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DOES CORPORATE SOCIAL RESPONSIBILITY OF PHARMACEUTICAL MANUFACTURING ENTERPRISES DECREASE DEBT FINANCING COSTS? ECONOMIC IMPLICATIONS THROUGH A MODERATED MEDIATION MODEL

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Abstract. In today's complex economy, debt financing costs play a crucial role in shaping corporate competitiveness and are significantly shaped by stakeholder interests. This study focuses on the pharmaceutical manufacturing industry, exploring how Corporate Social Responsibility (CSR) affects the debt financing costs, with CSR further divided into strategic CSR and altruistic CSR. Drawing on the data of 286 pharmaceutical enterprises publicly traded on China's A-share market during the 2010–2021 period, we construct a moderated-mediation framework to examine the complex mechanisms by which CSR affects debt financing costs. The findings show that stronger CSR efforts are linked to decreased debt financing costs. Financial performance acts as a mediator in this relationship, while media attention serves as a moderator. Specifically, strategic CSR initiatives, enterprises that are privately-owned, companies positioned in the eastern areas of China, and strong medical regulation witness a more significant reduction in financing costs. Furthermore, we find that compared to other industries, the fulfilment of social responsibility by pharmaceutical manufacturing enterprises plays a more crucial role in the sustainable development of the enterprise. This study examines the mechanisms through which pharmaceutical manufacturing firms reduce debt financing costs by fulfilling Corporate Social Responsibility (CSR), contributing to understanding of CSR's economic value creation China's emerging economy context. By incorporating firm-level and regional economic variations, the research addresses a gap in the existing literature and provides insights for pharmaceutical companies to optimize their financing strategies and attain sustainable economic development in emerging economies.

Keywords: corporate social responsibility, debt financing costs, pharmaceutical manufacturing companies, moderated mediation model, financial performance, media attention.

JEL Classification: M14, O16, P43.

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1. Introduction

In recent years, the global pharmaceutical manufacturing industry has shown a strong growth momentum. According to data from Grand View Research, the global pharmaceutical market size reached 1,482 billion US dollars in 2022. It is expected that during the period from 2023 to 2030, it is projected to grow at an average annual compound growth rate of 6.12%, which is well above the expected growth rate of the global economy. China, ranked as the world's second-largest pharmaceutical consumption market, not only boasts a complete pharmaceutical industry chain but also continues to see significant improvements in the innovation ca-

pabilities of its domestic pharmaceutical manufacturing enterprises. Significant breakthroughs have been made in cutting-edge technologies such as multi-modal imaging and magnetic resonance monitoring, and China is gradually occupying an increasingly important position in the global pharmaceutical manufacturing industry.

The pharmaceutical industry is one of the most productive and profitable sectors, with an average gross profit margin nearly twice that of semiconductor companies (Chen & Chang, 2010). However, pharmaceutical manufacturing enterprises generally face challenges such as high costs, high investment, high risks, strict supervision, and long R&D cycles (Lilleoere & Holme Hansen, 2011). In addition, pharmaceutical manufacturing consumes energy, water, and raw materials, and the industry spends a significant amount of money annually on energy to maintain facility operations (Chaturvedi et al., 2017). Therefore, securing financial support is crucial for pharmaceutical manufacturing enterprises to establish a competitive edge and achieve long-term sustainability. Given the relatively underdeveloped capital market in China, debt financing remains the primary funding source for enterprises, despite its high associated costs (S. Zhang et al., 2018). Consequently, a comprehensive examination of strategies to minimize debt financing costs is essential not only for fostering the sustainable development of pharmaceutical manufacturing firms in China but also for offering critical insights that can enhance capital procurement efficiency and contribute to the stable advancement of the global pharmaceutical sector.

Traditional views suggest that businesses can gain a competitive advantage through methods such as quality management, supply chain management, and technological innovation (Simek et al., 2023). However, existing studies (Rodrigo et al., 2018; Fukuda & Ouchida, 2020; D. Li et al., 2022) indicate that implementing Corporate Social Responsibility (CSR) initiatives can not only promote the improvement of social welfare, but also effectively align the interests of stakeholders, create a more favorable business environment, and enhance the company's economic performance, such as increasing stock market returns (Bae et al., 2021). Research by Shen et al. (2023) and Fang et al. (2023) finds that companies actively fulfilling their Environmental, Social, and Governance (ESG) responsibilities can significantly drive their high-quality development process, thereby enhancing economic value. By integrating CSR practices, organizations not only address the expectations of diverse stakeholders but also create a conducive environment for sustainable growth, ultimately leading to improved fiscal results. Therefore, can pharmaceutical manufacturing enterprises enhance their profitability by actively fulfilling their social responsibilities, thereby reducing their debt financing costs and achieving sustainable development? This issue is worthy of in-depth exploration.

Currently, the academic literature has extensively examined the effect of corporate social responsibility on debt financing costs, but the conclusions are quite divergent. At the national level, the study by Hajiha and Sarfaraz (2014), which analyzed data from companies listed on the Tehran Stock Exchange (TSE) in Iran, found no notable relationship between CSR and the costs of debt financing. In contrast, Aleknevičienė and Stralkutė (2023), who analyzed listed companies in Scandinavia, concluded that CSR significantly contributes to reducing the expenses associated with debt financing. At the enterprise type level, Rosa et al. (2018) pointed out that listed non-financial enterprises in Europe that actively fulfill their CSR are more likely to be recognized by debt financiers; Dvorský et al. (2023), focusing on 1,090 small and

medium-sized enterprises (SMEs) in Central Europe, found that enterprises' implementation of CSR exerts a positive impact on their financial management; Y. Li et al. (2022) discovered that in China, the debt financing costs for enterprises in highly polluting sectors tend to decrease as their level of CSR fulfillment increases, with this impact being especially pronounced in the pollution-heavy industries; Kong (2023), based on the research of Chinese family enterprises, revealed that the impact of CSR fulfillment at different development stages on debt financing costs varies. These studies highlight the complexity of the relationship between CSR and debt financing costs, which is influenced by factors such as the country and the type of enterprise. However, there is limited research addressing the connection between CSR fulfillment and debt financing costs within the pharmaceutical manufacturing sector. This is particularly important given that the sustainable development of Chinese pharmaceutical companies exerts a pivotal impact on the global pharmaceutical industry.

Moreover, creditors often prioritize the fiscal stability and operational efficiency of enterprises to protect their investments and ensure they receive appropriate returns (Acharya & Ryan, 2016; Minnis & Sutherland, 2017). As a crucial, all-encompassing indicator of an enterprise's financial condition and operational outcomes (Zhou et al., 2021), financial performance is highly likely to play a crucial role in determining how corporate social responsibility fulfillment affects debt financing costs for pharmaceutical manufacturing firms.

Finally, given the special nature of the pharmaceutical manufacturing industry, especially as a field highly sensitive to public opinion, it is often widely concerned by the media (Bhaduri, 2018). For example, Turing Pharmaceuticals in the United States was deeply reported by the media due to the sharp increase in the price of AIDS drugs, and Baiyunshan Pharmaceutical and its subsidiaries in China were involved in issues such as interest transfer and price collusion, both of which triggered strong public doubts about the social responsibility and moral bottom line of pharmaceutical enterprises. Therefore, further investigation is needed to better understand how media attention influences the debt financing costs faced by pharmaceutical manufacturing companies.

Overall, this study primarily examines Chinese pharmaceutical manufacturing companies, delving into how their social responsibility initiatives influence debt financing costs, while also investigating the roles that financial performance and media coverage play in this relationship. Compared with past studies, this study has three potential contributions. Firstly, the extant literature reveals a multitude of divergent perspectives regarding the relationship where corporate social responsibility interacts with debt financing costs. This study endeavors to resolve these contradictions and accentuates the intricate nature of this relationship, which is shaped by a multitude of factors. By undertaking such an analysis, it proffers a novel perspective and research trajectory for the academic community, allowing them to penetrate deeper into the mechanisms through which this relationship manifests itself across diverse industry settings. Secondly, empirical investigations regarding the connection between corporate social responsibility and debt financing costs remain scarce within the pharmaceutical manufacturing industry. This study centers on pharmaceutical manufacturing enterprises of China, deeply analyzes the impact of their fulfillment of social responsibility on debt financing costs, filling this gap and providing a highly targeted perspective for enterprises in the industry to formulate financing strategies and social responsibility plans. Thirdly, previous

research has primarily concentrated on how Corporate Social Responsibility (CSR) directly impacts debt financing costs. In contrast, this study delves deeper into the influence of financial performance and media attention on this relationship, thereby enhancing our understanding of the intricate ways in which CSR impacts debt financing costs within the pharmaceutical manufacturing sector.

The remaining structure is outlined as follows: The theoretical background will analyze relevant literature from the perspective of stakeholders and propose corresponding hypotheses. The section on research aims, methodological approaches, and data sources will detail the variables, techniques, and models essential for attaining the study's objectives. The results and extensions section will present key empirical findings and conduct robustness, endogeneity, and heterogeneity tests. The conclusion will contrast and analyze the acquired findings against prior research, elucidate the key results, pinpoint the constraints inherent in the study, and put forward prospective avenues for subsequent research.

2. Conceptual and theoretical background

2.1. Corporate Social Responsibility (CSR)

CSR refers to various voluntary initiatives taken by companies in response to different stakeholders, such as customers, suppliers, regulators, employees, investors, and the community (Sheehy, 2015). This means that the concept of corporate social responsibility involves the duty of enterprises to take into account not just shareholders, but also stakeholders such as employees, consumers, and creditors, and to strive to create value for them (Carroll & Shabana, 2010). Different stakeholders have varying impacts on the sustainable business practices of a company (Shubham et al., 2018). For example, Schons and Steinmeier (2016) identified different performance outcomes of substantive and symbolic CSR actions based on the "stakeholder proximity" concept. Their findings suggest that internal stakeholders (with high proximity) value substantive actions, while external stakeholders (with low proximity) focus more on symbolic actions, as they can better interpret the company's motivations. Similarly, consumer awareness of a company's CSR involvement can influence their attitudes towards the company, thus indirectly affecting company performance (Schramm-Klein et al., 2016). An interesting phenomenon is that the American restaurant group helped the company overcome operational difficulties during the COVID-19 pandemic through the implementation of CSR strategies (Ou et al., 2021). Therefore, exploring the impact of CSR implementation on corporate sustainability from the perspective of stakeholders is of significant importance. According to Baron (2001), CSR can be divided into two dimensions based on stakeholders and objectives: Strategic CSR (SCSR) and Altruistic CSR (ACSR), a classification widely adopted in recent scholarly studies (Nave & Ferreira, 2019).

Strategic Corporate Social Responsibility (SCSR) aims to achieve the strategic business objectives of a company, which are believed to align with its optimal economic interests (Nave & Ferreira, 2019). To achieve these strategic business objectives, driving CSR initiatives must have clear business motives, often associated with the company's primary stakeholders (Kim & Ji, 2021). Therefore, in implementing SCSR, companies place high importance on their primary stakeholders, balancing their interests while enhancing business performance

(Kuokkanen & Sun, 2020). For instance, amid the pandemic, the digital food delivery service Grubhub implemented a CSR initiative aimed at achieving financial goals by investing $85 million in local restaurants through discounted transactions and increased advertising, thereby balancing interests between the company, merchants, and consumers. Hence, SCSR can influence a company's sustainable business practices and play a crucial role in its strategic planning (Vishwanathan et al., 2020).

Altruistic Corporate Social Responsibility (ACSR) aims to improve society regardless of whether a company gains economic benefits from these activities (Xie & Wang, 2022). For example, companies may provide free special job training for people with disabilities or even directly offer them employment opportunities. Therefore, ACSR advocates actions that enhance social welfare, such as charitable donations and community services. However, these actions do not directly improve the sustainable business practices of a company; they are altruistic in nature.

In conclusion, this research will explore the ways in which Corporate Social Responsibility (CSR) exerts an impact on debt financing costs, by examining the impact mechanisms taking into account the standpoints of Strategic CSR (SCSR) and Altruistic CSR (ACSR).

2.2. Corporate Social Responsibility (CSR) and debt financing costs in the pharmaceutical manufacturing industry

Corporate Social Responsibility (CSR) represents a key form of non-financial information and has been the subject of extensive research. However, there is still no concordance among scholars regarding the exact relationship between CSR and its influence on debt financing costs. For example, Y. Li et al. (2022) investigated the relationship between the performance of corporate social responsibility in China's high-polluting industries and the debt financing costs, finding an association in which enhanced CSR performance corresponds to decreased debt financing costs. Conversely, Ye and Zhang (2011), focusing on the social performance of CSR, explored how CSR affects debt financing costs in Chinese firms, revealing a "U"-shaped relationship. This indicates that the connection between CSR and debt financing costs varies depending on industry contexts and research perspectives, underscoring the necessity for comprehensive studies within specific contexts to thoroughly investigate these issues.

The pharmaceutical manufacturing industry, classified as a heavy polluting sector due to its high research and development demands and complex production cycles, relies significantly on substantial capital. At the same time, the pharmaceutical industry and healthcare systems are characterized by management complexity, with a focus on balancing effectiveness, efficiency, and sustainability goals (Aquino et al., 2018). This creates numerous challenges in both funding requirements and operational management for the industry. Environmental governance and market competition pressures contribute to this industry's high dependence on external funding. Debt financing has become the primary means for pharmaceutical manufacturers to obtain external capital. The primary difficulty facing sustainable operations in this industry is obtaining adequate external funding with minimized debt financing expenses.

Enhanced Corporate Social Responsibility (CSR) initiatives enable pharmaceutical firms to foster more enduring partnerships with stakeholders such as consumers, employees, and suppliers, ultimately optimizing stakeholder benefits and mitigating operational risks (Bae

et al., 2019). Consequently, lenders tend to reduce interest rates on debt for companies demonstrating superior CSR performance (Luo et al., 2019). Moreover, firms exhibiting stronger CSR performance frequently exhibit greater transparency in disclosing CSR activities, thereby mitigating the disparity in information available to the firm and its stakeholders (S. Xu et al., 2019). Lower levels of information asymmetry lead to reduced risk premiums demanded by creditors, resulting in lower corporate debt financing costs (Franco et al., 2016).

In addition, like the implementation of other strategies, the implementation of CSR is crucial for ensuring the successful achievement of goals (Fatima & Elbanna, 2023). Considering the diverse stakeholders and objectives faced by CSR practices, the subsequent phase will investigate how corporate social responsibility influences the pharmaceutical manufacturing sector's debt financing costs through two perspectives: Strategic CSR (SCSR) and Altruistic CSR (ACSR).

Strategic corporate social responsibility is a proactive strategic measure taken by organizations to gain a competitive advantage, emphasizing the integration of CSR initiatives into core business operations to meet stakeholder expectations (Yu & Liang, 2020; Beji et al., 2021). This approach not only promotes value chain activities within the company but also enhances external competitiveness (Vallaster, 2017). Pharmaceutical manufacturers encounter substantial market pressures, prompting them to prioritize improving product quality and safety to protect the interests of consumers and employees (Kuokkanen & Sun, 2020). In other words, when confronted with market challenges, pharmaceutical manufacturers are inclined to bolster the implementation of SCSR (Flammer, 2015). Implementing SCSR enables these companies to cultivate stronger stakeholder relationships (Rodrigo et al., 2018), enhance transparency, and facilitate more effective business operations. This practice creates a reputation safeguarding effect and could potentially alleviate the adverse effects of regulatory fines (Gong et al., 2021). Therefore, implementing SCSR in pharmaceutical manufacturing communicates a positive signal of good management to creditors, reduces information disparities, and encourages creditors to consider lowering the debt financing costs.

Altruistic CSR (ACSR) emphasizes integrating a company's core competencies with societal welfare, often involving sacrificing some profits to align with social interests, such as through charitable donations and advocating for environmental conservation. However, unlike stakeholders directly linked to corporate interests, ACSR does not have direct economic ties, thus its implementation does not directly impact business operations (Luo et al., 2022). Conversely, this form of CSR may impose certain resource expenditures on the company (Xie & Wang, 2022). In the fiercely competitive pharmaceutical manufacturing industry, companies face significant competitive pressures, especially concerning creditors who are primarily concerned with the company's operational performance. Therefore, in the short term, ACSR may not offer a clear signal to creditors regarding the company's risk, and a significant reduction in the debt financing costs of pharmaceutical manufacturing enterprises is improbable. Drawing upon the analysis presented above, this study formulates the subsequent Hypotheses:

H1: *In pharmaceutical manufacturing companies, Corporate Social Responsibility (CSR) has a significant negative impact on the debt financing costs.*

H1a: *In pharmaceutical manufacturing enterprises, Strategic Corporate Social Responsibility (SCSR) exerts a remarkable negative influence on debt financing costs.*

H1b: *In pharmaceutical manufacturing enterprises, Altruistic Corporate Social Responsibility (ACSR) has an insignificant impact on debt financing costs.*

2.3. Financial performance's mediating influence

Financial performance is a significant reflection of a company's overall strength, reflecting its operational capability, profitability, debt repayment ability, development potential, and risk management among other factors (Shu et al., 2019). In the current competitive landscape of pharmaceutical manufacturing companies entering an era of low-profit margins, strong financial performance not only indicates a sound production and sales model but also suggests effective safeguarding of future debt repayment capabilities. Therefore, creditors attach great importance to companies' financial standing. Since robust financial standing indicates the capacity to punctually pay interest and settle debts, it thus diminishes creditors' perception of risk, which in turn is closely related to debt financing costs. Consequently, they are more inclined to provide financing support to these pharmaceutical manufacturing companies with excellent financial performance on more favorable terms, such as decreased interest rates or more pliable financing agreements.

The association between a company's Corporate Social Responsibility (CSR) initiatives and its financial performance metrics has been widely explored, yet no consensus has been reached. On one hand, when companies tightly integrate social responsibility with their core business and strategy, known as Strategic Corporate Social Responsibility (CSR), it significantly enhances stakeholder satisfaction and helps balance the interests of the economy, environment, and society (Fonseca et al., 2020). This approach not only adds value to existing operations but also creates potential opportunities (Chen et al., 2018a). Studies indicate that in various sectors such as industry, agriculture, technology, and tourism, integrating social responsibility into core business operations can substantially boost financial performance (Okafor et al., 2021; Oh et al., 2017; Chen et al., 2018b; Haque & Ntim, 2020). Therefore, Strategic CSR helps companies gain competitive advantages and long-term value in market competition. By enhancing relations with stakeholders and fostering a favorable corporate standing and brand identity, Strategic CSR ultimately contributes to improved financial performance.

On the other hand, fulfilling social responsibility directly or indirectly increases company costs; for example, community service and charitable donations require substantial financial investment (Xia et al., 2019). These activities can generate a short-term negative impact on corporate financial performance. Research indicates that company resources are limited, and engaging in altruistic activities such as charitable donations (i.e., Altruistic Corporate Social Responsibility) leads to cash outflows and thus decreases financial performance (Oikonomou et al., 2014). Therefore, implementing Altruistic CSR can adversely affect financial performance due to increased costs.

From an overall perspective, fulfilling Corporate Social Responsibility (CSR) significantly elevates a company's public image, reduces regulatory risks, and builds competitive advantages, thereby promoting improved corporate performance. By fulfilling CSR, companies not only ensure the rights and interests of their stakeholders (Freeman et al., 2010) but also increase willingness to collaborate with high-performing businesses. Furthermore, companies

that focus on diversity, equal opportunities, and employee training often attract more talented employees, thereby enhancing production efficiency (H. Wang et al., 2016). Therefore, outstanding CSR performance contributes to improving relationships with stakeholders and subsequently enhances corporate financial performance. This situation encourages creditors to offer more favorable financing support to companies, especially pharmaceutical manufacturing firms facing intense market competition and long investment return cycles. Drawing upon the analysis presented above, this study formulates the subsequent Hypotheses:

H2: *In pharmaceutical manufacturing enterprises, financial performance acts as an intermediary in the relationship between Corporate Social Responsibility (CSR) and debt financing costs.*

2.4. Media attention's moderating influence

Research indicates that the implementation of CSR and effective communication with stakeholders can have a positive impact on organizational performance (Du et al., 2010). In the context of media as the dominant force in information dissemination, corporate CSR efforts can reach a wider audience through media coverage, thereby facilitating effective communication with stakeholders. Media also helps enhance the visibility and credibility of CSR communications, offering new avenues for engaging stakeholders and involving them in CSR initiatives (Yang & Basile, 2021). Consequently, media coverage significantly influences corporate governance (Ren et al., 2024).

The influence that media attention exerts on governance mainly unfolds via mechanisms like supervisory disclosure, reputation, and market pressure (Ren et al., 2024). Regarding supervisory disclosure mechanisms, media attention inherently functions as an external oversight and managerial mechanism. Media coverage can mitigate the absence of legal constraints by encouraging enterprises to adhere to their social responsibilities and governance obligations (An et al., 2023). Regarding reputation mechanisms, media coverage draws social attention, influencing corporate image and thereby promoting improved corporate behavior. From the standpoint of market pressure mechanisms, media attention exerts diverse pressures on corporate managers (Oliver et al., 2023), encompassing aspects such as achieving performance targets, environmental sustainability, fostering corporate innovation, shaping public opinion, promoting social responsibility, and enhancing internal governance. Overall, media attention significantly reduces information asymmetry and thereby generates positive governance effects. This effect not only prompts companies to take a more proactive approach in meeting their social responsibilities and enhances the efficiency of disseminating corporate information but also aids investors in making more accurate assessments of a company's actual operational capabilities and potential.

Pharmaceutical manufacturing companies, as industries prone to public opinion scrutiny, are profoundly influenced by media attention. Therefore, this study argues that media attention can to some extent affect the efficiency of corporate information dissemination. A higher quantity of media coverage can expand the channels through which information affecting investment decisions is transmitted, thereby enhancing its impact. Within the framework of this study's impact mechanism, financial performance represents operational information that more directly influences investor decisions. Thus, media attention has the potential to

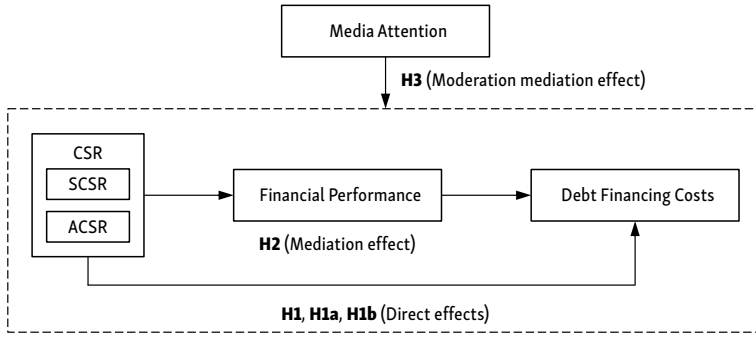

Figure 1. Conceptual framework and hypotheses

influence the way in which financial performance impacts the implementation and outcomes of corporate social responsibility initiatives. Drawing upon the analysis presented above, this study formulates the subsequent Hypotheses:

H3: *Media coverage serves as a moderating factor in the intermediary influence of financial performance.*

Based on the analysis of corporate social responsibility, debt financing costs, financial performance, and media attention as discussed above, we develop a theoretical model depicting the nexus between corporate social responsibility and debt financing costs, illustrated in Figure 1.

3. Methods and data

3.1. Model

To confirm the connection where corporate social responsibility exerts an impact on the debt financing costs, we developed Model (1).

$$DFC_{i,t} = \alpha_0 + \alpha_1 CSR_{i,t-1} + \alpha_2 Z_{i,t-1} + \mu_i + \gamma_t + \varepsilon_{i,t}, \quad (1)$$

where, $DFC_{i,t}$ represents the debt financing cost of enterprise (i) at time (t). $CSR_{i,t-1}$ denotes the corporate social responsibility score of enterprise (i) in period (t – 1). $Z_{i,t-1}$ represents control variables, including firm size, leverage ratio, enterprise growth, ownership nature, and enterprise age, all lagged by one period. The parameter (μ_i) signifies entity fixed effects, (γ_t) indicates period fixed effects, and ($\varepsilon_{i,t}$) denotes the Stochastic disturbance term.

Then we further analyze the impact of strategic Corporate Social Responsibility (CSR) and altruistic CSR on debt financing costs, constructing benchmark regression models as shown in Models (2) and (3).

$$DFC_{i,t} = \alpha_0 + \alpha_1 SCSR_{i,t-1} + \alpha_2 Z_{i,t-1} + \mu_i + \gamma_t + \varepsilon_{i,t}; \quad (2)$$

$$DFC_{i,t} = \alpha_0 + \alpha_1 ACSR_{i,t-1} + \alpha_2 Z_{i,t-1} + \mu_i + \gamma_t + \varepsilon_{i,t}, \quad (3)$$

where, $SCSR_{i,t-1}$ and $ACSR_{i,t-1}$ respectively denote the scores of strategic CSR (SCSR) and altruistic CSR (ACSR) of enterprise (i) in period (t – 1).

To examine the effect of Corporate Social Responsibility (CSR) performance on debt financing costs in pharmaceutical firms, with a specific focus on the mediating role of financial performance, this study employs the three-step mediation analysis framework developed by Baron and Kenny (1986). Following the approach outlined in their seminal work, we specify three regression models: Model 1 captures the overall impact of CSR on the costs of debt financing. Model 4 examines the link between CSR and the mediating factor, financial performance. Meanwhile, Model 5 evaluates the indirect effect via financial performance, while also controlling for the direct impact of CSR. This approach enables a comprehensive decomposition of the causal mechanisms, consistent with the corporate life-cycle theory of financial contracting.

$$ROA_{i,t} = \alpha_0 + \alpha_1 CSR_{i,t-1} + \alpha_2 Z_{i,t-1} + \mu_i + \gamma_t + \varepsilon_{i,t}; \quad (4)$$

$$DFC_{i,t} = \alpha_0 + \alpha_1 CSR_{i,t-1} + \alpha_2 ROA_{i,t-1} + \alpha_3 Z_{i,t-1} + \mu_i + \gamma_t + \varepsilon_{i,t}, \quad (5)$$

where $ROA_{i,t-1}$ represents the financial performance of enterprise (i) in the previous period ($t - 1$). If the coefficients in Models (4) and (5) are statistically significant, given that the coefficients in Model (1) are also significant, it suggests the presence of a mediating effect. If the coefficient in either Model (4) or Model (5) is not significant, additional Sobel testing is necessary.

3.2. Variable

(1) Dependent variable: Debt Financing Costs (DFC)

Debt financing costs denote the expenditures accrued by a company in acquiring funds through debt financing endeavors. These costs encompass the considerations of creditors regarding the enterprise's risk and credit assessment. Companies with strong operational capabilities and lower risk tend to have stronger debt-servicing capabilities and can often obtain lower financing costs.

According to G. Li and Liu (2009), the net financial expense index of a company is constructed using financial indicators to measure debt financing costs. Typically, a company's debt costs are reported under interest expenses in financial statements, but in practice, they also include transaction costs associated with debt financing. Moreover, in accounting terms, such as when a company uses installment loans to construct fixed assets, which essentially involve commercial credit, any unrecognized financing costs after completion are included in financial expenses. Therefore, debt financing costs are calculated by taking the ratio of a company's annual net financial expenditures to its total liabilities.

(2) Independent variable: Corporate Social Responsibility (CSR)

This study uses the Corporate Social Responsibility (CSR) score provided by Hithink Royal Flush Information Network (Hexun) to measure corporate social responsibility performance, implementing the methodology put forward by Gu et al. (2020). This indicator adopts a stakeholder perspective and covers five dimensions: the obligations towards shareholders, the commitments regarding employees, the duties to suppliers, the safeguarding of customer interests and consumer rights, environmental stewardship, and broader social responsibilities.

Among these dimensions, the responsibilities towards shareholders, employees, as well as those related to suppliers, customers, and consumer rights are effective in measuring Strategic Corporate Social Responsibility (SCSR). In contrast, environmental responsibility and social responsibility effectively measure Altruistic Corporate Social Responsibility (ASCR). A greater score is an indication of more favorable corporate social responsibility.

(3) Mediating variable: Financial Performance (FP)

This study utilizes Return on Assets (ROA) as an intermediate variable to investigate how Corporate Social Responsibility (CSR) influences debt financing costs by suggesting that a company's CSR initiatives impact its financial performance, thereby affecting its cost of debt financing. Market-oriented indicators are typically used to assess financial performance, as these metrics reflect current or future profitability prospects of a company. Therefore, ROA, ROE, and Tobin's Q are extensively utilized in studies concerning financial performance. In line with the methodology proposed by Aigbedo (2021), this research uses ROA as a measure to assess financial performance, with ROA computed as the company's after – tax net profit divided by its total assets.

(4) Moderating variable: Media Attention (MA)

Media attention can significantly influence corporate governance by drawing public scrutiny to corporate matters (B. Liu & McConnell, 2013). In the digital era, online publications have emerged as the predominant medium for media dissemination. Consequently, media attention is defined in this research as the scope of a company's coverage in online media, which is evaluated by taking the natural logarithm of the aggregate quantity of articles about the company on different online platforms.

(5) Control variable

To ensure model accuracy, we add supplementary control variables in accordance with established literature on debt financing costs. These variables are commonly recognized for their significant impact on explaining the costs of financing debt.

Firm Size (SIZE): Research consistently shows a negative correlation between firm size and anticipated returns. Smaller firms frequently encounter greater information asymmetry, while larger firms enjoy improved access to funding, leading to reduced costs of debt financing. However, larger firms with substantial asset bases may face challenges in adapting to rapid market changes, particularly in high research and development-intensive sectors such as pharmaceuticals, where product cycles and initial R&D investments contribute to sales uncertainty. Therefore, in regression models, the natural logarithm of total assets controls for firm size.

Mortgage ability (Mortgage): A strong mortgage capacity indicates that a firm possesses more assets available as collateral, thereby reducing the risk to creditors. This, in turn, generally lowers the debt financing costs, allowing the firm to secure funds at a more favorable interest rate. Adopting a method similar to that proposed by Zhao et al. (2023), this paper assesses mortgage capacity by using the ratio of fixed assets to total assets as the main metric.

Enterprise Growth (GROW): As highlighted by Cole and Sokolyk (2018), enterprise growth metrics reflect a company's developmental health. Typically, smaller firms exhibit higher growth rates, indicative of expansive market presence and enhanced debt repayment

capabilities, thereby lowering perceived risks. Creditors often offer lower interest rates to firms with higher growth rates as compensation for lower-risk investments. Therefore, in regression models, enterprise growth is controlled by measuring the ratio of the difference between current-period and previous-period total assets to previous-period total assets.

Ownership Nature (SOE): In China, ownership structure primarily consists of state-owned enterprises (SOEs) and privately-owned enterprises, with SOEs benefiting from richer resources, policy subsidies, and implicit credit guarantees. Conversely, privately-owned enterprises often face credit discrimination, resulting in higher loan rates compared to SOEs (G. Li & Liu, 2009). Therefore, ownership nature is controlled in regression models by assigning a value of 1 to SOEs and 0 to other ownership types.

Enterprise Age (AGE): Consistent with the life – cycle theory of corporate finance (Fama & French, 2002), older companies typically enjoy lower debt financing costs due to their established credit histories. To incorporate this factor into regression models, firm age is defined as the natural logarithm of the time span calculated by subtracting the company's registration year from the study year.

Two rights separation degree (SP): The market generally considers the extent of the separation of two rights to be a crucial signal. A higher degree of separation often conveys to the market that there may be potential governance risks within the company. Utilizing the approach put forward by S. Li et al. (2025), this study calculates the separation degree of the two rights in the following way: the control percentage under the ownership of the actual controller of the listed company is subtracted from the ownership percentage, and then the obtained difference is divided by the ownership percentage.

These variables are crucial for minimizing model misspecification and enhancing the robustness of our analysis regarding the factors influencing debt financing costs within the pharmaceutical industry.

Detailed descriptions of the variables are presented in Table 1.

3.3. Research sample and data sources

In light of the advancement of modern management paradigms, the role of Corporate Social Responsibility (CSR) within corporate governance has grown increasingly vital and has now become a key factor in achieving sustainable competitive advantage (McWilliams & Siegel, 2011). As resources consolidate, the daily lives of residents increasingly depend on products and services provided by large enterprises. This dependency is particularly pronounced in the pharmaceutical manufacturing sector, which profoundly impacts public health – an essential pillar of societal development. Therefore, studying CSR within pharmaceutical manufacturing is of paramount importance.

This study investigates how Corporate Social Responsibility (CSR) impacts debt financing costs within pharmaceutical enterprises. As an important component of the Chinese capital market, A-share listed companies have significant industry representativeness – their operational data and development trajectory can comprehensively reflect the overall ecosystem of the pharmaceutical manufacturing industry. Many scholars, such as Chen et al. (2018b), Gong et al. (2018), Peng et al. (2023), B. Wang et al. (2024), and others have explored CSR-related issues based on data from A-share listed companies. Therefore, this study focuses

Table 1. Specification of variable definitions

Type	Variable	Symbol	Measurement
Dependent variable	debt financing costs	DFC	(interest expense + fees + other property costs)/total liabilities*100%
Independent variables	corporate social responsibility	CSR	Sourced from Hexun.com data 2010–2021
	strategic corporate social responsibility	SCSR	Summed up from shareholders' liability, employees' liability and consumers' and suppliers' liability
	altruistic corporate social responsibility	ACSR	Summed up by social and environmental responsibility
Mediating variable	financial performance	FP	(net profit/average total assets)*100%
Moderator variable	media attention	MA	Ln (the number of online media reports on enterprises)
Control variables	firm size	SIZE	Ln (total assets at end of year)
	mortgage ability	MG	(fixed assets/total assets)*100%
	enterprise growth	GROW	(total assets at the end of the current period – total assets at the end of the previous period)/total assets at the end of the previous period*100%
	ownership nature	SOE	For state-owned enterprises, a value of 1 is assigned, whereas for other enterprises, a value of 0 is given
	enterprise age	AGE	Ln (study year – registration year)
	two rights separation degree	SP	(shareholding proportion control proportion of the actual Controller over the listed company-shareholding proportion)/shareholding Proportion*100%

on A-share listed pharmaceutical manufacturing companies between 2010 and 2021. These companies are classified in accordance with the "2012 Industry Classification Guidelines for Listed Companies" released by the China Securities Regulatory Commission (CSRC), falling precisely within the "Pharmaceutical Manufacturing" category.

During data compilation, companies classified as ST (special treatment) and those lacking CSR disclosures were excluded. The final sample consists of 286 A-share listed pharmaceutical manufacturing companies, totaling 2398 firm-year observations. CSR disclosure data were sourced from Hexun.com's primary CSR score classification, financial data from CSMAR, and media attention data from the CNRDS.

To effectively tackle endogeneity problems caused by bidirectional causality and omitted variables, while strengthening the model's robustness, this research adopts the methodologies proposed by Costinot et al. (2019) as well as those put forward by Long et al. (2023). A dual fixed-effects model is employed, accounting for both individual and time effects. Furthermore, the explanatory variables in the regression equation are lagged by one period.

3.4. Initial data analyses

The descriptive statistical figures for the main variables are displayed in Table 2. The mean and median of DFC (debt financing cost) are 1.573 and 1.023, respectively. The higher mean compared to the median indicates a typical right-skewed distribution of DFC data.

This suggests a significant imbalance in the debt financing costs of different pharmaceutical manufacturing firms. Specifically, most firms have DFC values clustered around the median (1.023), while a small number of firms, due to factors such as creditworthiness and risk levels, incur significantly higher debt financing costs, thereby raising the overall mean. Furthermore, the variance of CSR (Corporate Social Responsibility) is 13.513. Considering the measurement logic of CSR indicators (such as standardized assessments based on input scale or performance ratings), this relatively high variance indicates a notable degree of dispersion in the CSR performance among pharmaceutical manufacturing firms. In other words, there is a clear divergence in CSR practices and performance across firms. The descriptive statistics of the remaining variables are generally consistent with findings in the current literature in economics.

In addition, to eliminate the potential interference of multicollinearity among variables regarding the regression outcomes, this study performs a Variance Inflation Factor (VIF) assessment for each variable. As for the results, the highest VIF value among both the explanatory and control variables reaches 1.94, which is below the threshold of 10, with an average value of 1.43. According to the common judgment criteria in existing research (T. Liu & Lee, 2019), it can be considered that there is unlikely to be severe multicollinearity among the explanatory variables.

The Pearson correlation coefficient matrix results for each variable are illustrated in Table 3. In pharmaceutical enterprises, the correlation coefficient between debt financing costs and Corporate Social Responsibility (CSR) is –0.051, and it is statistically significant at the 5% level. This negative coefficient suggests that fulfilling CSR obligations can notably reduce debt financing costs for pharmaceutical firms, providing initial support for Hypothesis H1. Furthermore, the coefficient between strategic CSR and debt financing costs is highly significant at the 1% threshold of statistical significance, amounting to –0.087. This finding suggests that, relative to the overall CSR score, strategic CSR has a more pronounced impact on debt financing costs. In contrast, the coefficient for altruistic CSR is not significant, which initially validates Hypothesis H1b, namely that altruistic CSR does not directly confer benefits to firms.

Table 2. Summary of variable characteristics

VarName	Obs	Mean	SD	Min	Median	Max
DFC	2398	1.573	1.726	0.000	1.023	8.484
CSR	2398	24.829	13.513	–3.280	23.300	74.270
SCSR	2398	18.320	9.608	–1.630	17.265	51.210
ACSR	2398	6.517	4.973	–8.020	5.760	26.320
FP	2398	0.047	0.060	–0.154	0.038	0.217
MA	1933	5.254	0.924	3.045	5.226	7.597
SIZE	1976	17.942	1.086	16.520	21.491	24.271
MG	1976	0.211	0.113	0.019	0.188	0.531
GROW	2397	0.121	0.235	–0.251	0.056	1.429
SOE	2398	0.195	0.396	0.000	0.000	1.000
AGE	1746	2.045	0.909	0.000	2.303	3.258
SP	2398	4.252	6.979	0.000	0.000	27.858

Table 3. Pearson correlation coefficient matrix

	DFC	CSR	SCSR	ACSR	FP	MA	SIZE	MG	GROW	SOE	AGE	SP
DFC	1											
CSR	–0.051**	1										
SCSR	–0.087***	0.962***	1									
ACSR	0.028	0.853***	0.680***	1								
FP	–0.051**	0.517***	0.589***	0.267***	1							
MA	0.043*	0.231***	0.232***	0.183***	0.132***	1						
SIZE	0.066***	0.236***	0.232***	0.198***	0.126***	0.440***	1					
MG	0.222***	–0.134***	–0.172***	–0.035	–0.164***	–0.100***	–0.138***	1				
GROW	0.028	0.167***	0.185***	0.094***	0.338***	0.147***	0.087***	–0.174***	1			
SOE	0.096***	0.183***	0.135***	0.238***	0.088***	0.065***	0.191***	0.093***	0.000	1		
AGE	0.141***	–0.016	–0.082***	0.116***	–0.149***	0.164***	0.376***	0.038	–0.103***	0.361***	1	
SP	0.119***	0.168***	0.163***	0.142***	0.164***	0.068***	0.177***	–0.002	0.053***	0.089***	0.220***	1

Notes: ***Significant at $p < 0.01$, **Significant at $p < 0.05$, *Significant at $p < 0.1$.

4. Results

4.1. Primary regression

In order to guarantee the appropriateness of implementing the dual-fixed-effects model within the scope of this research, in accordance with the method proposed by Janssen and Zhang (2023), a Hausman Test was carried out. The outcomes of the test revealed that the P – value was 0.0000, indicating that the model with fixed effects is suitable.

Table 4 presents the outcomes of examining the direct effect of Corporate Social Responsibility (CSR) on pharmaceutical manufacturing enterprises' debt financing costs. As the findings presented in Column (1) of Table 4 show, there is a significant inverse correlation between CSR and debt financing costs, suggesting that the greater the extent to which pharmaceutical companies fulfill their social responsibilities, the lower their debt financing cost. This result concurs with the findings of Y. Li et al. (2022). In their research on polluting industries, they too detected an inverse correlation between CSR and debt financing costs. However, many prior studies, including those by Y. Li et al. (2022), have primarily concentrated on the general concept of corporate social responsibility, overlooking the distinctions between Strategic CSR (SCSR) and Altruistic CSR (ACSR).

This study delved into this difference. The findings presented in Column (2) of Table 4 indicate that Strategic CSR (SCSR) has a significant impact in reducing the cost of debt financing. Moreover, its consequence on the debt financing costs associated with pharmaceutical companies is more substantial compared to the overall corporate social responsibility. However, the findings presented in Column (3) of Table 4 indicates that Altruistic CSR (ACSR) fails to have a remarkable impact on reducing the debt financing costs. This means that, in the pharmaceutical manufacturing industry, compared with Altruistic Corporate Social responsibility (ACSR), the Strategic Corporate Social Responsibility (SCSR) related to the core stakeholders of the enterprise (shareholders, employees, customers, suppliers) is more

important for enterprises to attain a sustainable competitive advantage. In contrast, ACSR does not exert a direct impact on the company's operations or debt financing costs. These results further validate Hypotheses H1a and H1b.

For pharmaceutical companies aiming to achieve sustainable development through fulfilling their social responsibilities, they should focus on strengthening the fulfillment of Strategic Corporate Social Responsibility (SCSR). For example, companies can enhance cooperation with key stakeholders such as suppliers and customers, and optimize production processes to reduce environmental impacts. By adopting this approach, companies can enhance their long-term competitive advantage and effectively lower the costs of debt financing. This research not only addresses the gap in existing literature, which primarily focused on the broad concept of corporate social responsibility, but also offers a more detailed and specific framework for future studies in this area.

Table 4. Outcome of the primary regression

	(1)	(2)	(3)
	DFC	DFC	DFC
CSR	–0.013***		
	(–3.29)		
SCSR		–0.025***	
		(–4.21)	
ACSR			–0.012
			(–1.30)
Constant	–25.727***	–26.099***	–25.304***
	(–7.24)	(–7.36)	(–7.10)
Controls	Yes	Yes	Yes
Period-fixed effects	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes
N	1474	1474	1474
R2	0.545	0.547	0.541

Note: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1.

4.2. The mediating role of financial performance

Numerous prior studies, such as those by Ye and Zhang (2011), Gong et al. (2021), and Gigante and Manglaviti (2022), have mainly focused on the association between Corporate Social Responsibility (CSR) and debt financing costs. However, they have not provided an in-depth analysis of the mechanisms underlying this relationship. By deeply delving into this internal mechanism, this study bridges a gap in previous research within this field. It furnishes a novel and more incisive perspective for both academic community and economic entities. Specifically, it elucidates the underlying logic of how pharmaceutical manufacturing enterprises can achieve long-term sustainable economic performance and competitiveness through the implementation of Corporate Social Responsibility (CSR) initiatives. The findings of this research hold substantial significance for enhancing corporate social responsibility

theories and guiding corporate decision-making to boost economic operations.

Table 5 presents the results of an analysis of the mediating function of financial performance in the relationship between Corporate Social Responsibility (CSR) and debt financing costs within pharmaceutical manufacturing enterprises.

In this study, we conducted a more in-depth analysis of this mechanism. Column (2) of Table 5 clearly shows that, at a significance level of 1%, fulfilling CSR obligations can significantly improve financial performance. Meanwhile, the outcomes in Column (3) suggest that, with the same 1% significance level, enhanced financial performance can remarkably lower the debt financing costs. These results comprehensively confirm that financial performance truly serves as a mediator in the association linking corporate social responsibility with debt financing cost, further strongly validating Hypothesis H2.

Table 5. Outcome of the mediating effect

	(1)	(2)	(3)
	DFC	ROA	DFC
CSR	–0.013***	0.002***	–0.008*
	(–3.29)	(10.56)	(–1.90)
ROA			–3.256***
			(–4.42)
Constant	–25.727***	0.246*	–24.926***
	(–7.24)	(1.81)	(–7.06)
Controls	Yes	Yes	Yes
Period-fixed effects	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes
N	1474	1474	1474
R2	0.545	0.528	0.552

Notes: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1.

4.3. The moderating effect of media attention

This study employs the bootstrap method to test for moderated mediation, conducting 1000 samples at a 95% confidence interval, with the outcomes demonstrated in Table 6. Specifically, the indirect impact coefficient of financial performance on debt financing costs through media attention is –0.00010057. The corresponding confidence interval stands at [–0.0001482, –0.0000576], conspicuously excluding zero. Based on the research results of Shao et al. (2021), this result indicates that the indirect effect of financial performance on debt financing costs, which is mediated by media attention, is statistically significant. As a result, it strongly validates Hypothesis H3.

This study innovatively verifies a moderated mediation model, vividly revealing the modulating mechanism of media scrutiny over the mediating function of financial performance within the nexus between Corporate Social Responsibility (CSR) undertakings and debt financing expenses. As elucidated in the research by Ren et al. (2024), the media assumes a crucial and profound role in corporate governance. The results of this paper further authenticate

Table 6. Bootstrap testing results

	Observed coefficient	Bias	Bootstrap std. err.	[95% conf. interval]
_bs_1	–0.00007195	0.00000893	0.00004893	–0.0001528, 0.0000417 (P)
				–0.0001658, 0.0000207 (BC)
_bs_2	–0.00010057	–0.0000045	0.00002405	–0.0001556, –0.0000622 (P)
				–0.0001482, –0.0000576 (BC)
_bs_3	–0.00012919	–0.0000179	0.00004294	–0.0002658, –0.0000894 (P)
				–0.0002058, –0.0000777 (BC)

Notes: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1; Sample size of 1912; 1000 bootstrap resamples.

this conclusion, emphasizing the vital and fundamental role of media attention in boosting financial performance and diminishing debt financing costs. This offers a novel vantage point for pharmaceutical manufacturing firms to integrate corporate social responsibility and media impact into their strategic blueprints, thus attaining long-term sustainable growth.

4.4. Endogeneity tests

Based on the regression analysis mentioned above, endogeneity issues need to be considered. Although lagging the explanatory variables to some extent alleviates bidirectional causality issues, omitted variables may still bias the regression results.

(1) Adding city fixed effects and province fixed effects

In this study, to account for unobserved characteristics that remain constant over time and may influence the results, we adopt the approach used by Bhandari and Javakhadze (2017). Specifically, we include fixed effects for both cities and provinces in the panel regression model. Through this manipulation, the endogeneity problem that may arise due to the omission of such characteristic variables can be effectively resolved. Table 7 shows the regression results following the addition of city fixed effects and province fixed effects. The findings align with those of the benchmark regression, furthermore providing support for the robustness of the research conclusions.

(2) Instrumental variable approach

To tackle potential endogeneity concerns, we utilize the Instrumental Variable (IV) method and carry out a regression analysis using the Two-Stage Least Squares (2SLS) method. Firstly, to account for the time-lagged effect of corporate social responsibility on debt financing costs, we adopt the methodology outlined by L. Xu et al. (2021), using the explanatory variable lagged by two periods as an instrumental variable. Additionally, following the method of Benlemlih and Bitar (2018), we select the initial CSR score as another instrumental variable. It is crucial to highlight that, in all regression analyses utilizing instrumental variables, we include control variables, period fixed effects, and entity fixed effects, ensuring that the analysis is both comprehensive and reliable.

As shown in Column (1) of Table 8, the regression results demonstrate that the relationship between the instrumental variables and the independent variables is statistically significant.

Table 7. Outcomes of adding additional fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)
	DFC	DFC	DFC	DFC	DFC	DFC
CSR	–0.012***			–0.012***		
	(–3.12)			(–3.12)		
SCSR		–0.024***			–0.024***	
		(–3.98)			(–3.98)	
ACSR			–0.011			–0.011
			(–1.25)			(–1.25)
Constant	–25.781***	–26.092***	–25.489***	–25.781***	–26.092***	–25.489***
	(–7.15)	(–7.25)	(–7.05)	(–7.15)	(–7.25)	(–7.05)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Period-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Province-fixed effects	No	No	No	Yes	Yes	Yes
N	1473	1473	1473	1473	1473	1473
R2	0.549	0.551	0.546	0.549	0.551	0.546

Note: ***Significant at $p < 0.01$, **Significant at $p < 0.05$, *Significant at $p < 0.1$.

In light of the research findings of Antoine and Renault (2020), this demonstrates that all instrumental variables are exogenous, featuring an extremely low possibility of facing a weak instrumental variable difficulty. In Column (2) of Table 8, the Kleibergen-Paap rk LM statistic is found to be significant at the 1% level, which leads to the rejection of the null hypothesis of "under-identification". Moreover, the Kleibergen-Paap rk Wald F-statistic surpasses the critical threshold of 19.93 for the weak instrument test at the 10% significance level, thus rejecting the "weak instrumental variable" hypothesis. Additionally, the independent variable has a coefficient of 0.008, which is statistically significant at the 5% level. This finding enhances the credibility and solidity of the study's conclusions.

4.5. Sensitivity tests

To guarantee the precision and dependability of the regression outcomes, this study utilizes various methods to perform robustness checks.

(1) Sample selection

Given that outliers can distort empirical results, this study applies winsorization at the 1st percentile level to all relevant variables. In the subsequent regression analysis, each explanatory variable follows the baseline regression specification and is lagged by one period. The results, as reported in Table 9, confirm that the main findings remain robust to these treatments.

Table 8. 2SLS estimates results

	(1)	(2)
	CSR	DFC
CSR		–0.008**
		(–2.24)
L2.CSR	0.028*	
	(1.74)	
Initial	21.296***	
	(59.19)	
Constant	–56.132***	–8.102**
	(–4.25)	(–2.16)
Controls	Yes	Yes
Time-fixed effects	Yes	Yes
Individual-fixed effects	Yes	Yes
Hansen statistic J (overidentifying restrictions test p-value)	0.759	
First-stage F statistic	1895.73***	
Kleibergen-Paap rk LM statistic		250.880***
Kleibergen-Paap rk Wald F		1895.733
		[19.93]
N	1453	1453
R2	0.91	0.56

Notes: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1; The values within the square brackets are the critical values at the 10% significance level.

Table 9. Winsorization robust test results

	Winsorization at the 1% Level		
	DFC	DFC	DFC
CSR	–0.009***		
	(–2.79)		
SCSR		–0.019***	
		(–3.95)	
ACSR			–0.004
			(–0.55)
ROA			
Constant	–17.646***	–17.982***	–17.266***
	(–6.33)	(–6.47)	(–6.18)
Controls			
Period-fixed effects			
Entity-fixed effects			
N	1474	1474	1474
R2	0.610	0.612	0.608

Note: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1.

(2) Alternative variables

First, following the approach suggested by Khaw et al. (2019), we used the ratio of interest expense to average total liabilities as a proxy for debt financing costs and subsequently re-performed the regression analysis.

Additionally, prior researches have shown that the social contribution value per share can provide a comprehensive assessment of the value a company generates for its shareholders, employees, customers, the environment, the community, and society at large (D. Li et al., 2022). Drawing upon the research of Chen et al. (2015), this study selects the per-share value of social contributions as an alternative proxy for corporate social responsibility and conducts a robustness test. As demonstrated in Table 10, the regression results align with the benchmark model, further confirming the robustness of our research findings.

Finally, this study employs Return on Equity (ROE) as a financial performance indicator to reassess the mediating effect, by following the methodological framework developed by Gartenberg et al. (2019). The results, shown in Table 11, corroborate the original findings, reinforcing the robustness of our conclusions.

Table 10. Replace the explained and explanatory variables results

	Replace the explained variable			Replace the explanatory variable
	DFC	DFC	DFC	DFC
CSR	–0.006*			–0.364**
	(–1.66)			(–2.49)
SCSR		–0.013***		
		(–2.65)		
ACSR			0.001	
			(0.13)	
Constant	–19.333***	–19.578***	–19.137***	–16.875***
	(–6.47)	(–6.55)	(–6.40)	(–6.04)
Controls	Yes	Yes	Yes	Yes
Period-fixed effects	Yes	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes	Yes
N	1474	1474	1474	1474
R2	0.554	0.555	0.553	0.610

Note: ***Significant at $p < 0.01$, **Significant at $p < 0.05$, *Significant at $p < 0.1$.

(3) Alternative method

This study adopts the method proposed by Shrout and Bolger (2002) and utilizes the bootstrap technique to re-examine the mediating effect. As presented in Table 12, the bootstrap analysis reveals a 95% confidence interval of [-0.0109, -0.0001] for the indirect effect. Since this interval excludes zero, the mediating role of financial performance is statistically significant. These findings are consistent with the step-by-step regression analysis results, further enhancing the credibility and stability of the study' findings.

Table 11. Replace the mediating variable results

	Replace the mediating variable		
	DFC	ROE	DFC
CSR	–0.013***	0.003***	–0.010**
	(–3.29)	(10.77)	(–2.44)
ROE			–0.956**
			(–2.42)
Constant	–25.727***	0.216	–25.521***
	(–7.24)	(0.85)	(–7.20)
Controls	Yes	Yes	Yes
Period-fixed effects	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes
N	1474	1474	1474
R2	0.545	0.422	0.547

Note: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1.

Table 12. Replacement method for mediation testing

Mediating variable		Coef.	Std. Err.	z	P>|z|	[95% conf. interval]
ROA	Indirect effect	–0.005465	0.002761	–1.98	0.048	–0.0108763 –0.0000537
	Direct effect	–0.006881	0.003548	–1.94	0.052	–0.0138343 0.0000721

Notes: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1; Sample size: 1912; 1000 bootstrap resamples.

5. Extension

5.1. Heterogeneity analysis of corporate characteristics

Corporate Social Responsibility (CSR) has varying impacts on debt financing costs depending on the enterprises' ownership structure, particularly in the Chinese context (Ding et al., 2022). State-owned enterprises (SOEs) typically possess more substantial resources than private companies. As SOEs are often managed by local governments or directly controlled by the state, creditors perceive them as having a lower risk of default (Geng & Pan, 2024). Consequently, these firms typically receive financing under more favorable terms, including lower interest rates. Moreover, in times of operational distress, government entities frequently provide direct subsidies or other forms of support to maintain their stability. In contrast, private enterprises face greater challenges in securing financing and managing costs. Given these differences, it is crucial to examine how CSR influences debt financing costs in the pharmaceutical manufacturing sector across various ownership types.

Table 13 presents the results of the heterogeneity analysis based on the ownership structure of pharmaceutical manufacturing firms. The findings indicate that CSR exerts a more powerful influence on cutting debt financing costs for non-state-owned enterprises. For SOEs, the substantial government backing and resource access generally lead creditors

to expect lower default risk, which diminishes the effectiveness of CSR in reducing financing costs. Conversely, non-state-owned enterprises, facing more intense market competition and limited resources, can enhance their corporate image and reputation by actively engaging in CSR. This, in turn, boosts creditor confidence and significantly reduces their debt financing costs.

Table 13. Ownership nature heterogeneity test result

	State-owned enterprises	Non-state-owned enterprises
	DFC	DFC
CSR	–0.006	–0.017***
	(–0.93)	(–3.14)
Constant	–17.522***	–28.646***
	(–2.75)	(–6.27)
Controls	Yes	Yes
Period-fixed effects	Yes	Yes
Entity-fixed effects	Yes	Yes
N	390	1079
R2	0.594	0.548

Notes: ***Significant at $p < 0.01$, **Significant at $p < 0.05$, *Significant at $p < 0.1$.

5.2. Heterogeneity analysis of regional characteristics

Husted et al. (2016) employed a framework integrating economic geography to demonstrate that the impact of Corporate Social Responsibility (CSR) on equity capital costs varies across different regions. Specifically, firms in regions where CSR practices are more widespread are better positioned to reduce their equity capital costs than those in regions with lower CSR activity. These regions in which there is high CSR activity are prone to be more economically developed and face greater external scrutiny (W. Zhang et al., 2023).

Given these regional differences, it is essential to investigate how CSR influences debt financing costs in the pharmaceutical manufacturing industry across various regions. According to the classification by the National Development and Reform Commission (NDRC), the eastern region encompasses the municipalities of Beijing, Tianjin, and Shanghai, along with the provinces of Hebei, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, and Hainan, with a sample size of 811. The non-eastern regions, comprising other areas, account for 662 samples.

Table 14 presents the results of the regional heterogeneity analysis, which shows that CSR demonstrates a more significant impact when it comes to reducing the debt financing costs of pharmaceutical enterprises throughout the eastern zone compared to those in the non-eastern regions. One possible explanation is that the eastern region has a more vibrant business ecosystem with a greater emphasis on corporate image, so CSR activities are more likely to be recognized and rewarded in the form of lower debt costs.

Table 14. Regions heterogeneity test result

	Eastern region	Non-eastern region
	DFC	DFC
CSR	–0.015***	–0.013**
	(–2.97)	(–2.08)
Constant	–28.425***	–25.150***
	(–5.26)	(–5.23)
Controls	Yes	Yes
Period-fixed effects	Yes	Yes
Entity-fixed effects	Yes	Yes
N	811	662
R2	0.553	0.559

Notes: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1.

5.3. Heterogeneity analysis of regulatory intensity

Research has demonstrated that public regulations positively stimulate CSR-based entrepreneurship while non-public regulations significantly supplement the cultivation role of CSR-based entrepreneurship, highlighting the importance of regulatory frameworks in shaping corporate behavior (Zeng et al., 2022; Tang et al., 2024). The establishment of the China Food and Drug Administration (CFDA) in 2013 marked a milestone event in the healthcare sector, signaling the formation of a "full-chain, specialized, and rule-of-law-based" regulatory framework. This development strengthened oversight of the pharmaceutical industry and laid the foundation for subsequent reforms, including the medical insurance volume-based procurement and the implementation of the Marketing Authorization Holder (MAH) system. Therefore, we conduct a heterogeneity analysis by categorizing the regulatory intensity into low and high levels based on the period before and after the establishment of the CFDA. This approach aims to explore the differences in the policy landscape of China's pharmaceutical industry before and after this significant regulatory change.

Table 15 shows that the impact of Corporate Social Responsibility (CSR) on reducing corporate debt financing costs differs significantly before and after the establishment of the CFDA. Essentially, the CFDA's establishment institutionalized the social value of pharmaceutical companies, making CSR a strategic tool to mitigate information asymmetry in the debt market. The study demonstrates that under the strengthened regulatory framework, pharmaceutical companies, by aligning CSR strategies with regulatory priorities, can not only respond to policy demands but also optimize financing efficiency, thereby enhancing financial resilience in the long run.

Table 15. Regulatory intensity heterogeneity test result

	Pre-establishment	Post-establishment
	DFC	DFC
CSR	–0.001	–.0112***
	(–0.18)	(–3.29)
Constant	–38.180***	–4.875
	(–3.37)	(–1.51)
Controls	Yes	Yes
Period-fixed effects	Yes	Yes
Entity-fixed effects	Yes	Yes
N	333	1374
R2	0.857	0.616

Notes: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1.

5.4. Heterogeneity analysis of industry

To clarify the boundaries of CSR research between the pharmaceutical manufacturing industry and other sectors, we conducted a heterogeneity analysis based on industry attributes (pharmaceutical industry/other industries) as shown in Table 16. The impact of Corporate Social Responsibility (CSR) is more pronounced in the pharmaceutical industry, with significantly higher correlation coefficients. This indicates that, under similar conditions, pharmaceutical companies can more effectively reduce debt financing costs and gain a competitive advantage by strengthening CSR initiatives. This may be due to the direct impact of the pharmaceutical industry on public health and safety, which raises societal expectations for its social responsibility.

In conclusion, the performance of the pharmaceutical manufacturing industry in the debt financing market is closely related to its CSR investments. This finding highlights the strategic importance of optimizing CSR strategies in pharmaceutical companies to reduce financing costs. Such an approach not only meets societal expectations but also contributes to long-term financial efficiency and sustainable development.

Table 16. Industry heterogeneity test result

	Pharmaceutical industry	Other industries
	DFC	DFC
CSR	–0.013***	–0.005**
	(–3.29)	(–9.35)
Constant	–25.727***	–0.334***
	(–7.24)	(–7.65)
Controls	Yes	Yes
Period-fixed effects	Yes	Yes
Entity-fixed effects	Yes	Yes
N	1474	37634
R2	0.545	0.645

Note: ***Significant at p < 0.01, **Significant at p < 0.05, *Significant at p < 0.1.

6. Conclusions and implications

6.1. Conclusions

Currently, the question of whether enterprises can mitigate their debt financing costs through the CSR strategy and consequently realize sustainable development is a subject of widespread debate. Considering the importance of the pharmaceutical manufacturing industry for economic development, especially since China is the second largest pharmaceutical consumer market, this study, based on Chinese pharmaceutical manufacturing enterprises, aims to identify how pharmaceutical manufacturing enterprises can achieve sustainable development in a complex economic situation. This paper constructs a moderated mediation model, designating corporate financial performance as the mediator and media attention as the moderator. Furthermore, corporate social responsibility is divided into Strategic CSR (SCSR) and Altruistic CSR (ACSR), to study how fulfilling social responsibility helps Chinese pharmaceutical manufacturing enterprises reduce their debt financing costs and achieve sustainable development in a complex economic environment.

This research examines the panel data of pharmaceutical manufacturing companies listed on China's A-share market between 2010 and 2021, leading to the following key conclusions:

Firstly, this research demonstrates that pharmaceutical manufacturers' social responsibility efforts contribute to reducing their debt financing costs. The extent of this impact, however, is contingent upon the nature of the CSR activities undertaken, with differing outcomes observed between strategic and altruistic approaches to CSR. The pharmaceutical manufacturing industry's crucial role in economic development, combined with Chinese pharmaceutical manufacturing enterprises' significant global market position, motivates our exclusive focus on this sector. This study differs from existing CSR-debt cost literature by specifically examining pharmaceutical manufacturing firms, which allows for more targeted economic insights regarding strategic social responsibility investment optimization and sustainable competitive advantage development.

Secondly, this study advances the CSR-debt cost literature by empirically establishing financial performance as a significant mediating mechanism in the relationship between corporate social responsibility and debt financing costs within pharmaceutical manufacturing enterprises. This finding contributes to economic theory by demonstrating that CSR's impact on capital costs operates through observable financial performance improvements, thereby providing a clear transmission channel for understanding CSR's economic value creation. Furthermore, the results establish that for pharmaceutical enterprises, strategic CSR engagement constitutes an economically rational approach to achieving sustainable competitive advantage through reduced financing costs and enhanced financial performance.

Finally, this study innovatively verifies a moderated mediation model, thereby clearly revealing the moderating mechanism of media attention regarding the mediating function of financial performance within the connection between corporate social responsibility and debt financing costs. The findings suggest that media coverage plays a crucial role in amplifying stakeholders' attention toward the company. Additionally, it serves as an important moderator in the relationship between the firm's financial performance and the costs associated with debt financing. These findings provide robust empirical evidence for the economic

rationale of corporate social responsibility investments in pharmaceutical manufacturing firms, demonstrating significant value creation through reduced cost of capital and enhanced market efficiency.

6.2. Implications

Based on the above conclusions, the following policy suggestions are proposed:

Corporate strategy: In formulating corporate strategies, enterprises should prioritize social responsibility. As strategic CSR and altruistic CSR have distinct impacts on reducing debt financing costs, managers should allocate resources effectively and strategically, taking into account the company's unique positioning and stage of development. Specifically, enterprises should deeply integrate CSR implementation with strategic objectives, making it a core path to gaining competitive advantage. This requires top management to incorporate CSR into the strategic system from a visionary perspective, balancing stakeholder demands through differentiated resource allocation, and achieving the collaborative creation of economic and social value for sustainable development.

Investor considerations: Assessing CSR efforts is of great significance for measuring the enduring sustainability prospects of the enterprise. When evaluating pharmaceutical manufacturing companies for investment, investors should closely examine these companies' corporate social responsibility performance from the perspective of stakeholders and establish a multidimensional evaluation system. This approach not only helps investors better evaluate the company's value but also mitigates investment risks and enhances returns.

Government policy and supervision: In the realm of government regulation and policy-making, authorities should encourage the media to play a constructive role in both oversight and public awareness. A supportive public opinion environment should be fostered to encourage companies to embrace social responsibility actively. By means of efficacious policy directives and a well-structured regulatory architecture, pharmaceutical manufacturing enterprises should be urged to harmonize economic and social benefits in their CSR practices, thereby promoting the industry's healthy and sustainable growth. In addition, as an important communication channel between enterprises and stakeholders, the media can amplify the comprehensive benefits of CSR implementation through its oversight mechanisms, creating more development opportunities for business, esespecially in the pharmaceutical manufacturing sector, which is highly sensitive to public opinion.

Although this study provides valuable insights, there are several limitations and areas that warrant further investigation. Future research should incorporate a broader range of enterprises, especially when more comprehensive data becomes available. This would help to create a more diverse and representative sample, facilitating a deeper understanding of how Corporate Social Responsibility (CSR) affects debt financing costs among diverse categories of pharmaceutical enterprises.

Moreover, during the study period, the pharmaceutical manufacturing industry has experienced significant policy changes, such as adjustments to the medical insurance catalogue and reforms in drug pricing. These dynamic policies continue to shape how Corporate Social Responsibility (CSR) affects debt financing costs. However, due to the limited timeframe of this research, capturing the long-term and comprehensive effects of these policy shifts is

challenging. To address this gap, future studies could extend the observation period to track the ongoing impact of these policies. This would allow for a more detailed analysis of how CSR and debt financing costs evolve in response to different policy stages, ultimately refining the understanding of this relationship.

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Author contributions

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Data availability statement

The datasets used or analysed during the current study are available from the corresponding author on reasonable request.

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