

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Resumo

Este estudo explora a relevância da Responsabilidade Social Corporativa (RSC) e o desempenho em inovação das empresas farmacêuticas chinesas, enfatizando o papel mediador das restrições financeiras e o efeito moderador da Relação Dívida/Capital Próprio (D/E). Utilizando dados de empresas farmacêuticas listadas na bolsa de valores da China (A-share) no período de 2010 a 2020, realizamos análises empíricas empregando múltiplos modelos de regressão, complementados por verificações de robustez através de variações nas variáveis dependentes e redução do tamanho da amostra. Os resultados revelam que as empresas farmacêuticas podem melhorar diretamente seu desempenho em inovação ao cumprir suas responsabilidades sociais e indiretamente ao aliviar restrições financeiras. Além disso, constatou-se que o D/E modera negativamente a relação entre RSC e desempenho em inovação. Esses resultados oferecem novas percepções para as empresas que buscam cumprir suas responsabilidades sociais. Para enfrentar desafios como "a dificuldade e o alto custo de financiamento" enfrentados por pequenas e médias empresas farmacêuticas, é essencial a colaboração entre o governo chinês, as empresas farmacêuticas e as instituições financeiras para promover ainda mais a inovação dentro do setor.

Palavras-chave: Responsabilidade Social Corporativa; Desempenho em Inovação; Restrições Financeiras; Relação Dívida/Capital Próprio; Empresas farmacêuticas chinesas.

Abstract

This study explores the relevance of Corporate Social Responsibility (CSR) and the innovation performance of Chinese pharmaceutical companies, emphasizing the mediating role of financial constraints and the moderating effect of the Debt-to-Equity Ratio (D/E). Utilizing data from A-share listed pharmaceutical firms in China spanning from 2010 to 2020, we conducted empirical analyses employing multiple regression models, complemented by robustness checks through variations in dependent variables and sample size reduction. The findings reveal that pharmaceutical companies can directly enhance their innovation performance by fulfilling social responsibilities and indirectly improving it by alleviating financial constraints. Furthermore, D/E is found to negatively moderate the relationship between CSR and innovation performance. These results offer new insights for companies striving to meet their social responsibilities. To address challenges such as "the difficulty and high cost of financing" faced by small and medium-sized pharmaceutical enterprises, collaboration among the Chinese government, pharmaceutical companies, and financial institutions is essential for further promoting innovation within the industry.

Key words: Corporate Social Responsibility; Innovation Performance; Financial Constraints; Debt-to-Equity Ratio; Chinese pharmaceutical companies

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CHAPTER 1 Introduction

1. 1 Research Background

The products and services provided by the pharmaceutical industry play a crucial role in safeguarding the health of the Chinese population and are intricately linked to their well-being. This paper aims to explore the influence of CSR on enterprise innovation performance within the pharmaceutical manufacturing sector, a subdivision of the pharmaceutical industry. Drawing upon the concept that inferior practices can displace superior ones, companies may opt for cost reduction at the expense of product quality in pursuit of higher profits. Regrettably, China's pharmaceutical industry has witnessed numerous instances of misconduct, making it one of the most notorious sectors with as many as 61,700 reported cases in 2020 alone. The frequent occurrence of quality and safety incidents, particularly concerning "fake vaccines," has not only jeopardized consumers' lives and right to health but also eroded public trust in pharmaceutical corporations. Consequently, this has impeded industry development significantly. Guiding pharmaceutical companies towards fulfilling their social responsibilities has thus become a pressing concern for society at large. Recognizing its importance, the Chinese government places great emphasis on corporate accountability and fulfillment of social responsibilities within this sector. As part of ongoing pharmaceutical reforms, various relevant policies have been introduced over time. For instance, the release of *the CSR Implementation Guidelines for Pharmaceutical companies in China* in 2017 provided a guide for the writing of the CSR report for the pharmaceutical industry in China; while more recently in 2020, new measures *Measures for the Supervision and Administration of Pharmaceutical Production* were implemented to enhance supervision and administration regarding drug production specifically within the pharmaceutical industry —aligning it with contemporary demands—and encouraging proactive assumption of social responsibilities by more companies.

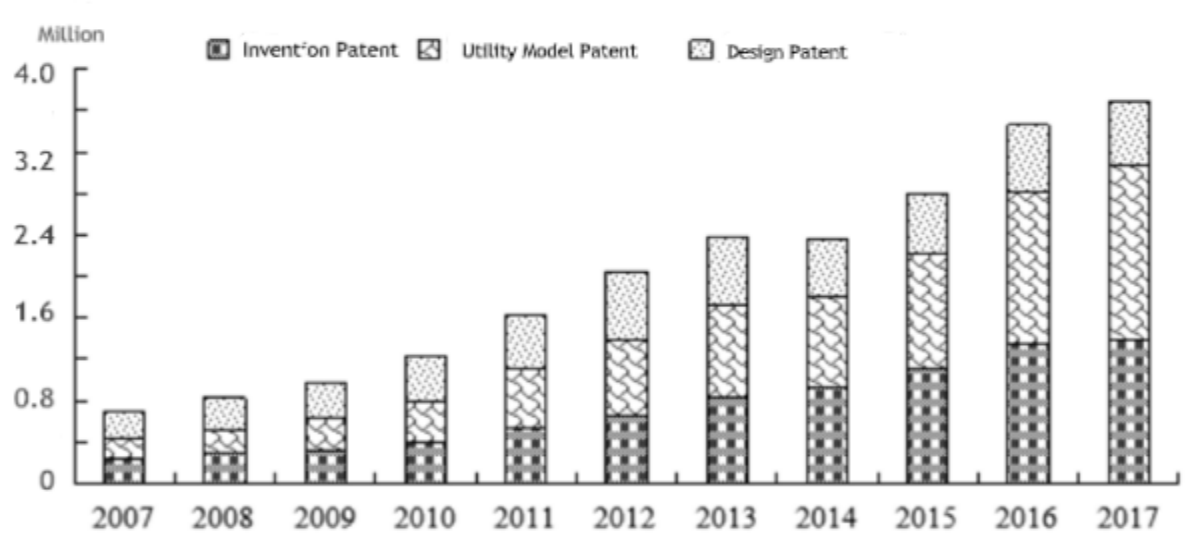
With the advancement of China's industrialization process and the upgrading of its industries, Chinese companies are confronted with a more intricate competitive landscape both domestically and internationally. The Chinese government and Chinese enterprises have gradually come to realize that innovation has emerged as the new core competitiveness required to confront novel opportunities and challenges.

As China's industrialization process and industrial upgrading progress, Chinese enterprises are encountering an increasingly complex competitive landscape, both domestically and internationally. The Chinese government and enterprises are gradually realizing that, to embrace new opportunities and meet challenges, innovation has emerged as a new core competitiveness.

From a macro perspective, innovative development serves as the cornerstone of China's transformation in its economic development model. From a micro perspective, innovation represents

the fundamental driving force behind sustainable and healthy growth for enterprises. In the context of the new normal in the economy, China encounters numerous opportunities and challenges. The government is dedicated to implementing an innovation-driven development strategy with the aim of establishing an innovative nation. In this process, enterprises, as the main force of innovation, directly influence the overall strength of the country.

Therefore, companies should not merely be content with keeping pace with the times; rather, they should proactively assume the responsibility of leading the era to achieve sustainable development in the context of global business competition. As illustrated in Figure 1, from 2007 to 2017, there was a significant increase in the total number of patent applications in China, particularly for invention patents and utility model patents. This trend indicates that the innovative capacity of Chinese enterprises has been notably enhanced.



Source: http://epub.cnipa.gov.cn/

Figure 1 Total number of patent applications in China

1. 2 Problem Statement

As issues such as ecological protection, green innovation, and sustainable development garner increasing attention, research on the relationship between CSR and innovation performance has surged in response to policies set forth by the Chinese government. This trend reflects a reevaluation of the role of enterprises within society, particularly in an era where environmental and social responsibilities are becoming increasingly critical.

Some scholars argue that actively engaging in CSR can significantly enhance a company's innovation performance. They assert that by implementing social responsibility initiatives, companies not only bolster their reputation but also cultivate strong relationships with stakeholders. A positive

reputation enables firms to gain recognition and support from local governments during their developmental phases, allowing them to benefit from various governmental incentives that create a favourable external environment for innovation. Furthermore, these companies are better positioned to secure funding since they can more readily earn the trust of investors and consumers; this reduces information asymmetry and attracts additional capital necessary for ongoing innovative efforts.

Conversely, some scholars present opposing viewpoints. They contend that the primary value of an enterprise lies in generating economic returns for shareholders. From this perspective, fulfilling social responsibilities may divert resources away from potential investments in innovation and development—ultimately impeding growth in innovation performance. Consequently, companies may encounter dilemmas regarding resource allocation while pursuing social responsibility commitments; this could lead to insufficient investment in innovative activities and a subsequent decline in competitiveness.

Additionally, some scholars investigate the relationship between CSR and innovation performance, positing that a clear linear relationship may not exist between the two. They suggest an inverted U-shaped relationship, wherein moderate CSR activities can enhance innovation performance within a certain range; however, when CSR initiatives surpass a specific threshold, they may hinder innovation performance. This perspective underscores the necessity for companies to meticulously balance their social responsibility endeavours to ensure that their innovative capabilities remain unaffected.

At the same time, biopharmaceutical companies are in urgent need of substantial cash flow to support their development, innovation, and industrial upgrading processes. These companies require funding not only for research and development of new drugs but also to advance technological innovations, enhance production processes, meet market demands, conduct marketing activities, and expand production capacity. However, the primary financing method for biopharmaceutical firms in China currently relies on bank loans, resulting in a relatively narrow financing channel that imposes numerous constraints on fund acquisition.

In addition to limitations in financing channels, most biopharmaceutical companies face challenges such as "difficult financing" and "expensive financing." Many enterprises struggle to secure bank loans due to insufficient credit history or lack of collateral; even when loans are obtained, they often come with high interest rates and stringent repayment conditions. This situation severely impacts the liquidity of these companies and restricts their flexibility regarding innovation and market expansion.

Therefore, addressing these financing issues has become a significant challenge for Chinese biopharmaceutical firms. There is an urgent need for enterprises to explore diversified financing avenues such as venture capital, private equity funding, public offerings, and government subsidies to achieve low-cost and efficient capital acquisition. Additionally, establishing a favourable financial

environment along with a comprehensive support system is essential for promoting the sustainable development of biopharmaceutical companies. By leveraging multiple financing options effectively, these enterprises can alleviate financial pressures while maintaining competitiveness and innovative capabilities within an intensely competitive market.

1. 3 Research contents

1. 3. 1 Research problem

This paper selects pertinent data from China's A-share pharmaceutical listed companies as the research sample. It employs Hexun's comprehensive score for CSR to quantify CSR and utilizes the annual patent application volume of these companies as a metric for assessing corporate innovation performance. The study investigates the influence of CSR fulfilment by biopharmaceutical companies on their innovation performance. Furthermore, this article incorporates the financing constraints (FC) data of biopharmaceutical firms as a mediating variable.

During the analysis, three primary questions are posed:

RQ1 What impact does CSR exert on pharmaceutical corporate innovation performance?

RQ2 Do financing constraints affect the nuanced relationship between CSR and corporate innovation performance?

RQ3 Can the Debt-to-Equity ratio serve as a moderating factor in the relationship between CSR and corporate innovation performance?

All the research and analysis in this paper also focus on solving these three problems.

1. 3. 2 Paper Structure

The structure of this paper is composed of the following sections:

Chapter 1 Introduction. This section begins with a detailed explanation of the research background, highlighting the current state and existing problems in the field. It then delves into the significance of the study, emphasizing its theoretical contributions and practical implications for corporate management. The main research content and core issues are outlined, along with a detailed description of the overall structure and technical roadmap of the paper. Finally, the research methodology is introduced, highlighting potential innovations and contributions.

Chapter 2 Literature Review. This chapter systematically reviews and organizes the literature on CSR, corporate innovation, and financial constraints. Through an analysis of existing studies, the research framework of this paper is clarified, providing a solid foundation for the formulation of research hypotheses and empirical analysis.

Chapter 3 Theoretical Analysis and Research Hypotheses. This chapter elaborates on the

theoretical foundations and background relevant to the study, including economic and management theories. Based on these theoretical foundations, specific research hypotheses are proposed in response to the research questions, laying the groundwork for empirical analysis.

Chapter 4 Research Design. This section provides a detailed explanation of the criteria for sample selection, data sources, and variable design. Based on these elements, the empirical analysis model is constructed, ensuring thorough preparation for subsequent data analysis.

Chapter 5 Empirical Analysis. Based on the theoretical analysis and research design presented earlier, this chapter conducts an in-depth empirical study of the selected sample data. It begins with descriptive statistics, correlation analysis, and multicollinearity tests to preliminarily understand the relationships between variables. Subsequently, regression analysis is used to verify the relationship between CSR and corporate innovation performance, exploring the mediating role of financial constraints and the moderating effect of the Debt-to-Equity ratio (D/E).

Chapter 6 Conclusion and Discussion. This section provides a comprehensive summary and in-depth analysis of the empirical findings from Chapter 5, offering insights into the management of Chinese pharmaceutical companies. Finally, the limitations of the study are discussed, and suggestions for future research are proposed based on these limitations.

1. 3. 3 Framework Diagram

The research framework diagram of this paper is shown in the following figure:：

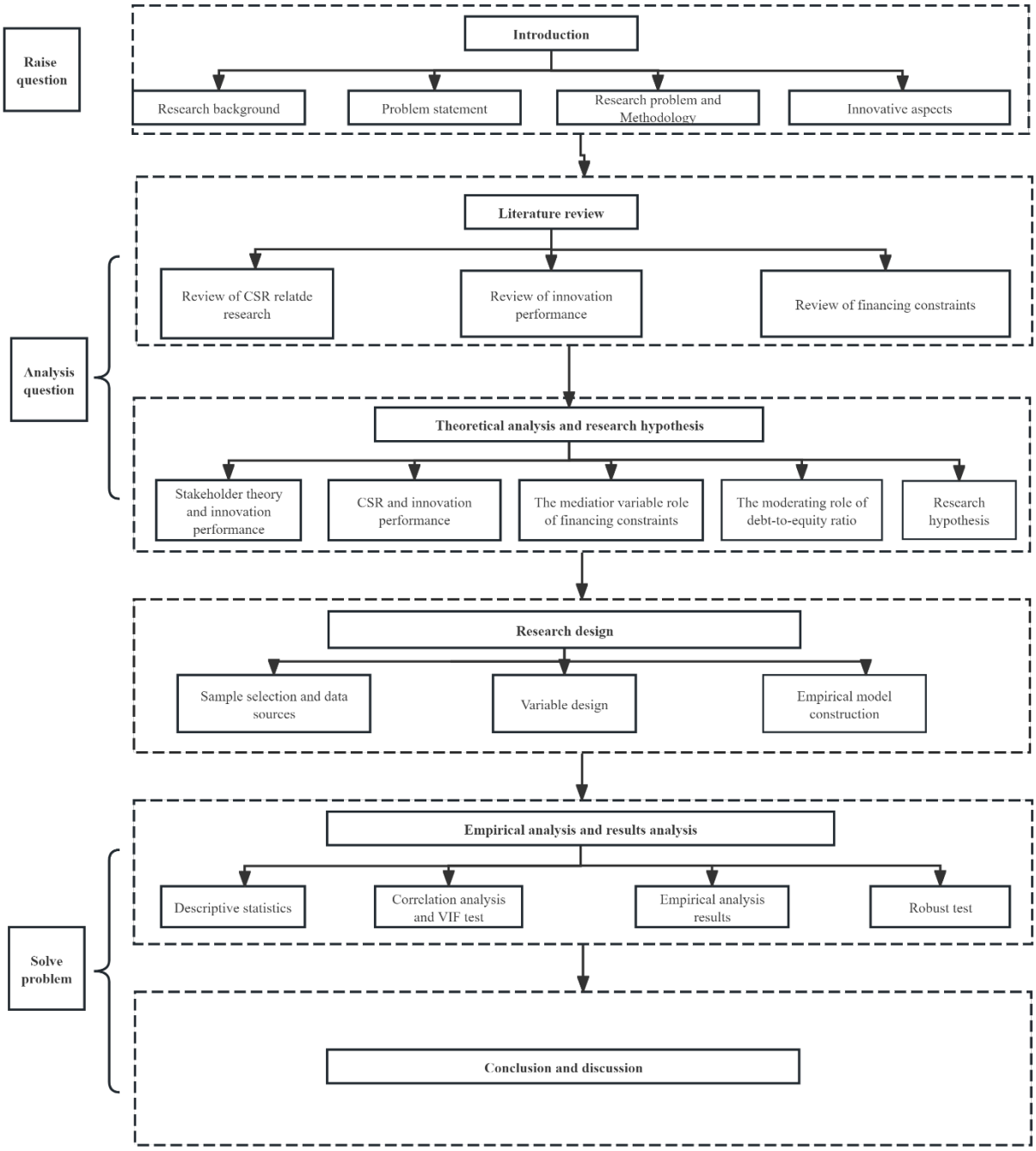


Figure 2 The research framework diagram of this paper

1. 4 Research Methodology

1. 4. 1 Literature Review Method

Based on the established research theme, this paper conducted extensive searches of Chinese and English databases, meticulously reviewing and organizing relevant literature on CSR, innovation performance, and financing constraints. Through a systematic analysis of these documents, this

paper not only achieved a comprehensive understanding of the current state of research in this domain but also identified key issues and emerging trends. Furthermore, we examined the fundamental research approaches and methodologies employed by other scholars, which provided significant theoretical support and methodological guidance for this study. This thorough literature review ensured the rationality and scientific validity of the research ideas and methods presented herein, thereby enhancing the rigour of our investigation. This process not only laid a solid foundation for subsequent research but also offered a clear framework for deeper exploration into the relationship between CSR and innovation performance.

1. 4. 2 Empirical Research Method

This study selects pharmaceutical companies listed on the A-share market in China from 2010 to 2020 as the research sample. Drawing upon existing literature, appropriate proxy variables for CSR, innovation performance, and financing constraints were identified. The necessary data was subsequently collected to establish a relevant empirical model, followed by regression analysis conducted using STATA 18. The results of the regression analysis were interpreted in conjunction with the hypotheses posited in this study. Furthermore, to enhance the robustness of the findings, additional tests were performed within this section; these included substituting the explained variable for innovation performance and reducing the sample size.

1. 5 Innovative Aspects

1. In contrast to other studies examining the relationship between CSR and corporate innovation performance, this paper narrows its research focus to a specific industry, thereby enhancing the representativeness of the findings.

2. This study integrates financing constraints and Debt-to-Equity ratios into the research model, investigating their mediating and moderating effects on CSR's influence on corporate innovation performance. This approach broadens the scope of inquiry regarding how social responsibility impacts innovation outcomes.

3. The paper contextualizes its analysis within China's pharmaceutical industry to assess CSR's effect on innovation performance across varying market environments. It highlights the significance of industry characteristics and cultural factors in implementing CSR, thus providing empirical evidence that can inform relevant policy development and corporate strategy formulation.

CHAPTER 2 Literature Review

2. 1 Corporate Social Responsibility

2. 1. 1 The Concept and Its Development

Current academic consensus indicates that the origins of CSR can be traced back to the 1920s. In 1924, British scholar Oliver Sheldon (1925) first introduced the concept of CSR in his book *Management Philosophy*. He argued that company executives while pursuing internal economic interests, must also take into account the needs of various stakeholders both within and outside their industry. This perspective underscores that a corporation's responsibilities extend beyond merely generating economic value; it encompasses the social value it can create as well. Thus, this lays a foundational framework for CSR theory.

Building upon Sheldon's foundational ideas, subsequent scholarly debates, particularly those involving Berle and Dodd and Berle and Manne (1932), engaged more deeply with the discourse surrounding CSR. However, during this period, significant advancements in CSR development remained elusive. The economic crisis of the 1950s prompted a critical reevaluation of the social roles that businesses occupy. In 1953, Bowen (1953) clearly defined the social responsibilities incumbent upon businessmen in his seminal work *Social Responsibilities of the Businessman*. He posited that businesses possess the capacity to influence citizens' lives in myriad ways, thereby engendering an obligation for business leaders to align their policy-making, decision-making, and actions with societal value expectations. This perspective heralded a new phase in the exploration of modern corporate responsibility and led to Bowen being acknowledged as the father of contemporary CSR. His insights provided a pivotal direction for advancing social responsibility practices within enterprises and catalyzed further developments in CSR initiatives.

The United States Economic Development Committee (CED) published a report titled *Social Responsibility of Busine*ss (1971), which asserted that businesses should not only provide products and services but, more importantly, contribute to enhancing the quality of life for the American populace. The report introduced the influential "three concentric circles" theory, which explored various dimensions of corporate responsibility and offered a theoretical framework for companies engaged in social responsibility initiatives. Notable researcher Carroll (1979) presented the significant "Corporate Social Responsibility Pyramid" model. This model categorizes social responsibility into four distinct levels: economic, legal, ethical, and philanthropic responsibilities. These categories are arranged in a pyramid structure with economic responsibility at its base, followed by legal, ethical, and philanthropic responsibilities. This framework not only delineates the responsibilities that businesses should undertake at different levels but also provides practical guidance for enterprises in their social responsibility practices.

Additionally, the "Triple Bottom Line" principle proposed by Elkington (2014) emphasizes that businesses should consider economic, social, and environmental dimensions in fulfilling their CSR, thereby broadening the scope of CSR. Within this framework, businesses are encouraged not only to pursue economic gains but also to be cognizant of their social and environmental impacts, ultimately striving for sustainable development.

As the 21st century approached, the increasing interconnectedness of global trade led scholars to a deeper understanding of CSR. Guided by the principles of the Triple Bottom Line, Newell and Frynas (2007) linked CSR with stakeholder theory, further defining it as the interaction arising from engagement between enterprises and their stakeholders. This perspective underscores the importance of considering various stakeholders' expectations and needs while pursuing corporate interests, reflecting CSR's critical role within corporate strategy. Carroll (2015) has continually refined his theory by incorporating elements such as sustainable development and shared value into his definition of corporate social responsibility, thereby advancing the depth of research in this field.

2. 1. 2 Studies on Corporate Social Responsibility in China

Compared to other developed countries and regions, the theoretical development of CSR in China has emerged relatively late. Chinese scholar Yuan Jiafang (1990), after systematically organizing and analyzing various academic perspectives on CSR from Western countries, proposed the significant notion that “corporate social responsibility is the obligation of companies to address diverse social issues while safeguarding the interests of all stakeholders, alongside ensuring their survival and development,” taking into account China's unique market conditions.

Building upon this theoretical framework, Chinese scholars have begun to examine CSR from multiple aspects to bolster their arguments, thereby contributing a range of distinctive perspectives to the study of this concept.

For instance, Daifu Lu (2005) posits from a legal standpoint that CSR transcends being merely an ancillary outcome of shareholder profit maximization; rather, it constitutes a fundamental obligation to uphold and enhance social welfare. He delineates four distinct qualitative characteristics of CSR in contrast to other forms of responsibility: first, CSR is characterized as a relational or proactive responsibility, underscoring the interaction between businesses and society; second, the obligations associated with CSR encompass non-shareholder stakeholders, necessitating that enterprises consider a broader spectrum of interests in their decision-making processes; third, CSR amalgamates legal and moral responsibilities, encouraging companies to proactively engage in social responsibilities beyond mere compliance; finally, CSR acts as both a corrective measure and complement to the traditional principle of shareholder profit maximization, suggesting that businesses should also take into account social impacts while pursuing economic benefits.

Concurrently, Chen Honghui (2003) and Jia Shenghua (2014) examine this subject through the lens of economic contract theory. They assert that when enterprises fulfil a comprehensive social contract—which encompasses both explicit and implicit agreements—they must regard the reasonable interests of their stakeholders. This perspective not only accentuates the significance of stakeholders within corporate operations but also advocates for enterprises to actively embrace social responsibility. This includes several specific dimensions: equitable distribution of legal income generated by the enterprise; respect for employees' legitimate rights; enhancement of consumer satisfaction; lawful tax contributions; fostering positive relationships with media entities; environmental stewardship; and promotion of sustainable development. These research findings provide substantial academic support for advancing CSR theory in China while offering practical guidance for policy formulation and corporate strategy development.

2. 1. 3 Quantification of Corporate Social Responsibility

Waddock and Graves (1997) evaluated previous measurement methods for CSR, observing that while each method possesses some significance, they are often overly simplistic to accurately reflect a company's CSR level. Some methods apply only to specific companies or industries, thereby lacking universality. Ferrell (2000) categorized these methods into three primary types: expert evaluations, single- and multiple-issue indicators, and surveys of managers. Aguinis (2014) assessed CSR based on three dimensions: economic responsibility, environmental responsibility, and social responsibility.

Scholars have adopted varied evaluation standards due to their distinct research approaches toward CSR. Common methodologies for evaluating CSR include the utilization of databases such as the U.S. KLD database and the Fortune Index or employing specific tools like CSRO.

In China, quantification methods for CSR encompass:

1. Utilizing CSR reports published by third-party authoritative agencies; however, this approach heavily relies on the subjective evaluation methods and indicators employed by these agencies.

2. Evaluating CSR from multiple stakeholders' perspectives—including employees, government entities, consumers, suppliers, residents, and society at large—and calculating performance through averaging.

3. Manually analyzing company annual reports to quantify financial data and convert it into CSR scores based on established criteria.

4. Conducting surveys with questions focused on CSR issues; gathering scores from both companies and stakeholders; then aggregating these scores using weighted averages to derive a final CSR score.

2. 2 Definition and Measurement of Innovation Performance

With the continuous development of global trade, companies are facing increasingly intense market competition. In this context, innovation has become a crucial strategy for enhancing a company's core competitiveness. However, effectively measuring innovation performance to ensure that investments in innovation yield the expected benefits has become a significant concern.

In the research on corporate innovation performance, there is a consensus among scholars that multi-dimensional indicators and methods are necessary for evaluation. However, there is no unified standard on which specific methods should be used. Most researchers assess corporate innovation performance based on their perspectives and needs.

Currently, the academic community defines corporate innovation performance primarily from two aspects. The first is from the innovation process. The scholars argue that innovation performance is the result of innovation activities within a company's production and operations. This perspective emphasizes the importance of innovation activities in daily business operations. Hagedoorn and Cloodt (2003) suggest that innovation performance is the natural outcome of a company's innovation process. In their 2003 study, they examined indicators such as R&D inputs to analyze the innovation activities and performance of different companies. On the other hand, innovation performance can also be defined from the perspective of innovation outcomes. Coombs (1996) posits that a company's innovation performance is a reflection of various resource inputs during the innovation process. These resources, including capital, technology, talent, and equipment, provide guidance and support for the company's innovation activities. Through this process, companies acquire new knowledge, products, and processes. Lovelace et al. (2001) define innovation performance in terms of the number of new ideas, product innovation characteristics, adaptability, and overall technological performance.

Additionally, Prajogo and Ahmed (2006) highlight that a company’s innovation performance is well reflected in product innovation. Their research indicates that through product innovation, companies can not only enhance market competitiveness but also more effectively meet customer needs, thereby achieving sustainable development.

overall, although there is no consensus on the methods and standards for measuring corporate innovation performance, evaluating it from both process and outcome perspectives has become a widely accepted approach among researchers. Through multi-faceted analysis, companies can gain a more comprehensive understanding and enhancement of their innovation capabilities.

2. 3 Financing Constraints

Modigliani and Miller (1958) introduced the Modigliani-Miller theorem (MM theorem), which has become one of the foundational principles of modern financial theory. This theorem asserts that a company's cost of capital is independent of its capital structure and instead hinges on its expected returns. This perspective challenges the traditional view that a company’s market value is influenced

by its capital structure. Within the MM framework, Modigliani and Miller contended that neither the method of financing nor a company's financial status affects its investment decisions; rather, the primary determinant for corporate financing lies in the demand for investments in projects.

The MM theory serves as an essential basis for advancing investment theory. Nonetheless, it arises from idealized assumptions. In real-world capital markets, factors such as information asymmetry, transaction costs, trading barriers, and market imperfections result in external capital being more expensive than internal capital. In an idealized perfect capital market devoid of corporate income tax, both external and internal capital would share identical costs—indicating that they could be interchangeable under these conditions. However, in practice—and particularly with corporate income tax considerations—the ability to deduct interest on debt before taxation results in internal capital typically being less costly than external capital.

Myers and Majluf (1984), along with Greenwald, Stiglitz, and Weiss (1984), introduced the concept of information asymmetry into the analysis of capital market operations. They proposed the pecking order theory of financing within imperfect markets. Their argument posits that information asymmetry elevates a company's cost of financing, thereby complicating firms' efforts to raise capital. This challenge subsequently impedes their ability to secure adequate funds for investment projects. When internal funds are insufficient, companies may opt to forgo positive Net Present Value (NPV) investment opportunities. In markets characterized by information asymmetry, there is a positive correlation between the disparity in costs between internal and external financing and the degree of information asymmetry present. Their research offers a theoretical foundation for comprehending financing constraints.

Fazzari, Hubbard (1987), and Peterson conducted a comprehensive examination of the effects of information asymmetry in capital markets on corporate financing constraints. They noted that due to the inefficiencies inherent in capital markets, certain firms encounter greater challenges when seeking external financing. Specifically, within the hierarchy of financing options, internal financing offers a significant cost advantage over external alternatives. Notably, fluctuations in a company's cash flow play a critical role in shaping its investment behaviour.

For firms that distribute dividends, the dividend payout ratio not only influences the amount of retained earnings but also directly impacts the funds available for internal financing. Consequently, this ratio serves as an important indicator of the extent to which a company faces financing constraints. When a firm maintains high dividend payouts while retaining fewer earnings, its capacity for internal funding may be diminished; thus increasing reliance on external sources. In scenarios characterized by information asymmetry within capital markets, such firms often confront elevated costs associated with external financing—leading to heightened difficulties and ultimately constraining their investment activities.

Conversely, companies that do not issue dividends tend to base their investment decisions more heavily on variations in internal cash flow. These entities are free from the obligations tied to dividend

payments and can therefore allocate all available resources toward business development initiatives.

Fazzari, Hubbard, and Peterson (1987) conducted a comprehensive investigation into the effects of capital market information asymmetry on corporate financing constraints. They posited that the inherent imperfections within capital markets restrict certain corporations' access to external financing opportunities. Furthermore, within the hierarchy of financing options, internal financing presents a more pronounced cost advantage compared to external sources of funding.

The fluctuations in a company's cash flow have a direct impact on its investment behaviour. For dividend-paying companies, the dividend payout ratio influences retained earnings, thereby determining the availability of internal funds within the organization. Consequently, the dividend payout ratio serves as an indicator of a company's financing constraints. In contrast, non-dividend-paying companies experience limitations in their investment activities due to variations in cash flow. A decline in cash flow restricts their ability to invest; conversely, when a company is financially stable, it encounters fewer financing constraints and has access to sufficient funds for investment endeavours.

As research has progressed, scholars have systematically and comprehensively examined the issue of corporate financing constraints, building upon earlier theoretical foundations. Bernanke and Gertler posited that under conditions of information asymmetry, agency problems exacerbate the effects of financing constraints, resulting in significantly higher external financing costs compared to internal financing costs. Specifically, as agents responsible for investment decisions, managers may act in ways that prioritize their interests over those of the principals—namely, the investors. To mitigate this potential agency risk, investors typically demand a premium from capital users, thereby increasing companies' external financing costs.

In this context, corporate investment decisions are influenced not only by project funding requirements but also by the availability of internal capital. Given the lower cost associated with internal financing, firms often prefer to utilize internal funds to minimize additional burdens imposed by external financing. When external financing costs are elevated, these constraints can hinder firms from fully exploiting positive net present value investment opportunities; consequently inhibiting their overall investment activities.

The interplay between agency problems and information asymmetry underscores the growing importance of financing constraints in corporate investment decision-making. This theoretical framework enhances our understanding of how corporate financing behaviour interacts with investment decisions while providing a robust foundation for future research and illuminating the core impact of capital market imperfections on corporate investments and financial activities.

Through a systematic review of the literature on financing constraints, it has been observed that the presence of information asymmetry, agency cost issues, and transaction costs contribute to the widespread occurrence of financing constraints across various types of enterprises, albeit to differing extents. Furthermore, the analysis indicates that Chinese companies operate within a market

environment characterized by lower levels of freedom and relatively limited financial instruments compared to their Western counterparts. In this context, banks serve as the primary—if not exclusive—channel for financing for many firms.

In light of China's highly monopolized financial system, banks have emerged as the most significant source of credit for enterprises. During the lending process, these institutions exhibit tendencies toward "ownership discrimination" and "scale discrimination." Specifically, banks are more predisposed to extend loans to state-owned enterprises and large corporations while imposing greater financing constraints on private enterprises and small- to medium-sized enterprises (SMEs). This disparity places private firms and SMEs at a distinct disadvantage in accessing capital resources, thereby exacerbating their financing challenges and constraining their competitiveness and sustainable development within the market.

CHAPTER 3 Theoretical Analysis and Research Hypotheses

3. 1 Theoretical Analysis

3. 1. 1 Stakeholder Theory and Innovation Performance

The origins of stakeholder theory can be traced back to the 1960s, emerging slightly later than the concept of CSR. However, until the 1980s, shareholder primacy theory remained the dominant perspective in both academic and practical contexts. Proponents of shareholder primacy contended that shareholders, as owners of the company, wielded absolute control over corporate decisions and were entitled to reap ultimate benefits.

As time progressed, companies expanded in size and globalization accelerated, leading to a gradual erosion of material capital owners' influence within corporate governance. Concurrently, an increasing number of scholars began re-evaluating corporate governance models in search of more diverse and inclusive theoretical frameworks. Against this backdrop, stakeholder theory began to emerge and evolve.

Following the 1980s, a plethora of new ideas and perspectives surfaced within both academia and industry, propelling the continuous evolution of stakeholder theory. This framework posits that a company should not solely act as an agent for shareholder interests but also consider the needs and expectations of other stakeholders—including employees, customers, suppliers, communities, and the environment. It advocates that by balancing and harmonizing various parties' interests, a company can achieve sustainable development and long-term value creation.

The advancement of stakeholder theory signifies a substantial shift in corporate governance philosophy—from a singular focus on shareholder interests to a comprehensive consideration of multiple stakeholders' needs. The introduction and evolution of this theory have enriched the theoretical foundation underpinning corporate governance while providing new guiding principles and operational frameworks for businesses in practice—thereby promoting deeper implementation of corporate social responsibility alongside sustainable development.

It is noteworthy that, through a review of relevant literature, the author of this paper has identified that Chinese scholars commenced their exploration of stakeholder theory approximately 10 to 20 years later than their counterparts in other developed Western nations. During the 1990s, when stakeholder theory had already emerged as a prominent research topic abroad, most Chinese scholars remained focused on mainstream corporate theories, particularly emphasizing shareholder primacy.

In Western countries, stakeholder theory began to attract significant attention in the 1980s and

quickly evolved into a vital area of corporate governance research. Conversely, throughout the 1990s, much of the academic inquiry in China continued to centre around shareholder primacy theory, with limited engagement with stakeholder theory. This lag in scholarly activity can be attributed to both the economic system and the stage of corporate development prevalent in China at that time.

Despite this delayed initiation into stakeholder discourse, China's rapid economic growth and accelerated globalization have fostered an increasing interest among Chinese scholars regarding stakeholder theory. In recent years, there has been a notable rise in research focusing on how to balance diverse interests within corporate governance frameworks—aiming for sustainable development and long-term value creation for enterprises. This shift not only signifies a gradual alignment between Chinese academia and international cutting-edge theories but also offers new theoretical insights and practical guidance for enhancing the competitiveness of Chinese enterprises within the global market.

Currently, one of the most influential interpretations of stakeholder theory is attributed to R. Edward Freeman (1984). He examines this concept through the lens of a company's social network and strategic management, defining stakeholders as individuals, groups, or organizations that are affected by a company’s strategic decisions and, in turn, influence the formulation of those strategic objectives. These stakeholders encompass customers, suppliers, shareholders, employees, and the broader community.

Freeman's explanation emphasizes the bidirectional nature of the relationship between a company and its stakeholders. This relationship is characterized by mutual influence: a company's strategic decisions impact stakeholders' interests and behaviours while stakeholders’ needs and feedback significantly shape the company’s strategic goals and decision-making processes. This interdependence and reciprocal influence constitute the core tenets of stakeholder theory.

From Freeman's definition, it becomes evident that stakeholder theory not only concentrates on internal management practices and shareholder interests but also underscores a company's role and responsibilities within an expansive social network. A company's success hinges not solely on its internal strategies but also on its effective engagement with various stakeholders. This theory provides companies with a more comprehensive framework for formulating and implementing strategies while highlighting the necessity to balance economic interests with social responsibilities and sustainable development.

Freeman's stakeholder theory carries significant practical implications for corporate management. It urges corporate managers to take into account the interests of various stakeholders and to balance these needs when developing strategies, thereby fostering long-term value creation and sustainable development for the organization. This theory has attracted considerable attention within academic circles and has been increasingly applied and validated in real-world corporate management practices.

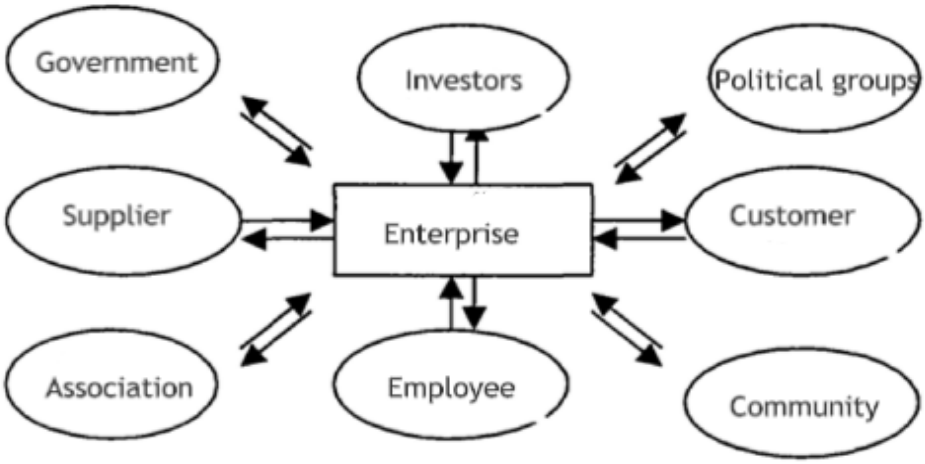


Figure 3 Interest-correlated model

Source: Donaldson, T., & Preston, L. E. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *The Academy of Management Review, 20*(1), 65-91.

Donaldson and Preston's (1995) stakeholder model (see Fig. 3), proposed in 1995, provides a vital theoretical framework for understanding the operations of contemporary enterprises. This model underscores that companies are not merely agents of shareholder interests; they must also consider the needs and expectations of various stakeholders. These stakeholders include but are not limited to, investors, suppliers, customers, employees, communities, and governments—each playing a pivotal role in the long-term development of the enterprise.

In an era characterized by globalization and informatization, the business environment has become increasingly complex and dynamic. To thrive within such a context, companies must learn to establish and maintain robust relationships with diverse stakeholders. Specifically, while pursuing profit maximization, firms should focus on securing expected returns for investors by ensuring both the safety and profitability of their investments; fostering sustainable development among suppliers to guarantee stability and efficiency within the supply chain; enhancing customer satisfaction as well as employee engagement through improved product quality and service delivery; committing to community environmental protection in alignment with corporate social responsibility; and adhering strictly to governmental laws and regulations to ensure lawful operations.

Consequently, companies need to adopt a more open and inclusive approach in their strategic planning and operational management processes. This involves actively listening to—and responding appropriately to—the perspectives of all parties involved. Through cooperation, dialogue, and transparent communication practices, organizations can build trust and consensus among stakeholders thereby facilitating mutually beneficial outcomes.

Moreover, according to Wernerfelt's (1984) resource-based theory, a company's competitive advantage significantly hinges on its capacity to acquire and effectively utilize external resources. These resources encompass but are not limited to, raw materials, technology, information, talent, and market access—elements that often cannot be secured solely through the efforts of the company

itself. Consequently, companies must cultivate close cooperative relationships with stakeholders to obtain these critical resources through mutually beneficial collaborations.

In the realm of corporate innovation activities, the resources and support provided by stakeholders play an essential role. Innovation necessitates considerable investments in capital, talent, knowledge, technology, and market insights—often surpassing the capabilities of any single enterprise. By collaborating with suppliers, research institutions, customers, and governmental entities, companies can secure vital funding sources as well as new ideas and technical support while also identifying market opportunities that drive innovation forward.

In summary, while pursuing economic benefits, companies must also prioritize their relationships with various stakeholders. They should seek strategies that balance the interests of all parties and acquire the resources necessary for innovation activities through collaboration with these stakeholders. This bidirectional relationship management not only facilitates sustainable development for companies but is also crucial for maintaining competitiveness in the global market. From the perspective of stakeholders, firms that actively engage in CSR are more likely to establish robust bilateral cooperative relationships with stakeholders. Consequently, this can lead to increased financial and resource support, thereby enhancing corporate innovation performance.

3. 1. 2 Corporate Social Responsibility and Innovation Performance

As discussed in the preceding literature review, the academic community widely acknowledges that the concept of CSR emerged in the 20th century. Bowen (1953) was the first to articulate the social responsibility of business leaders in the 1960s, signifying the inception of CSR as a distinct area of research. Subsequently, with an increasing awareness of social responsibility and advancements in globalization, a growing number of scholars began to focus on CSR. This shift led to a transition in research emphasis from individual entrepreneurs to entire enterprises, thereby fostering the ongoing development and refinement of CSR theory.

The essence of CSR theory lies in the pursuit of a balance between corporate interests and societal benefits. This framework posits that enterprises should not solely focus on profit maximization but also take into account their impact on society. In China, the Confucian principle that "wealth should benefit the world" is deeply embedded in cultural values, prompting companies to actively engage in social welfare initiatives while striving to achieve their economic objectives. This sense of responsibility not only enhances a company's public image but can also yield long-term economic advantages. For instance, during the severe flooding in Henan Province in 2021, the Chinese brand Hongxing Erke responded to calls for assistance by donating supplies valued at 50 million RMB to affected areas. This act of generosity received widespread acclaim from internet users and favourable media coverage, significantly bolstering Hongxing Erke's brand reputation. Consumers are increasingly inclined to support companies that proactively fulfil their social responsibilities; this

inclination subsequently drives up product sales. This case exemplifies the positive interplay between corporate social responsibility and commercial interests, suggesting that companies can attain sustainable development while meeting their societal obligations. Therefore, it is imperative for enterprises to incorporate social responsibility into their strategic planning processes to foster mutual advancement for both themselves and society as a whole.

Under the auspices of the "Building a Beautiful China" policy, Chinese companies are presented with significant opportunities for transformation and upgrading. By optimizing production capacity structures and enhancing industrial chains, companies can not only fulfil their social responsibilities regarding environmental protection but also provide employees with improved working conditions. This strategic initiative holds considerable importance in achieving ecological protection and carbon neutrality goals while simultaneously injecting new vitality into the long-term development of enterprises.

In this transformative process, enhancing enterprise innovation performance is particularly critical. The pharmaceutical and biotechnology sectors can achieve cost savings by adopting advanced technologies while allocating more resources to research and innovation, thereby bolstering market competitiveness. The integration of digital technologies—such as artificial intelligence, big data analytics, and cloud computing—has emerged as a pivotal force in advancing innovation performance within pharmaceutical and biotechnology firms. These technologies not only streamline the innovation process but also expedite product iteration and enhance service efficiency.

Furthermore, research on enterprise innovation performance within the context of digitalization is experiencing rapid advancement. Scholars are investigating how digital transformation can reshape corporate innovation models and promote comprehensive research through interdisciplinary integration alongside the mature application of emerging technologies. Such studies offer a range of strategies and recommendations for organizations aiming to improve their innovation performance.

Although the prevailing perspective posits that CSR is essential for the long-term sustainability of businesses, there exists a contingent of scholars who advocate alternative viewpoints. They contend that a company's primary obligation is to maximize shareholder value; consequently, firms should concentrate on CSR initiatives that directly enhance profit growth. From this standpoint, excessive investment in CSR may divert attention from core business operations, escalate unnecessary operational costs, and ultimately detrimentally affect the company’s financial health and profitability. These critics assert that the allocation of corporate resources ought to prioritize augmenting shareholder value over pursuing expansive social responsibilities.

Although there is ongoing debate regarding CSR, its significance has become increasingly apparent in contemporary society. Companies should not solely focus on economic gains; they must also consider the implications of their activities on both society and the environment. In practice, businesses are required to evaluate the interplay between profit maximization and social responsibility,

striving for an appropriate equilibrium that fosters sustainable development. As global awareness of CSR continues to escalate, it has emerged as a vital element of corporate strategic planning and is essential for the long-term success and sustainability of enterprises.

3. 1. 3 The Mediator Variable Role of Financing Constraints

In the practical financial environment, pharmaceutical manufacturing companies encounter a myriad of challenges when seeking financing, particularly external financing, due to the inherent incompleteness of capital markets. These challenges encompass information asymmetry, transaction costs, and barriers to transactions—factors that significantly elevate the cost of financing for these companies and exacerbate cash flow difficulties. Such constraints hinder pharmaceutical manufacturers from allocating adequate funds toward critical projects, thereby adversely affecting their innovative capacities. Access to financing is vital for fostering innovation within pharmaceutical firms, especially among young and small enterprises where inadequate funding directly jeopardizes their developmental prospects. When financing constraints are excessively stringent, companies may struggle to secure the necessary resources for effective investment; this not only diminishes production efficiency but also undermines sustainable growth.

According to the theory of information asymmetry, pharmaceutical manufacturing firms are likely to invest in long-term, capital-intensive innovation projects only when they experience lower levels of financing constraints. This investment process generates numerous development opportunities for these organizations—particularly pertinent in an innovation-driven sector like pharmaceuticals where development and innovation are intricately linked. The failure to capitalize on such opportunities not only results in lost potential market share but may also detrimentally impact overall innovation performance, placing the company at a competitive disadvantage within its industry.

Moreover, as the Chinese government increasingly prioritizes environmental protection, innovation, and healthcare development, pharmaceutical manufacturing companies are encountering urgent pressures for industrial upgrades in alignment with national policy directives. While this policy landscape presents opportunities for these companies, it simultaneously introduces significant challenges. If a company's financing constraints are excessively high, even firms with robust capabilities may find themselves at a disadvantage in the market. This diminished competitiveness renders companies more susceptible to fluctuations in a rapidly evolving market environment, further impeding their access to financing and leading to a vicious cycle that continuously undermines their innovative capacities.

In the field of academia, there is an increasing consensus that corporate social responsibility CSR can play a significant role in alleviating financing constraints. Numerous studies have demonstrated that when companies engage in CSR activities, they can enhance their reputation and strengthen trust-based relationships with stakeholders, thereby mitigating financing challenges. However, a

systematic review of the existing literature indicates that merely perceiving CSR as a resource yields limited effects on both financing constraints and corporate innovation performance. This finding suggests that the influence of CSR extends beyond mere resource provision; it also encompasses its mediating effect between financing constraints and innovation performance. Consequently, employing financing constraints as a mediating variable facilitates a more profound exploration of the mechanisms through which CSR impacts corporate innovation, offering valuable insights for both theoretical frameworks and practical applications.

3. 1. 4 The Moderating Role of Debt-to-Equity Ratio

The debt-to-equity ratio (D/E) is a frequently utilized key indicator in corporate financial reporting. It serves as a critical metric for investors and financial institutions to assess a company's financial leverage and risk profile. Investors and banks typically reference the D/E ratio to evaluate the extent of a company's reliance on external funding, which subsequently influences investment opportunities. Generally speaking, a higher D/E ratio indicates greater dependence on borrowing, increased financial leverage, and heightened financial risk. Consequently, the D/E ratio plays an essential role in investment decision-making, affecting the credibility and attractiveness of companies to potential investors.

3. 2 Research Hypothesis

Based on the theoretical analysis in the above section of this paper, the following three hypotheses are proposed:

H1: There is a positive correlation between "Pharmaceutical and Biotech companies' active fulfilment of corporate social responsibility and the enhancement of their innovation performance.

H2: Actively engaging in CSR initiatives can alleviate financing constraints for pharmaceutical manufacturing companies, thereby fostering enhancements in their innovation performance.

H3: The debt-to-equity ratio negatively moderates the impact of corporate social responsibility on innovation performance.

CHAPTER 4 Research Design

4. 1 Sample Selection and Data Sources

4. 1. 1 Refinement of Data Sample Selection

This study employs data from pharmaceutical companies listed on the Shanghai and Shenzhen A-shares between 2010 and 2020. To enhance the validity and rigour of the empirical analysis, the following data processing steps were undertaken: first, we excluded data from ST and *ST companies; second, we removed information related to veterinary medicine and pharmaceutical retail firms; finally, we eliminated companies with incomplete datasets. These measures ensure both the reliability of the data and the accuracy of our research findings.

4. 1. 2 Data Source

The CSR evaluation metrics are sourced from CSR reports of listed companies published by Hexun. Patent data is obtained from the China Research Data Service Platform(CNRDS), while all other data are sourced from the CSMAR database.

4. 2 Variable Design

4. 2. 1 Dependent Variable

After a comprehensive review of relevant domestic and international literature, it is evident that the academic community primarily employs two methods to measure corporate innovation performance. The first method assesses innovation performance through the number of patents filed by a company within a given year, as patent data directly reflects a firm's innovation activity and research outcomes. The second method evaluates innovation performance by the proportion of new product sales revenue to the company's total operating revenue, focusing on the market performance and commercial value of innovative outputs.

While the second method has advantages in assessing the market impact of innovation, patent data offers superior continuity and universality in measuring innovation performance. Patent data not only reflects the innovation output of a company but is also more accessible and quantifiable. Therefore, in this study, following the approach of other scholars, the number of patent applications filed by a company in a given year is chosen as a proxy indicator for measuring corporate innovation performance.

To ensure the accuracy and reliability of the data, patent data in this study is sourced from the

China Research Data Service Platform (CNRDS), a widely used database in academic research that provides micro-level data on enterprises, including listed companies. When utilizing this data, the number of patent applications will be log-transformed to mitigate skewness and approximate a normal distribution, facilitating empirical analysis.

4. 2. 2 Independent Variable

Based on stakeholder theory, CSR encompasses the obligations and duties that a company owes to its internal stakeholders—such as shareholders and employees—as well as external stakeholders, including community residents, consumers, society at large, and the environment. These responsibilities not only involve safeguarding the rights of shareholders and employees but also extend to commitments toward the community, consumers, and environmental sustainability.

To evaluate how effectively companies meet these responsibilities, Hexun has developed a CSR evaluation system. This system emphasizes stakeholder interests and employs a series of indicators to assess a company's performance in terms of social responsibility. The indicators include environmental protection measures, employee rights safeguards, community relations initiatives, and consumer rights protections.

In this paper, we draw upon existing literature from other scholars to select the overall score from Hexun's *Listed Companies Social Responsibility Report* for the years 2010 to 2020 as our explanatory variable for CSR.

4. 2. 3 Mediator Variable

Financial constraints represent a critical factor influencing corporate operations, particularly within the context of publicly listed companies. Several indices are commonly used to measure these constraints, including the Kaplan-Zingales (KZ) Index, the Fazzari-Hubbard-Petersen (FC) Index, the Whited-Wu (WW) Index, and the Hadlock-Pierce (SA) Index. Each of these indices offers a distinct perspective on the financial limitations encountered by firms.

Following an extensive review of existing literature and taking into account data accessibility as well as computational convenience, this paper selects the FA Index as a proxy for financial constraints. This choice is especially pertinent for analyzing pharmaceutical companies listed on China's A-share market. The FA Index has been selected due to its appropriateness in capturing specific financial dynamics and constraints prevalent within this sector, thereby providing a robust measure for empirical analysis.

4. 2. 4 Moderator Variable

The Debt-to-Equity Ratio is commonly used to demonstrate the proportion of debt in a company's capital structure, reflecting the relationship between debt and equity financing. This ratio directly impacts the decision-making and investment strategies of the company's top management. Specifically, a higher Debt-to-Equity Ratio may indicate a greater reliance on debt financing, which could increase financial risk but also potentially enhance financial leverage. Conversely, a lower ratio might suggest that the company prefers equity financing, thereby reducing financial risk.

For investors and financing institutions, the Debt-to-Equity Ratio is a crucial indicator for assessing a company's financial health and risk level. When making financing decisions, they carefully consider this ratio to evaluate the company's debt repayment capability and sustainable development potential.

In this paper, we utilize the Debt-to-Equity Ratio as a moderator variable to examine whether CSR can influence the Debt-to-Equity Ratio, thereby affecting the innovation performance of pharmaceutical companies. Through this analysis, we aim to uncover the potential mechanisms by which CSR impacts a company's capital structure and its pathways of influence on corporate innovation activities.

4. 2. 5 Control Variable

In order to mitigate the influence of extraneous factors on the results of this paper, which controls for variables that may affect corporate innovation performance. Drawing upon relevant research findings from other scholars, this paper ultimately selects the following seven variables that exhibit a high correlation with corporate innovation performance as control variables:

Year of the listed company (AGE), Innovative R&D investment (RD), Enterprise revenue growth rate (ROE), Asset liability ratio (LEV), Enterprise Growth (GROW), Proportion of independent directors (InDep), Whether the enterprise is state-owned or not (SOE).

At the same time, during the model construction process, time-fixed effects and industry-fixed effects were incorporated to minimize the influence of other variables.

Table 1 Names, symbols, and definitions of the main variables

Variable Types	Variable Name	Variable Symbol	Variable Definition
Dependent Variable	innovation performance	PI	Number of patents applied by enterprises
Independent Variable	Corporate Social Responsibility	CSR	

Table 1 Names, symbols, and definitions of the main variables (continued)

Variable Types	Variable Name	Variable Symbol	Variable Definition
			Hexun
Mediator variable	Financial Constraints	FC	Fazzari-Hubbard-Petersen (FC) Index
Moderator Variable	Debt-to-Equity Ratio	DER	Debt-to-Equity Ratio
Control Variable	Year of the Listed Company	AGE	Natural logarithm of (current year minus listing year plus 1)
	Innovative R&D Investment	RD	R&D innovation investment divides operating revenue
	Enterprise Revenue Growth Rate	ROE	Net profit divided by average balance of shareholders' equity
	Asset Liability Ratio	LEV	Total liabilities at year-end are divided into total assets at year-end
	Enterprise Growth	GROW	Current year's operating income divide previous year's operating income minus 1
	Proportion of Independent Directors	InDep	The number of independent directors of the enterprise/the total number of directors of the enterprise
	State-Owned Enterprise	SOE	Whether the enterprise is state-owned or not

4. 3 Empirical model construction

To test the three hypotheses proposed in this paper, and drawing on the research of other scholars, we constructed an empirical model using time and industry-fixed effects. The fixed effects model is specified as follows: θ_i represents industry fixed effects, θ_t represents time fixed effects, and ε_{it} is the random error term. This model helps mitigate the endogeneity issues caused by omitted variables to some extent.

Drawing on the research findings of numerous scholars, this paper constructed Model (1) to verify the positive impact of CSR on firm innovation performance, specifically addressing Hypothesis 1 of this paper.

$$PI_{i,t} = \alpha_0 + \alpha_1 CSR + \alpha_i \Sigma Control + \theta_t + \theta_i + \varepsilon_{it} \quad (1)$$

To verify the mediating role of financing constraints, this paper adopts the mediation effect testing steps proposed by scholars such as Wen Zhonglin (2004) and constructed Model (2) and Model (3) to test Hypothesis 2.

$$FC_{i,t} = \alpha_0 + \alpha_1 CSR + \alpha_i \Sigma Control_{it} + \theta_t + \theta_i + \varepsilon_{it} \quad (2)$$

$$PI_{i,t} = \alpha_0 + \alpha_1 CSR + \alpha_2 FC + \alpha_i Control_{it} + \theta_i + \varepsilon_{it} \quad (3)$$

Finally, in order to verify the moderating role of D/E in CSR affecting corporate innovation performance, Model (4) is constructed based on Hypothesis 3 proposed in this paper.

$$PI_{i,t} = \alpha_0 + \alpha_1 CSR + \alpha_2 FC + \alpha_3 DER \times CSR + \alpha_i Control_{it} + \theta_i + \varepsilon_{it} \quad (4)$$

CHAPTER 5 Empirical Analysis

5. 1 Descriptive Statistics

Table 2 Descriptive statistics

Variable	N	Mean	P50	SD	Min	Max
PI	1735	2.541	2.639	1.382	0	6.267
CSR	1735	26.62	24.88	14.24	-10.17	87.02
FC	1735	0.541	0.570	0.266	0.000503	0.984
DER	1735	0.622	0.379	0.815	0.0282	7.482
RD	1735	0.0247	0.0203	0.0192	0	0.114
Age	1735	2.021	2.197	0.890	0	3.332
Lev	1735	0.305	0.275	0.186	0.0274	0.882
ROE	1734	0.104	0.104	0.101	-0.738	0.407
Growth	1734	0.174	0.143	0.302	-0.589	3.808
SOE	1735	0.230	0	0.421	0	1
Indep	1735	0.369	0.333	0.0486	0.273	0.571

After excluding ST, *ST data, and other missing data, a total of 1,735 sample observations were obtained. Before conducting empirical analysis, a basic descriptive statistical analysis of the samples was performed, with the results presented in Table 2.

The dependent and independent variables of this study were examined in detail. The dependent variable, the logarithm of the annual number of patent applications, exhibited a large standard deviation, with a maximum value of 6.267 and a minimum value of 0. The mean was 2.45, indicating a left-skewed distribution across the sample. This suggests that, between 2010 and 2020, the annual patent applications by pharmaceutical manufacturing companies in China were generally low, reflecting weak innovation performance within the industry. This highlights significant potential for improvement and advancement in the future.

The core independent variable, CSR, showed considerable variability among the sample companies, with a maximum value of 87.02 and a minimum of -10.17. The wide range indicates a high degree of dispersion in CSR data within the biopharmaceutical sector, suggesting substantial variability. Similar to corporate innovation performance, the mean CSR value also displayed a left-skewed distribution, indicating that overall CSR engagement among Chinese companies was low, with significant differences in CSR practices between individual firms.

The mediating variable, which proxies for corporate financial constraints (FC), ranges between 0

and 1. Higher values indicate greater financial constraints. Among the 1,735 observations, the minimum FC value was 0.0023 and the maximum was 0.973, also showing a wide range. The overall mean of FC values was right-skewed, indicating substantial variability in financial constraints across the sample during the 2010-2020 period, with many companies experiencing significant financial constraints.

The moderating variable, the debt-to-equity ratio (DER), also exhibited a wide range. However, its mean, median (P50), and standard deviation (SD) values were all below 1, suggesting that most of the observed samples had low leverage, indicating relatively high financial stability and flexibility.

5. 2 Correlation Analysis

Table 3 Correlation Coefficient

	PI	CSR	FC	RD	Age	DER	Lev	ROE	Growth	SOE	Indep	Top1
PI	1											
CSR	0.0687***	1										
FC	0.3173***	0.0887***	1									
RD	0.2691***	0.0562**	0.0545**	1								
Age	0.1940***	0.0059	0.5699***	0.1248***	1							
DER	0.0707***	0.1636***	0.5034***	0.1803***	0.3016***	1						
Lev	0.1965***	0.1520***	0.5682***	0.1192***	0.3911***	0.8448***	1					
ROE	0.0857***	0.4837***	-0.0056	0.1086***	0.1102***	0.1838**	0.1926***	1				
Growth	0.0440*	0.0924***	-0.0009	0.0124	0.1001***	0.0052	0.0078	0.2900***	1			
SOE	0.0359	0.1313***	0.2523***	0.2065***	0.3651***	0.2502***	0.2583***	-0.0414*	0.0975***	1		
Indep	-0.0002	0.0799***	-0.0229	-0.0072	0.0152	0.0481**	0.0546**	0.1077***	0.0025	0.0763***	1	
Top1	-0.0347	0.2010***	0.0062	0.0558**	0.1985***	0.1089***	0.1312***	0.1928***	0.0253	0.0570**	0.0496**	1

Prior to conducting the regression analysis, a correlation analysis of the sample data was performed to preliminarily evaluate the relationships among the variables. The Pearson correlation coefficient was utilized to quantify the linear associations between these variables, with significance levels indicated by asterisks. The correlation matrix for the variables is presented in Table 3.

Through correlation analysis, the correlation coefficient between the dependent variable, PI (corporate innovation performance, such as the number of patent applications), and the independent variable, CSR (corporate social responsibility), is 0.069. This result indicates a positive correlation between PI and CSR at the 1% significance level. This suggests that, from a preliminary analysis, a company's engagement in social responsibility may positively impact its innovation performance.

The relationship between the mediating variable, corporate financial constraints (FC), and the dependent variable, innovation performance (PI), was examined. The findings reveal that the correlation coefficient between FC and PI is -0.317, which is statistically significant at the 1% level. This indicates a negative correlation between financial constraints and innovation performance. In other words, as firms experience more severe financial constraints, their innovation performance tends to decline.

Additionally, the correlation coefficient between the independent variable, CSR, and the mediating variable, FC, is -0.89, which is significant at the 1% level. This finding indicates a negative correlation between corporate social responsibility and financial constraints. In other words, active engagement in social responsibility can potentially alleviate a company's financial constraints to some extent.

Among the control variables, the relationship between SOE, Indep and Top1 and the explanatory variable PI was not significant. The correlation between RD, Age, DER, Lev, ROE and PI was 1%, while the correlation between Growth and PI was 5%, and the correlation coefficient between these variables and PI was positive, which preliminarily judged that RD, Age, DER, Lev, ROE, Growth and PI were positively correlated.

It is essential to clarify that correlation analysis solely identifies the linear relationship between two variables, without considering the comprehensive effects of other potential factors. Consequently, correlation results cannot be interpreted as direct evidence of causation; they merely offer preliminary indications of a possible association. To comprehensively examine the intricate interactions among financial constraints, corporate social responsibility, and innovation performance, more rigorous regression analysis is necessary. Regression analysis allows for the control of other variable influences, thereby providing a more accurate depiction of causal relationships and underlying mechanisms.

5. 3 VIF Test

Table 4 VIF test

Variable	VIF	1/VIF
ROE	1.510	0.661
CSR	1.400	0.715
Age	1.370	0.731
SOE	1.280	0.782
Lev	1.280	0.782
Top1	1.130	0.884
Growth	1.120	0.892
RD	1.080	0.928
Indep	1.030	0.969
Mean	VIF	1.240

To evaluate the presence of multicollinearity among the variables, a Variance Inflation Factor (VIF) test was performed on the observed samples. The VIF value represents the inverse of tolerance; thus, a higher VIF indicates lower tolerance for an independent variable, suggesting a more severe multicollinearity issue. It is widely accepted that when the VIF exceeds 10, it signals a significant problem with multicollinearity that can substantially distort regression analysis outcomes.

According to the results of the VIF test presented in the table, all VIF values among the variables are above 1 but significantly below 10. This finding indicates that there is no substantial multicollinearity issue present among these variables.

Having established preliminary correlations between variables through correlation analysis and confirmed the absence of multicollinearity via the VIF test, we proceeded to conduct an empirical examination of the observed samples using multiple regression analysis.

5. 4 Empirical Analysis Results

Table 5 Regression Results of CSR and Innovation Performance

	(1)	(2)
	PI	PI
CSR		0.0122***
		(4.3680)

Table 5 Regression Results of CSR and Innovation Performance (continued)

	(1)	(2)
	PI	PI
RD	14.9281***	15.1917***
	(9.7865)	(9.8933)
Age	0.3205***	0.2990***
	(8.0113)	(7.4045)
Lev	1.6949***	1.7976***
	(9.1223)	(9.6719)
ROE	1.7618***	0.9845***
	(5.4056)	(2.7369)
Growth	0.0699	0.0878
	(0.6721)	(0.8621)
SOE	-0.0434	-0.0847
	(-0.5645)	(-1.1095)
Indep	-0.9111	-0.8980
	(-1.5351)	(-1.5341)
Top1	0.3309	0.1933
	(1.3608)	(0.7947)
Year	Control	Control
Industry	Control	Control
_cons	0.3641	0.2552
	(0.7317)	(0.5336)
N	1734	1734
R^2	0.261	0.271

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In the empirical regression analysis, this paper controls for year and industry fixed effects and employs robust standard errors to enhance the robustness of the results. According to the specifications of Model 1, Table 5 uses PI as the dependent variable to examine the impact of the independent variable CSR, along with various control variables on innovation performance.

The regression results indicate that the coefficient for CSR is 0.0122 and is significant at the 1% confidence level. This indicates a substantial positive linear relationship between CSR and IP, suggesting that increased investment in CSR can significantly improve a company's innovation performance, thereby supporting Hypothesis 1.

Table 6 The mediating effect of financing constraints

	(1)	(2)
	FC	PI
CSR	-0.0020***	0.0091***
	(-5.6824)	(3.3538)
FC		-1.5359***
		(-9.8271)
RD	-0.7497***	14.0402***
	(-2.6045)	(8.9621)
Age	-0.1287***	0.1013**
	(-20.0225)	(2.2117)
Lev	-0.6546***	0.7923***
	(-23.1680)	(3.8527)
ROE	-0.1549***	0.7467**
	(-2.7593)	(2.0165)
Growth	-0.0108	0.0711
	(-0.6421)	(0.6824)
SOE	0.0228*	-0.0496
	(1.8823)	(-0.6779)
Indep	-0.0258	-0.9376*
	(-0.2715)	(-1.6859)
Top1	-0.2255***	-0.1531
	(-6.4284)	(-0.6330)
Year	Control	Control
Industry	Control	Control
_cons	1.2650***	2.1981***
	(19.7876)	(4.3386)
N	1734	1734
R^2	0.531	0.312

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Based on Hypothesis 1, it has been confirmed that CSR has a positive linear impact on innovation performance. This study further explores the role of financing constraints as a mediating variable in this relationship. By referencing the mediation effect verification procedure of Wen Zhonglin, this paper constructs Models 2 and 3 to verify the mediating effect

of financing constraints between CSR and innovation performance.

Specifically, in Model (1), we use FC as the dependent variable to analyze the impact of CSR and other control variables. The results show that the coefficient of CSR is -0.0020 and is significant at the 1% level, indicating that CSR can effectively reduce a company's financing constraints.

In Model (2), we use innovation performance as the dependent variable. The results show that the coefficient of CSR is 0.091, significant at the 1% level, further confirming the positive impact of CSR on innovation performance. Meanwhile, the coefficient of the mediating variable, FC, is -1.5359, also significant at the 1% level. This indicates that financing constraints play a crucial mediating role in the positive linear impact of CSR on innovation performance.

In summary, companies can effectively reduce financing constraints by actively fulfilling social responsibilities, thereby obtaining more funds for investment in innovative projects. This finding not only confirms the direct impact of CSR on innovation performance but also reveals the key role of financing constraints in this process, enriching the understanding of corporate innovation mechanisms. Table 6 provides detailed results of the model verification, supporting the above conclusions.

Table 7 The moderating effect of debt-to-equity ratios

	(1)
	PI
FC	-1.6360***
	(-10.4386)
CSR	0.0117***
	(3.5784)
CSR*DER	-0.0074**
	(-2.2481)
DER	-0.2650***
	(-3.3769)
RD	12.9341***
	(8.3319)
Age	0.0713
	(1.5510)
Lev	2.2337***
	(6.6964)
ROE	0.9086**

Table 7 The moderating effect of debt-to-equity ratios (continued)

	(1)
	PI
	(2.4061)
Growth	0.0676
	(0.6479)
SOE	-0.0131
	(-0.1783)
Indep	-0.8271
	(-1.4815)
Top1	-0.1676
	(-0.7009)
Year	Control
Industry	Control
_cons	2.0896***
	(4.2641)
N	1734
R^2	0.325

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5. 5 Robust Test

To enhance the credibility and validity of the empirical research findings, this paper implements two robustness checks: substituting the dependent variable and shortening the study period, which consequently reduces the sample size.

5. 5. 1 Replace the Dependent Variable PI

To enhance the credibility of the empirical findings, this study conducts a robustness check by substituting the dependent variable. A review of relevant literature reveals that the annual number of patent applications and patent grants are commonly employed as proxies for innovation performance. Consequently, this study replaces the original dependent variable with the annual number of patent grants (PIA) for robustness testing, as illustrated in Table 8.

Results (1) to (4) indicate that when substituting the dependent variable with PIA, the regression outcomes for CSR and PIA remain consistent with those observed for CSR and the

annual number of patent applications. This consistency confirms that CSR continues to exhibit a positive correlation with firm innovation performance, wherein financing constraints serve as a mediating variable.

Result (5) demonstrates that when changing the dependent variable to PIA, the moderating effect of the Debt-to-Equity ratio DER becomes more pronounced. Specifically, while CSR*DER is significant at the 5% confidence level when measuring innovation performance through PI, it attains significance at the 1% confidence level when assessed via PIA. This finding indicates that D/E's moderating effect is more substantial when utilizing PIA as a proxy for innovation performance.

Table 8 Robustness test for replacing the dependent variable PI

	(1) PIA	(2) PIA	(3) FC	(4) PIA	(5) PIA
CSR		0.0122***	-0.0020***	0.0092***	0.0125***
		(4.5098)	(-5.6824)	(3.4932)	(4.1375)
FC				-1.4928***	-1.5809***
				(-9.4411)	(-9.9471)
CSR*DER					-0.0085***
					(-2.8669)
DER					-0.2224***
					(-2.9118)
RD	12.3964***	12.6605***	-0.7497***	11.5413***	10.4698***
	(8.5223)	(8.6249)	(-2.6045)	(7.6368)	(6.9565)
Age	0.3018***	0.2804***	-0.1287***	0.0882**	0.0605
	(7.7845)	(7.1552)	(-20.0225)	(1.9766)	(1.3470)
Lev	1.6878***	1.7907***	-0.6546***	0.8136***	2.2026***
	(8.8852)	(9.3970)	(-23.1680)	(3.8255)	(6.6796)
ROE	1.6179***	0.8391**	-0.1549***	0.6079*	0.8041**
	(5.1530)	(2.3080)	(-2.7593)	(1.6711)	(2.1462)
Growth	0.0005	0.0184	-0.0108	0.0022	-0.0029
	(0.0046)	(0.1896)	(-0.6421)	(0.0221)	(-0.0285)
SOE	-0.0714	-0.1127	0.0228*	-0.0786	-0.0444
	(-0.9395)	(-1.4936)	(1.8823)	(-1.0864)	(-0.6126)
Indep	-0.9435	-0.9304	-0.0258	-0.9689*	-0.8617
	(-1.6192)	(-1.6147)	(-0.2715)	(-1.7587)	(-1.5589)
Top1	0.5548**	0.4169*	-0.2255***	0.0803	0.0711

Table 8 Robustness test for replacing the dependent variable PI (continued)

	(1) PIA	(2) PIA	(3) FC	(4) PIA	(5) PIA
	(2.3648)	(1.7866)	(-6.4284)	(0.3444)	(0.3096)
Year	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control
_cons	0.1892	0.0802	1.2650***	1.9685***	1.8361***
	(0.4012)	(0.1762)	(19.7876)	(3.9169)	(3.7985)
N	1734	1734	1734	1734	1734
R^2	0.257	0.268	0.531	0.310	0.324

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5. 5. 2 Reduced Sample Size

At the end of 2016, the Central Committee of the Communist Party of China and the State Council released the *Healthy China 2030 Planning Outline*, which serves as an action plan for advancing the construction of a healthy China over the next 15 years. A core component of this initiative is the development of the health industry, with particular emphasis on the pharmaceutical sector. Consequently, this study narrows its sample period to 2017-2020 in order to conduct robustness checks and evaluate model reliability under government policy intervention. The regression results are presented in Table 9.

From Table 9, it can be observed that: (1) to (4) indicate that CSR consistently exerts a positive influence on corporate innovation performance, with coefficients increasing from 0.0122 to 0.230, significant at the 1% level. Financing constraints serve as a mediating effect; although there is a slight decrease in their coefficient, they remain significant at the same level. (5) is the robustness check regarding the moderating effect of Debt-to-Equity reveals that CSR*DER's coefficient shifts from -0.0074 to -0.0243, suggesting that Debt-to-Equity transitions from partial moderation to full moderation while also enhancing significance levels from 5% to 1%.

Table 9 Robustness test with reduced sample size

	(1) PA	(2) PA	(3) FC	(4) PA	(5) PA
CSR		0.0230***	-0.0041***	0.0166***	0.0281***

Table 9 Robustness test with reduced sample size (continued)

	(1) PA	(2) PA	(3) FC	(4) PA	(5) PA
		(3.5541)	(-3.0234)	(2.7699)	(3.8491)
FC				-1.5806***	-1.6826***
				(-7.7281)	(-8.3817)
CSR*DER					-0.0243***
					(-2.9656)
DER					-0.0705
					(-0.4141)
RD	14.9322***	15.3567***	-1.0239***	13.7383***	12.4269***
	(8.3236)	(8.4117)	(-2.8537)	(7.2942)	(6.6143)
Age	0.4866***	0.4749***	-0.1818***	0.1875***	0.1496**
	(8.9277)	(8.6141)	(-20.6572)	(2.8007)	(2.2582)
Lev	2.2224***	2.2819***	-0.5209***	1.4584***	3.2562***
	(8.2572)	(8.4726)	(-11.4807)	(5.2133)	(6.2323)
ROE	1.5446***	0.2958	-0.0204	0.2635	0.6774
	(3.9528)	(0.6159)	(-0.2300)	(0.5609)	(1.2841)
Growth	-0.0412	-0.0302	-0.0542**	-0.1158	-0.1602
	(-0.2223)	(-0.1664)	(-1.9742)	(-0.6423)	(-0.8814)
SOE	0.0972	0.0954	0.0365**	0.1531	0.2008*
	(0.8793)	(0.8685)	(2.0093)	(1.4615)	(1.8512)
Indep	-2.0145**	-1.8014**	0.1640	-1.5422*	-1.3893
	(-2.2388)	(-2.0179)	(1.1504)	(-1.8493)	(-1.6361)
Top1	0.2299	0.1072	-0.2688***	-0.3177	-0.4102
	(0.6326)	(0.2923)	(-4.7547)	(-0.8702)	(-1.1244)
Year	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control
_cons	0.4826	0.1735	1.2819***	2.1997***	1.9819***
	(0.6694)	(0.2496)	(13.9260)	(3.1819)	(3.0171)
N	796	796	796	796	796
R^2	0.331	0.340	0.476	0.387	0.404

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

CHAPTER 6 Discussion and Conclusion

6. 1 Discussion

This paper reviews and organizes the existing literature on CSR, financing constraints, and innovation performance. It integrates the current research context with theoretical analysis to thoroughly investigate the impact of CSR on innovation performance. Additionally, it verifies the mediating role of financing constraints and examines the moderating effect of the debt-to-equity ratio.

The study utilizes data from 2010 to 2020 for A-share listed pharmaceutical companies in China, employing the total CSR score from Hexun.com as the explanatory variable and the logarithm of patent applications as the dependent variable. The firm's financing constraints are treated as a mediating variable, while D/E is considered a moderating variable. Four multiple regression models are constructed to test three hypotheses presented in this paper.

Subsequently, robustness checks are conducted by altering the dependent variable and narrowing down the sample to include only data from 2017-2020, ensuring reliability in experimental results. Furthermore, this paper addresses limitations found in previous studies that often regarded D/E as a dependent variable when examining relationships between CSR and financial performance. In contrast, this study employs D/E as a moderating variable to explore interactions among CSR, firm financial indicators, and innovation performance.

In existing research, scholars have reached a relatively consistent consensus regarding the relationship between CSR and financing constraints. Cheng et al. (2021) have clearly articulated this relationship in their work. However, the interplay among CSR, financing constraints, and innovation performance has not been as thoroughly examined. Clarifying these interrelationships is essential for effectively addressing the challenges faced by Chinese pharmaceutical companies in reform and innovation, thereby enhancing their innovation performance. This exploration can also provide valuable insights for the development of other industries.

Overall, as outlined in the literature review of this paper, scholars currently hold differing opinions on the impact of active CSR engagement on corporate innovation. These perspectives include linear impacts, and U-shaped relationships, and some argue that CSR engagement may lead to resource wastage. Nevertheless, the results from multiple regression analyses conducted in this study support the notion that active CSR engagement by Chinese pharmaceutical companies is positively correlated with innovation performance at a significance level of 1%. This finding aligns with research conducted by Luo and Du (2015) in 2015. Additionally, Gallardo et al.'s (2019) analysis of Spanish firms indicated that companies actively engaging in CSR demonstrate superior innovative capabilities.

Certainly, this empirical analysis is grounded in stakeholder CSR theories. According to Smith's (2000) framework, active engagement in CSR during production and operational processes enables pharmaceutical companies to cultivate robust, long-term relationships with their stakeholders. Such proactive involvement in CSR can significantly influence innovation performance both internally and externally. As noted by Chinese scholar Chen Wan (2019), active CSR engagement facilitates the integration of diverse resources; when these resources are synergized with the company's capabilities, they collectively enhance innovation performance across multiple dimensions and levels.

Youcai Ma (2023) posits that within China's distinctive operational environment and regulatory framework, pharmaceutical companies seeking to fulfil CSR towards the ecological environment are likely to phase out outdated production capacities in favour of adopting more advanced technological methods. This initiative can enhance public and governmental acceptance of these companies, thereby securing additional resources and policy advantages, which creates a positive feedback loop.

Consequently, while striving to maximize economic value and profitability, companies should balance their relationships with various stakeholders by actively fulfilling relevant CSR obligations and improving their production and operational environments. This approach will facilitate access to optimal resources for innovation and development, ultimately promoting the innovative growth of these companies.

Most scholars generally support the perspective that "increased funding leads to enhanced innovation." However, the current financial environment in China presents considerable financing constraints for domestic pharmaceutical companies. This paper employs the firm's FC index as a proxy variable for these financing constraints and conducts an empirical analysis of the significant mediating effect of financing constraints on the relationship between CSR and corporate innovation performance. The final regression results are statistically significant at the 1% confidence level.

This finding suggests that pharmaceutical companies can mitigate their financing constraints by actively engaging in CSR initiatives, thereby indirectly improving their innovation performance. The empirical results align with those reported by Surroca et al., as well as Chinese scholars Leilei GU and Yan Ding (2020). Based on this analysis, it is evident that when Chinese pharmaceutical firms proactively fulfill their social responsibilities, they send positive signals to the market, enhance their reputation, reduce information asymmetry, and lower agency costs associated with financing.

These actions alleviate concerns from external angel investors and banks regarding corporate risk, effectively easing the financing challenges faced by pharmaceutical companies.

Consequently, these firms find it easier to secure funding for long-term innovation projects and subsequently enhance their overall innovation performance.

Rauf et al. (2024) emphasize in their study that debt-to-equity ratios can mediate the relationship between CSR and corporate innovation performance by influencing resource allocation within firms. Similarly, Guo et al. (2012) propose that a company's financial flexibility can help balance CSR activities with innovation investments, thereby enhancing overall performance. The empirical research presented in this paper finds that debt-to-equity ratios partially moderate the impact of CSR on innovation performance, with regression results significant at the 5% confidence level. Notably, this moderating effect is negatively correlated.

Referencing other scholars such as Costa and Fonseca (2022), it is evident that debt-to-equity ratios can influence the relationship between CSR and corporate innovation performance by affecting financial stress, risk tolerance, and access to external capital. According to the regression analysis results displayed in Table 7, when the D/E ratio is elevated, the positive impact of CSR on innovation performance may be constrained. This phenomenon could stem from increased financial leverage leading to diminished risk tolerance, prompting firms to adopt a more conservative approach toward project investments. Consequently, investors might exercise caution as well, which limits available funds for innovation and ultimately hampers corporate innovation performance.

Conversely, when a firm's financial health is robust—supported by empirical findings related to Hypothesis 1, CSR can more effectively drive improvements in innovation performance.

In summary, the empirical findings of this study are consistent with the proposed hypotheses. The results substantiate the positive influence of CSR on innovation performance within pharmaceutical companies. Furthermore, the study validates the mediating role of financing constraints in this affirmative relationship. When companies actively engage in CSR initiatives, they mitigate financing constraints, thereby facilitating increased investment in innovation activities and enhancing overall innovation performance. Additionally, the moderating effect of the debt-to-equity ratio suggests that an excessively high ratio may diminish the positive impact of CSR on innovation performance.

Based on this analysis and taking into account the current operational landscape for Chinese pharmaceutical companies, we propose the following recommendations for future development:

1. China is currently experiencing a pivotal phase of economic transition. At this critical juncture, if Chinese pharmaceutical companies aspire to achieve industrial upgrading, enhance their innovation performance, and improve both their innovation capacity and core

competitiveness, they must acknowledge the beneficial effects of actively engaging in Corporate Social Responsibility (CSR). Furthermore, these companies should prioritize the establishment of robust and trustworthy relationships with key stakeholders—including government entities, consumers, employees, suppliers, and investors.

2. Capital plays a central role in the development of any business; however, within the current financial landscape in China, pharmaceutical companies encounter challenges such as difficulties in securing financing and excessively high costs associated with it. Consequently, collaborative efforts among the Chinese government, pharmaceutical firms, and financial markets are essential to optimize the financing environment for the pharmaceutical industry. Additionally, governmental authorities should consider directing more favourable policies and allocating financial resources toward China's pharmaceutical sector when making economic decisions to bolster its growth.

3. For sustainable enterprise development, maintaining an appropriate debt-to-equity ratio is crucial. Nevertheless—as illustrated in Table 2—the R/D ratios of Chinese pharmaceutical companies remain relatively low. This situation presents an opportunity for these Chinese pharmaceutical firms within the manufacturing sector to capitalize on potential advancements.

The main limitations of this article are as follows:

1. Sample Size: This study only includes A-share listed pharmaceutical companies in China, excluding well-performing companies with excellent CSR practices. Some data omissions also reduced the representativeness of the study.

2. Regional Factors: The study does not account for regional economic disparities across China's vast territory, which might introduce bias in the results.

3. Innovation Performance Measure: Using patent applications as the sole measure of innovation performance may not accurately reflect the performance of companies with fewer patents or those that do not apply for patents.

4. Impact of "Internet + Healthcare": The study does not consider the effects of the emerging "Internet + Healthcare" model on CSR, especially as companies increasingly adopt online smart platforms in the era of big data and AI.

6. 2 Conclusion

In summary, this paper academically confirms the relationship between CSR and innovation performance and highlights the mediating and moderating roles of financing constraints and debt-to-equity ratios in this process. From a practical perspective, the findings offer new insights for the innovative development of pharmaceutical companies. Both the government and enterprises should consider the extent to which firms fulfil their CSR obligations and the

level of financing constraints they face when formulating policies aimed at maximizing development.

Furthermore, future research could focus on the following four aspects to clarify the relationship between CSR, financing constraints, and innovation performance:

1. In future studies, researchers could collect more influential corporate data and extend the research timeline to further refine the hypothetical model, making the empirical results more objective and representative.

2. Future research could focus on different provinces or regions, creating control groups of companies from various areas, to gain a deeper understanding of how varying levels of economic development impact the CSR activities of pharmaceutical companies. This would provide a multi-faceted exploration of the relationships between CSR, financing constraints, and innovation performance in pharmaceutical companies, making the findings more relevant for practical guidance.

3. A more detailed evaluation system of variable construction could be established, and multi-dimensional data could be gathered using methods such as questionnaires and interviews to improve the reliability of the research.

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