

**FACTORS INFLUENCING CORPORATE ENVIRONMENTAL
DISCLOSURE AND ITS IMPACT ON FINANCING COST:
EMPIRICAL EVIDENCE BASED ON LISTED PHARMACEUTICAL
COMPANIES IN CHINA**

By

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ABSTRACT

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Wang Shiyi

With China's rapid economic development, environmental issues have become increasingly evident. Corporate environmental disclosure requires companies to publicly report their environmental activities, encouraging them to better fulfil their environmental responsibilities. Identifying the factors that influence such disclosure and understanding the economic motivations behind it are essential for establishing an effective mechanism that integrates internal and external forces. This promotes voluntary and proactive disclosure practices, thereby contributing to environmental protection.

Based on stakeholder, legitimacy, signalling, and agency theory, this study aims to examine the influencing factors of corporate environmental disclosure and its impact on financing costs, as well as to explore the moderating role of corporate governance. Using panel data of listed pharmaceutical companies in China from 2018 to 2022, a multiple regression approach is adopted, and empirical tests are conducted using a Fixed Effects regression model. Additionally, robustness checks are performed using the system Generalised Method of Moments to

address potential endogeneity concerns.

Empirical findings indicate that first, regulatory pressure and firm profitability significantly enhance corporate environmental disclosure among Chinese listed pharmaceutical companies. Furthermore, corporate governance not only has a significant and positive influence on corporate environmental disclosure directly, but also exerts a moderating effect on the influence of regulatory pressure and firm profitability. However, there is no statistically significant correlation between media exposure and disclosure. Second, corporate environmental disclosure is found to significantly reduce both the cost of equity and the cost of debt, with corporate governance further strengthening this cost-reduction effect.

Overall, the study highlights the broader relevance of corporate environmental disclosure by clarifying how external institutional pressures, internal firm conditions, and corporate governance jointly shape disclosure practices, and how such disclosure, when supported by effective corporate governance, carries meaningful implications for firms' financing outcomes. These implications are relevant for regulators, corporate managers, and capital market participants.

Keywords: Corporate Environmental Disclosure; Chinese Pharmaceutical Companies; Influencing Factors; Financing Costs; Corporate Governance

Subject Area: HF5601-5689 Accounting

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DECLARATION

I hereby declare that the dissertation is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

Name _____

Date _____

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LIST OF ABBREVIATIONS

Big Four	Big Four accounting firms
CNRDS	Chinese Research Data Services
COD	Chemical Oxygen Demand
CSMAR	China Stock Market Accounting Research
CSRC	China Securities Regulatory Commission
EPS	Earnings Per Share
ESG	Environmental, Social and Governance
FE	Fixed Effects
GMM	Generalised Method of Moments
HVZ	Hou-Van Dijk-Zhang
KMO	Kaiser-Meyer-Olkin
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
PEG	Price/Earnings to Growth
PITI	Pollution Information Transparency Index
PM	Particulate Matter
R&D	Research and Development
RE	Random Effects
RO	Research Objectives
RQ	Research Questions
ROA	Return on Assets
ROE	Return on Equity
SD	Standard Deviation

SNSI	Sino-Securities Index
SOEs	State-Owned Enterprises
Non-SOEs	Non-State-Owned Enterprises
SSE	Shanghai Stock Exchange
SZSE	Shenzhen Stock Exchange
ST	Special Treatment
*ST	Delisting Risk Warning
VIF	Variance Inflation Factor

Chapter One

INTRODUCTION

1.1 Overview of the Chapter

Section 1.2 presents the background of the study, which encompasses overall corporate environmental disclosure by Chinese listed companies and the specific challenges related to corporate environmental disclosure faced by Chinese listed pharmaceutical companies. Section 1.3 discusses the problem statement, highlighting the gaps to be addressed, while sections 1.4 and 1.5 outline the research questions and research objectives, respectively. Next, section 1.6 discusses the significance of the study, and section 1.7 defines the terms used in the study. Finally, section 1.8 offers an overview of the study organization.

1.2 Background of the Study

1.2.1 General Overview of Corporate Environmental Disclosure by Chinese Listed Companies

As China's economy rapidly grows¹, ecological and environmental problems become increasingly apparent. These issues pose significant threats to public health and have also led to numerous conflicts (Huang et al., 2019).

¹ The total volume of China's economy has increased from 568.98 billion yuan at the beginning of the reform and opening-up period (National Bureau of Statistics, 2002) to 121,020.7 billion yuan in 2022 (National Bureau of Statistics, 2023).

Enterprises play a significant role in socio-economic activities and are major contributors to environmental pollution (Lyu, 2022). As microeconomic entities in social and economic development, enterprises serve as key factors in balancing environmental protection and high-quality economic growth (Kan & Li, 2025). Therefore, companies should proactively embrace environmental responsibility in the face of increasingly serious environmental challenges (He et al., 2020). One effective way to do so is through corporate environmental disclosure. Through the disclosure of environmental information, enterprises allow governments as well as the public to guide and supervise their behaviour. This helps promote legal compliance and leads to improved environmental awareness and protection practices. Hence, paying more attention to corporate environmental disclosure can impact society's environmental protection efforts (Dai & Shi, 2019).

Since 1997², the Chinese government's institutional regulations for corporate environmental disclosure have evolved. In particular, for Chinese listed companies, the regulations on corporate environmental disclosure have been gradually expanded (refer to Appendix A for details). Of particular importance is the *Guidelines for the Contents and Formats of Information Disclosure by Companies Offering Securities to the Public No. 2 - Contents and Formats of Annual Reports (2017 Revision)* (hereinafter referred to as the 2017

² The China Securities Regulatory Commission first required that companies making public offerings should mention in their prospectuses environmental information relating to environmental protection and natural resource constraints in 1997.

Guidelines), as promulgated by the China Securities Regulatory Commission (CSRC). It stipulates that starting in 2018, key polluting listed companies must participate in mandatory corporate environmental disclosure. This signifies a shift in the corporate environmental disclosure regime of Chinese listed companies from voluntary to partially mandatory (Zhang & Ge, 2021). Against this context, Chinese listed companies may experience changes in their corporate environmental disclosure practices due to stricter government regulations. Therefore, scholarly attention to the corporate environmental disclosure practices of Chinese listed companies post-2018 becomes increasingly important (Y. S. Wang et al., 2021).

As depicted in Figure 1.1, data from the *Evaluation Report on Environmental Responsibility Information Disclosure of Listed Companies in China* (hereinafter referred to as the *Evaluation Report*, China Environmental Journalists Association & Beijing University of Chemical Technology, 2024) show a significant increase in disclosure activity. In 2018, 928 listed companies disclosed environmental information, and by 2022, this figure had risen to 1,675 companies. This increase appears to be driven by the implementation of relevant regulations, which have encouraged more listed companies to disclose environmental information. However, the statistics also indicate that the proportion of listed companies making such disclosure still remains comparatively low, averaging only about 25% for the first four years, and only

about 32.3% in the fifth year.

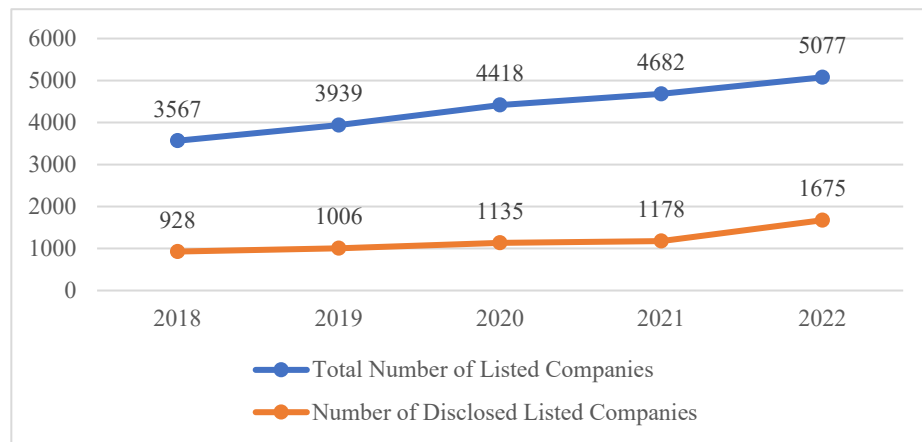


Figure 1.1 The number of total listed companies and listed companies disclosing environmental information in China

Note. Data from the *Evaluation Report* (China Environmental Journalists Association & Beijing University of Chemical Technology, 2024)

In spite of this, the corporate environmental disclosure quality of these listed companies remains unsatisfactory. As depicted in Figure 1.2, the *Evaluation Report* (China Environmental Journalists Association & Beijing University of Chemical Technology, 2024) shows that the Environmental Disclosure Index, which measures disclosure quality on a 100-point scale, was 33.14 in 2018 and rose slightly to 40.57 in 2022. This indicates that, despite the modest improvement, the Index has remained at around 40% over the past five years, reflecting persistently unfavourable disclosure quality among Chinese listed companies.

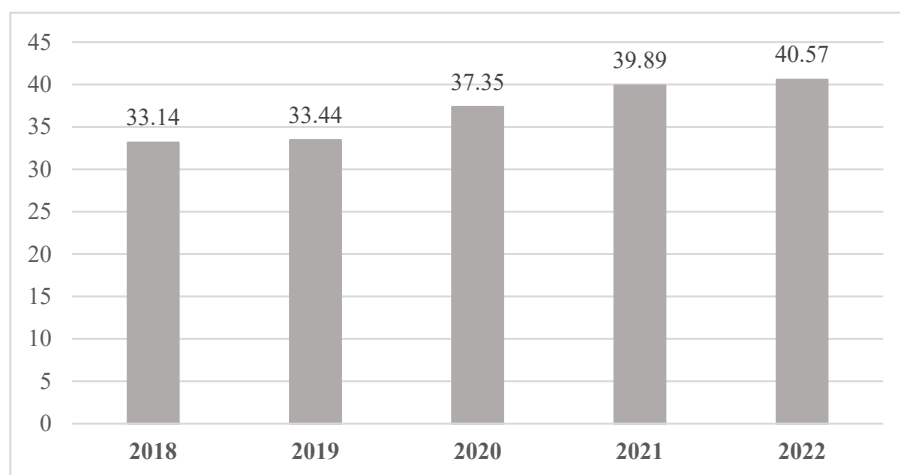


Figure 1.2 Environmental Disclosure Index of Listed Companies in China

Note. Data from the *Evaluation Report* (China Environmental Journalists Association & Beijing University of Chemical Technology, 2024)

The unfavourable corporate environmental disclosure may be attributed to several reasons. First, while some companies are classified as key polluting enterprises and thus subject to mandatory disclosure, others disclose environmental information voluntarily. Mandatory disclosure can ensure a baseline level of information but is often compliance-oriented and lacks depth, whereas voluntary disclosure can be richer but tends to be selective and inconsistent across firms. This dual system leads to uneven reporting standards and ultimately lower overall disclosure quality (Chen & Shen, 2021). Second, even among firms subject to mandatory disclosure, the regulatory requirements regarding the content of environmental reporting remain relatively vague. Companies retain significant discretion over what and how much to disclose, further exacerbating inconsistency (Chen et al., 2022). Finally, the absence of standardised disclosure guidelines has led to substantial variations in reporting practices across firms (Han et al., 2018; Zhou, 2020). This fragmentation

contributes to issues such as dispersed disclosure channels, limited comparability, and low information quality (Chen, 2019). These structural and regulatory limitations help explain why the Environmental Disclosure Index has remained at around 40% over the past five years, as shown in Figure 1.2.

1.2.2 Corporate Environmental Disclosure by Chinese Listed Pharmaceutical Companies

Divergences in corporate environmental disclosure across industries are evident, stemming from the distinct characteristics of each sector (Mu, 2021). Examining a single industry in detail can therefore shed light on how such differences manifest in practice. The pharmaceutical industry provides a relevant case in the Chinese context, not only because of its close link to public health but also due to its unique environmental and economic dynamics.

Firstly, the rapid development of the Chinese pharmaceutical industry has significant environmental implications. Driven by an ageing population and unexpected public health events such as the COVID-19 pandemic, health demands have surged, leading to robust industry expansion with notable increases in operating profits and asset scales (as depicted in Figure 1.3). However, this growth has also been accompanied by rising environmental pollution challenges that cannot be overlooked (Lin & Yang, 2020).

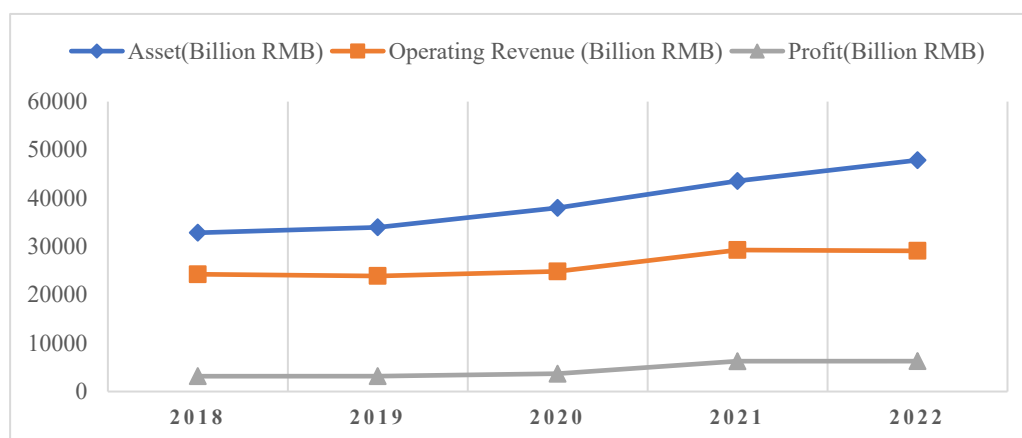


Figure 1.3 Key Financial Data of Chinese Pharmaceutical Industry
Note. Data from China Stock Market Accounting Research Database (2018-2022)

Secondly, the pharmaceutical industry is classified by the CSRC as a heavily polluting sector due to the substantial environmental impacts of pharmaceutical production. This includes the generation of large quantities of active pharmaceutical ingredients, wastewater, exhaust gases, and solid waste (Bengtsson-Palme et al., 2018). The total emissions of various pollutants are substantial, leading to prominent pollution issues (Wang, 2020). Meanwhile, data from Sino-Securities Index (SNSI) (2023) on environmental information scores for Chinese listed companies indicate that, compared to other heavily polluting industries ³, pharmaceutical companies perform worse in environmental disclosure. Specifically, over the five-year period from 2018 to

³ Including: coal mining and washing industry, oil and gas mining industry, ferrous metal mining and processing industry, non-ferrous metal mining and processing industry, textile industry, leather, fur, feather and their products and footwear industry, paper and paper products industry, petroleum processing, coking and nuclear fuel processing industry, chemical raw materials and chemical products manufacturing industry, pharmaceutical manufacturing industry, chemical fibre manufacturing industry, rubber and plastic products industry, non-metallic mineral products industry, ferrous metal smelting and rolling processing industry, non-ferrous metal smelting and rolling processing industry, electric power, heat production and supply industry.

2022, their average environmental information score was 58.47, compared to 62.81 for other heavily polluting sectors (as depicted in Table 1.1). The environmental information score in the SNSI evaluates companies based on their performance in environmental protection measures, resource efficiency, carbon emission control, and pollution management. This suggests that Chinese pharmaceutical companies underperform in environmental domains, including corporate environmental disclosure, as well as actual environmental management and performance.

Table 1.1 Comparison of the Environmental Information Scores of the Pharmaceutical Industry and Other Heavily Polluting Industries

Industry	2018	2019	2020	2021	2022	Average
Pharmaceutical	57.36	58.37	58.84	58.49	59.30	58.47
Other Heavily Polluting Industries	61.83	62.63	63.35	62.72	63.51	62.81

Note. Data from SNSI (2018-2022)

Thirdly, pharmaceutical companies face substantial financing demands. In 2021, the Chinese pharmaceutical industry disclosed a total financing amount of RMB 318.2 billion, ranking first among all industries (Chinese Society of Biotechnology & Firestone Technology, 2022). This high demand for capital is driven by multiple factors. Healthcare reform policies, such as drug price negotiations and volume-based procurement, have compressed profit margins, while the sector's extended investment cycles, high risk, and slow returns make substantial capital a prerequisite for sustainable growth (Liu, 2020; Shan & Qiu, 2021; Cui et al., 2021). Given these challenges, pharmaceutical firms must

leverage the capital market to secure adequate resources for development (Chen, 2020). At the same time, policy guidance such as the *Guiding Opinions on Building a Green Financial System* (People's Bank of China et al., 2016) explicitly calls for improving mandatory corporate environmental disclosure requirements for listed and bond-issuing companies. Consequently, enhancing corporate environmental disclosure can help companies meet regulatory expectations more effectively, thereby alleviating financing constraints (Zhan & Hou, 2021).

Based on the characteristics of the Chinese pharmaceutical industry outlined above, addressing its environmental issues has become an urgent priority. Compared with listed companies in other heavily polluting industries, the pharmaceutical sector performs among the worst in corporate environmental disclosure (Mu, 2021). Current practices are fragmented and selective, often highlighting favourable performance while omitting critical information (Xu, 2021a). Enhancing disclosure can exert pressure on companies to prioritise environmental concerns and improve environmental management.

Such improvements can deliver two main benefits. First, they help ensure that industrial development does not come at the expense of environmental degradation, supporting a path of green and sustainable growth (Xia, 2020). Second, they enable firms to better identify and mitigate environmental risks, make more informed operational decisions, and improve the overall

effectiveness of environmental actions (Xu, 2021a). Therefore, advancing research on corporate environmental disclosure in China's pharmaceutical industry is crucial for enhancing disclosure practices, fulfilling environmental responsibilities, and fostering sustainable development.

1.3 Problem Statement

The pharmaceutical industry in China, designated by the CSRC as a heavily polluting sector, faces mounting expectations to enhance environmental transparency. Although the partially mandatory corporate environmental disclosure requirements have been in place since 2018, the regulations remain vague, providing limited guidance on the scope and quality of disclosure (CSRC, 2017). Consequently, listed pharmaceutical companies retain substantial discretion in reporting practices, leading to fragmented information, weak comparability, and low-quality disclosures (Chen, 2019; Chen et al., 2022). According to the SNSI, pharmaceutical firms consistently underperform other heavily polluting industries in corporate environmental information scores (SNSI, 2018-2022), underscoring the urgency of improving corporate environmental disclosure in this industry.

To address these shortcomings, it is essential to examine the key factors that influence disclosure behaviour. Prior studies have shown that external pressures such as regulatory pressure and media exposure, along with internal factors such as firm profitability and corporate governance, enhance corporate

environmental disclosure (Su & Zhang, 2020; Yi & Zhou, 2023; Zeng et al., 2021; Sun & Ye, 2020). These factors influence disclosure through different mechanisms. Regulatory pressure enforces compliance, media exposure generates reputational risk, firm profitability affects the affordability of disclosure, and corporate governance shapes overall transparency. Together, these factors shape firms' environmental disclosure decisions by influencing the disclosure costs, constraints, and incentives associated with providing environmental information. However, existing literature has rarely focused on these factors within the pharmaceutical sector, especially under the post-2018 disclosure regime. Additionally, while corporate governance has been widely studied, much of the existing research focuses on individual attributes in isolation, failing to capture its system-level influence. Thus, this study examines regulatory pressure, media exposure, firm profitability, and corporate governance as influencing factors of corporate environmental disclosure among listed pharmaceutical companies in China, corresponding to Research Objectives One through Four.

Beyond its direct influence, corporate governance may also serve as a moderator between influencing factors and corporate environmental disclosure. Prior studies have suggested that effective corporate governance can enhance firms' responsiveness to regulatory pressure and media exposure, and help translate firm profitability into improved disclosure (Pan & Guo, 2018; Li &

Zhai, 2018; Ardi & Yulianto, 2020). In this context, corporate governance shapes firms' responses to external pressures and internal conditions by influencing managerial incentives, internal oversight, and the effectiveness of disclosure implementation. However, while these studies often examine specific corporate governance features, this study adopts a broader approach by constructing a composite corporate governance index, enabling a comprehensive assessment of how overall corporate governance moderates the influence of regulatory pressure, media exposure, and firm profitability on corporate environmental disclosure among listed pharmaceutical companies in China. This analysis corresponds to Research Objective Five.

Beyond identifying the factors influencing disclosure, it is also important to examine its economic consequences, particularly in corporate financing. Several studies have found that corporate environmental disclosure can help reduce the cost of equity and cost of debt (Wu & Qin, 2022; Zhao & He, 2021). Accordingly, this impact operates by improving the firms' capital market information environment, thereby lowering perceived risk and enhancing transparency for investors and creditors. However, much of this research focuses on resource-intensive or high-emission industries, while evidence from the pharmaceutical sector remains limited. Pharmaceutical firms typically have high financing needs, long investment cycles, and substantial uncertainty. Therefore, assessing whether the disclosure can reduce financing costs is especially relevant

for this industry. This forms the basis for Research Objectives Six and Seven.

The ability of corporate environmental disclosure to reduce financing costs depends not only on the amount of information provided, but also on its credibility. In China, the absence of standardised disclosure frameworks and third-party verification mechanisms has raised doubts about the reliability of reported environmental information (Cao & Xu, 2019). Accordingly, more effective corporate governance can strengthen the extent to which corporate environmental disclosure is reflected in financing costs by enhancing disclosure credibility and signalling value in capital markets (Li, 2019; Shan, 2018). Yet, many studies examine only individual corporate governance attributes. Building on these insights, this study adopts a composite corporate governance index to evaluate whether more effective corporate governance can amplify the impact of corporate environmental disclosure on both the cost of equity and the cost of debt. This constitutes Research Objective Eight.

This study focuses on listed pharmaceutical companies in China under the post-2018 disclosure regime and addresses two main research streams. The first examines the influencing factors of corporate environmental disclosure, namely regulatory pressure, media exposure, firm profitability, and corporate governance. It also considers whether corporate governance shapes the influence of the first three factors. The second assesses the economic consequences of disclosure by analysing its impact on the cost of equity and the cost of debt. It

further explores whether corporate governance enhances these effects. Together, these gaps provide the foundation for the research questions and objectives that follow.

1.4 Research Questions

This study focuses on listed pharmaceutical companies in China. Accordingly, the Research Questions (RQ) are as follows:

RQ1. How does regulatory pressure influence corporate environmental disclosure?

RQ2. How does media exposure influence corporate environmental disclosure?

RQ3. How does firm profitability influence corporate environmental disclosure?

RQ4. How does corporate governance influence corporate environmental disclosure?

RQ5a. Does corporate governance moderate the relationship between regulatory pressure and corporate environmental disclosure?

RQ5b. Does corporate governance moderate the relationship between media exposure and corporate environmental disclosure?

RQ5c. Does corporate governance moderate the relationship between firm profitability and corporate environmental disclosure?

RQ6. What is the impact of corporate environmental disclosure on the cost of equity?

RQ7. What is the impact of corporate environmental disclosure on the cost of

debt?

RQ8a. Does corporate governance moderate the impact of corporate environmental disclosure on the cost of equity?

RQ8b. Does corporate governance moderate the impact of corporate environmental disclosure on the cost of debt?

1.5 Research Objectives

With a focus on listed pharmaceutical companies in China, this study aims to achieve the following Research Objectives (RO):

RO1. To examine how regulatory pressure influences corporate environmental disclosure.

RO2. To examine how media exposure influences corporate environmental disclosure.

RO3. To examine how firm profitability influences corporate environmental disclosure.

RO4. To examine how corporate governance influences corporate environmental disclosure.

RO5a. To examine whether corporate governance moderates the relationship between regulatory pressure and corporate environmental disclosure.

RO5b. To examine whether corporate governance moderates the relationship between media exposure and corporate environmental disclosure.

RO5c. To examine whether corporate governance moderates the relationship

between firm profitability and corporate environmental disclosure.

RO6. To assess the impact of corporate environmental disclosure on the cost of equity.

RO7. To assess the impact of corporate environmental disclosure on the cost of debt.

RO8a. To assess whether corporate governance moderates the impact of corporate environmental disclosure on the cost of equity.

RO8b. To assess whether corporate governance moderates the impact of corporate environmental disclosure on the cost of debt.

1.6 Significance of the Study

As China's economy has developed rapidly, environmental problems have become increasingly prevalent. Environmental pollution and ecological destruction have restricted China's sustainable development and affected the economies of other developing countries. Therefore, while pursuing their own economic interests by utilizing social resources, enterprises should also shoulder equal responsibilities and fulfil their social and environmental obligations. The pharmaceutical industry has a significant environmental impact, characterised by high levels of pollution and ecological degradation. At the same time, China's environmental disclosure system is rapidly evolving, resulting in continuous changes in firms' disclosure practices. The system is regularly adjusted to address emerging environmental concerns, compliance requirements, and public

expectations, thus leading to frequent changes in how companies report their environmental performance.

This study utilises data from Chinese listed pharmaceutical companies between 2018 and 2022, following the implementation of mandatory corporate environmental disclosure requirements. Through a targeted approach, the research examines the factors influencing corporate environmental disclosure and its impact on financing costs. Thus, this study has important theoretical and practical implications.

1.6.1 Theoretical Significance

Firstly, this study is grounded in stakeholder theory (Freeman, 1984) and approaches the analysis from a stakeholder perspective. It selects regulatory pressure to represent the government, media exposure to represent the public, and firm profitability and corporate governance to represent the interests of owners, managers, and employees. In addition, the study incorporates insights from legitimacy theory (Parsons, 1960) and agency theory (Jensen & Meckling, 1976) to examine the influence of these factors on corporate environmental disclosure, providing a more comprehensive theoretical perspective on the influencing factors.

Secondly, this study also integrates stakeholder theory (Freeman, 1984) with signalling theory (Spence, 1978) to comprehensively analyse the

relationship between corporate environmental disclosure and financing costs. This theoretical combination allows the study to explain how disclosure transmits information about firm responsibility and risk to investors and creditors. In doing so, it provides a more comprehensive foundation for understanding the impact of corporate environmental disclosure on both the cost of equity and the cost of debt.

Thirdly, this study extends agency theory (Jensen & Meckling, 1976) by conceptualising corporate governance as a holistic mechanism for aligning managerial behaviour with stakeholder interests. While prior studies often examined governance through isolated variables such as equity balance, board size or CEO duality (Gao, 2024; Nuskiya et al., 2021; Ma, 2020), this study constructs a composite corporate governance index using PCA, allowing a more systematic evaluation of how overall corporate governance structures reduce agency problems and promote transparent disclosure.

Finally, this study further deepens agency theory (Jensen & Meckling, 1976) by exploring whether corporate governance strengthens the influence of both external and internal drivers, such as regulatory pressure, media exposure, and firm profitability, on corporate environmental disclosure. By testing this moderating role, the study highlights governance as an internal enabler that translates external expectations into improved disclosure outcomes. In addition, this study further examines whether corporate governance enhances the impact

of disclosure on financing costs. Although corporate governance is widely regarded as a mechanism that supports transparency and accountability (Salehi et al., 2023), few studies have empirically tested its moderating effect on the relationship between environmental disclosure and financing outcomes. This study addresses that gap, offering a more integrated understanding of how corporate governance reinforces the financial relevance of environmental disclosure.

1.6.2 Contributions to the Scholars

This study advances academic understanding of corporate environmental disclosure. In particular, it adopts improved measurement approaches for regulatory pressure and corporate governance. First, while most prior research in China used the Pollution Information Transparency Index (PITI), this indicator has not been updated since 2019. As an alternative, this study measures regulatory attention by examining how frequently environment-related terms appear in provincial government work reports, thereby drawing on more recent and readily accessible data. Second, instead of relying on a single indicator, corporate governance is measured using a composite index constructed through PCA. This approach offers a more comprehensive view of governance mechanisms and their influence on corporate environmental disclosure.

Furthermore, this study enhances the robustness of its findings by employing a dynamic panel data approach. Specifically, the study uses the two-

step system Generalised Method of Moments (GMM) estimation to analyse the influence of various factors on corporate environmental disclosure and its impact on financing costs. The two-step system GMM estimation is more effective in analysing the above issues from the perspective of dynamic panels, considering that an economic entity's current behaviour may be influenced by past actions. Additionally, it better addresses endogeneity concerns, thereby enhancing the reliability of the research findings.

1.6.3 Contributions to the Companies

This study helps identify the key factors influencing corporate environmental disclosure among Chinese listed pharmaceutical companies. In particular, it highlights the multifaceted role of corporate governance. A clearer understanding of these influences can encourage companies to pay greater attention to improving their own governance practices. In this context, companies can enhance their corporate governance standards to achieve improved outcomes in corporate environmental disclosure, which, in turn, enables them to meet government and society expectations while safeguarding their corporate reputation more effectively.

Moreover, if the impact of corporate environmental disclosure on reducing the cost of equity and the cost of debt is clarified, it can also serve as an internal motivating factor for companies to voluntarily engage in enhanced corporate environmental disclosure. It is particularly pertinent for

pharmaceutical companies, given the stringent financing requirements and intense industry competition. By prioritizing effective corporate environmental disclosure, these companies can attain lower financing costs, thereby greatly enhancing their competitive edge in the market. Furthermore, clarifying the moderating role of corporate governance as an intrinsic driver of corporate environmental disclosure can better promote and strengthen the interrelationship between corporate environmental disclosure and its economic consequences, such as equity financing and debt financing.

1.6.4 Contributions to the Regulatory Authorities

This study provides a deeper and more comprehensive analysis of the influencing factors of corporate environmental disclosure, and also contributes to offering more specific and targeted theoretical foundations for government authorities when formulating relevant legal regulations. Firstly, by establishing that regulatory pressure plays a constructive role in shaping this type of disclosure, the effectiveness of policies can be affirmed, encouraging regulatory bodies to further issue more detailed requirements for disclosure content and impose stricter penalties for corporate environmental disclosure violations. Secondly, this study finds that firm profitability positively influences corporate environmental disclosure. This conclusion can help regulatory authorities identify companies that have strong profitability but still perform poorly in disclosure. Such firms are capable of improving disclosure and can serve as

benchmarks for others. These companies have the capability to engage in enhanced corporate environmental disclosure and can lead by example for other companies with average firm profitability. Lastly, this study affirms both the direct and moderating effects of corporate governance on environmental disclosure. These findings can draw greater government attention to the importance of strengthening governance effectiveness. This affirmation is particularly relevant in the context of strengthening corporate governance standards, helping stakeholders better understand how to enhance corporate environmental disclosure from a corporate governance perspective.

Similarly, by elucidating the impact of corporate environmental disclosure on financing costs, government authorities can refine the mechanisms for environmental credit restrictions on companies. The restrictions involve registering companies with deficiencies in their corporate environmental disclosure practices in the environmental credit system, thereby imposing restrictions on financial activities such as equity issuance, bond issuance and stock exchange listing. In addition, clarifying the positive moderating effect of corporate governance on the relationship between corporate environmental disclosure and financing costs may further prompt government bodies to place greater emphasis on the effectiveness of governance mechanisms. Hence, for enterprises that engage in effective corporate governance and environmental disclosure, regulators can offer appropriate certifications to reduce information

asymmetry and enhance the credibility of disclosed information. Such recognition can help alleviate concerns among banks and support differentiated lending practices. In addition, it can improve firms' credibility in stock and bond markets, thereby attracting investors and facilitating low-cost financing. Ultimately, this will help companies with enhanced corporate environmental disclosure practices progress more smoothly and promote their sustainable development.

1.7 Definition of Terms

1.7.1 Corporate Environmental Disclosure

Corporate environmental disclosure refers to the practice whereby companies make their environmental performance and corresponding environmental responsibilities publicly available through various channels (X. Wang, et al., 2022).

In this study, corporate environmental disclosure refers to the quality of disclosure, which is measured based on a content analysis of five dimensions: environmental certification, environmental management, environmental regulatory disclosure, environmental liabilities, and environmental performance and governance. Each component is assessed using a structured scoring system adapted from the China Stock Market Accounting Research (CSMAR) database.

1.7.2 Pharmaceutical Companies

In accordance with the *Industrial Classification for National Economic Activities* (National Bureau of Statistics of China, 2017), the pharmaceutical manufacturing industry (C27) refers to the process wherein raw materials undergo physical or chemical changes to become new pharmaceutical products.

In this study, pharmaceutical companies refer to Chinese listed companies whose industry classification falls under pharmaceutical manufacturing and whose shares have been publicly issued and approved for listing and trading on the Shanghai Stock Exchange (SSE) or the Shenzhen Stock Exchange (SZSE), under the supervision of the CSRC.

1.7.3 Regulatory Pressure

Regulatory pressure refers to the government's utilization of coercive measures to impose constraints and limitations on individuals, legal entities, and enterprises at the micro level. These measures are intended to achieve public policy objectives, thereby creating welfare or potential welfare for the public (Feng, 2021).

In this study, regulatory pressure is operationalised by counting the occurrences of 15 environment-related keywords in provincial government work reports, following the approach proposed by Yin et al. (2022). This proxy captures cross-provincial variation in regulatory intensity, as reflected in official

policy documents.

1.7.4 Media Exposure

Media exposure refers to the level of focus that media directs toward a specific enterprise, measured by the quantity of news reports that are either published by or reproduced in the media (Ji, 2020).

Media exposure is operationalised through the natural logarithm of "1 + the number of news reports" about each company, following the approach of F. S. Wang et al. (2022). This approach captures the overall volume of media exposure received from multiple channels.

1.7.5 Firm Profitability

Firm profitability refers to the ability of a business or investment to generate profit or financial gain relative to its costs and expenses. It is typically manifested by the amount of earnings generated by a company within a specific period and the level of those earnings. In this study, firm profitability is measured using the Return on Total Equity (ROE) (Lin & Zhou, 2022).

1.7.6 Corporate Governance

Corporate governance constitutes a comprehensive institutional arrangement to coordinate the economic relationships among various stakeholders (Lin et al., 1995). Thus, examining a single variable in isolation

may not effectively reflect the overall governance status of a company.

This study applies principal component analysis (PCA) to nine selected corporate governance variables, following Wang and Yuan (2022). Based on the first principal component, the factor loading coefficients for each indicator are used to construct a composite measure reflecting overall governance.

1.7.7 Financing Cost

Financing cost refers to the expense incurred by a company in obtaining a stable source of funds during the financing process. It represents the remuneration paid by the capital recipient to the capital provider. Corporate financing is broadly divided into two main types based on investors' nature: equity financing and debt financing (Jiang, 2009).

1.7.7.1 Cost of Equity

The cost of equity refers to the expected rate of return that investors require as compensation for bearing ownership risk in a company, after assessing operational risks and profitability potential. It represents the return that shareholders expect to receive in return for bearing the risk of investing in the firm's shares (Modigliani & Miller, 1958). This study employs the Price/Earnings to Growth (PEG) model to measure the cost of equity, in accordance with the method employed by Yao et al. (2024).

1.7.7.2 Cost of Debt

Cost of debt refers to the cost to a firm of using funds from creditors (Modigliani & Miller, 1958). This study measures the cost of debt using the financial expense ratio (the proportion of financial expenses relative to year-end total liabilities), based on the method of Peng and Sun (2024).

1.8 Structure of the Study

The specific structure of this study is as follows:

Chapter 1 is the introduction. First, the background of the study is introduced. Then, it provides a clear statement of the problems under the study, and outlines the research questions and objectives. Additionally, the significance of the study is discussed from four perspectives: theoretical significance, contributions to scholars, companies and regulatory authorities. Finally, key definitions of terms are provided to establish a foundational understanding.

Chapter 2 is the literature review. In this chapter, theoretical foundations and the theoretical framework are presented. Then, it summarizes and organizes existing literature (on the influencing factors and financing costs), and develops related hypotheses and two conceptual frameworks.

Chapter 3 is the research methodology. Firstly, the research design is clearly outlined. Secondly, sample selection and data collection are presented.

Thirdly, all variables are defined, including explanatory variables, dependent variables, moderating variables, and control variables. Finally, research models and the methods of data analysis are specified, including both static and dynamic panel estimations.

Chapter 4 is the analysis and discussion of the factors influencing corporate environmental disclosure. This chapter begins with a descriptive analysis, correlation analysis and preliminary analysis of the variables involved. The analysis then examines the influence of four factors (regulatory pressure, media exposure, corporate governance and firm profitability) on corporate environmental disclosure, while also examining the moderating effects of corporate governance. Finally, the robustness of the conclusions is validated.

Chapter 5 is the analysis and discussion of the impact of corporate environmental disclosure on financing costs. Similar to chapter 4, it includes the descriptive analysis, correlation analysis and preliminary analysis of the related variables. Then, the analyses examine the impact of corporate environmental disclosure on the cost of equity and the cost of debt, in conjunction with corporate governance acting as a moderator. Finally, robustness tests of the regression are performed.

Chapter 6 is the conclusion of the study. This chapter begins by summarizing the conclusions from earlier analyses on the factors influencing

corporate environmental disclosure and its impact on financing costs. Next, some study implications are explained from theoretical, policy and managerial aspects. Finally, it discusses the limitations and future research directions, followed by final remarks on the overall findings and contributions of the study.

Chapter Two

LITERATURE REVIEW

2.1 Overview of the Chapter

This chapter analyses the theories employed in the study along with relevant literature. Section 2.2 first discusses the main theories related to corporate environmental disclosure. In Section 2.3, the theoretical framework of this study is formulated. Section 2.4 analyses both the disclosure quality and the accessibility of disclosure data. Sections 2.5 analyses the influencing factors of corporate environmental disclosure in light of the past literature and formulates the corresponding hypotheses and Conceptual Framework 1. Section 2.6 investigates the impact of corporate environmental disclosure on financing costs and formulates the corresponding hypotheses and Conceptual Framework 2. Section 2.7 summarizes the problems and research gaps in the existing literature. Section 2.8 concludes the chapter.

2.2 Theoretical Foundation

While many studies on corporate environmental disclosure rely on a single theoretical lens, such as stakeholder theory (Shah et al., 2021), legitimacy theory (Akhter et al., 2023), or agency theory (Gerged, 2021), corporate environmental disclosure is inherently complex and multifaceted. It involves interactions between internal decision-making, external stakeholder demands,

institutional legitimacy pressures, and capital market dynamics. Therefore, no single theory can comprehensively explain the full range of factors driving corporate environmental disclosure (Cormier et al., 2005). To address this complexity, scholars increasingly adopt multiple theoretical perspectives as complementary rather than competing, providing a more holistic understanding of corporate environmental disclosure behaviour (Helfaya & Moussa, 2017).

In the context of China, where government-led institutional transitions, evolving disclosure mandates, and stakeholder expectations coexist, an integrated theoretical framework is particularly relevant. This study draws on stakeholder theory, legitimacy theory, signalling theory, and agency theory to build an inclusive framework for analysing both the influencing factors and economic consequences of corporate environmental disclosure, with special attention to the moderating role of corporate governance.

2.2.1 Stakeholder Theory

The concept of stakeholder was first introduced by the Stanford Research Institute in 1963, defined as "those groups without whose support the organization would cease to exist" (as cited in Freeman, 1984). Building on this initial definition, Freeman (1984) broadened the concept to include any individuals or groups who can affect, or are affected by, the achievement of a company's objectives. This expanded concept formally recognises a diverse range of stakeholders, such as competitors, local communities, governments,

environmentalists, and the media. As companies extend their operations and impact boundaries, the number and diversity of relevant stakeholders continue to increase.

Given this broadened stakeholder landscape, it becomes essential to consider how companies should address the varied expectations and interests of these groups. According to Donaldson and Preston (1995), beyond addressing the explicit needs of shareholders and creditors, firms should also take into account the implicit interests of other stakeholders. The development of companies is intertwined with these stakeholders and thus requires a proactive response to their concerns and a sense of responsibility towards them (Freeman & Velamuri, 2023). The disclosure of social responsibility and environmental information seeks to protect stakeholder interests by enhancing the monitoring function of information (Brown & Fraser, 2006). Consequently, corporate environmental disclosure is seen as a mode through which firms respond to stakeholders (Huang & Kung, 2010). Accordingly, underpinned by the stakeholder theory (Freeman, 1984), timely and effective environmental disclosure helps meet company stakeholders' information needs.

In China, the key stakeholders of corporate environmental disclosure encompass government authorities (Huang & Kung, 2010), the media (Bi et al., 2012), managers (Wang & Li, 2020), the board of directors and supervisory

board⁴ (Liu, 2013), shareholders and creditors (Wang et al., 2013).

First, in China, both government authorities and the media exert substantial influence on the environmental disclosure practices. (1) Government authorities in China⁵ serve as crucial consumers of environmental information. The more emphasis the government places on corporate environmental disclosure, the stronger the regulatory measures it enforces on it (Shen & Feng, 2012). Therefore, regulatory pressure can exemplify the government's stakeholder concern about corporate environmental disclosure. (2) The media possesses the "Fourth Estate"⁶ (Schultz, 1998) and functions as a watchdog and information conduit for society. Heightened media exposure can direct public attention towards a company's environmental performance, generate societal pressure, and compel enterprises to enhance corporate environmental disclosure (Dai & Dong, 2015). Hence, media exposure represents the media's stakeholder oversight of corporate environmental disclosure.

Second, internal stakeholders such as managers, the board of directors and the supervisory board also play important roles in influencing corporate

⁴Supervisory Board: A legally required and permanent body composed of supervisors elected by the shareholders' (or general) meeting and those elected democratically by the company's employees, responsible for overseeing and inspecting the company's business activities (Standing Committee of the National People's Congress, 2018).

⁵Such as: Ministry of Ecology and Environment of China, China Securities Regulatory Commission, China Banking and Insurance Regulatory Commission, SSE, SZSE, etc. (Liu & Li, 2014).

⁶Fourth Estate refers to the fourth political power in addition to the "executive, legislative, and judicial powers" and generally refers to the media power (Stewart, 1974).

environmental disclosure. (3) Managers may demand high-quality corporate environmental disclosure to preserve their personal reputation (Li & Huo, 2018). However, the profit-oriented nature of managerial behaviour implies that goals related to corporate social and environmental responsibility are typically pursued conditional upon the achievement of primary commercial objectives. Therefore, managers can promote corporate environmental disclosure only on the basis of strong firm profitability. (4) In China, listed companies typically adopt a dual board system, comprising a board of directors and a supervisory board. These two bodies also need to acquire environmental information to fulfil their respective supervisory and governance responsibilities (Zhang, 2013; Lyu, 2006). Effective corporate governance requires a clear allocation of responsibilities among managers, the board of directors, and the supervisory board, which creates strong internal constraints on the quality of disclosed information (Xu, 2011). Thus, they also can influence corporate environmental disclosure based on the needs of stakeholders.

Finally, in order to mitigate the information asymmetry between firms (Zhang et al., 2003; Yan, 2012), both investors and creditors emphasise corporate environmental disclosure. (5) Investors, driven by concerns over investment security and profitability, necessitate access to a company's environmental information to analyse environmental costs and benefits, mitigate environmental risks, and avert negative repercussions such as litigation and penalties (Dai &

Dong, 2015). Therefore, a deeper understanding of corporate environmental disclosure can help investors make informed investment decisions. (6) Creditors, in pursuit of their interests (timely repayment of debt and interest), also require insights into corporate environmental disclosure. If a company faces environmental pollution issues, it not only affects future corporate earnings but also escalates creditor risk (Zheng, 2010). Meanwhile, within firms, executives who act as agents of shareholders tend to demonstrate higher ethical standards when their companies perform better in fulfilling environmental protection responsibilities (as part of broader social responsibilities). Such executives place greater value on long-term, mutually beneficial partnerships with creditors and are therefore less likely to act in ways that harm creditors' interests (Choi et al., 2017). Hence, obtaining corporate environmental disclosure is essential to assist creditors in making sound lending decisions.

In conclusion, based on stakeholder theory (Freeman, 1984), corporate environmental disclosure is subject to the attention of stakeholders (Huang & Kung, 2010). Taking into account the Chinese context, regulatory pressure and media exposure, representing the government and media, can influence corporate environmental disclosure. Additionally, considering the managers and the dual board system, both firm profitability and corporate governance can significantly shape corporate environmental disclosure. Finally, investors and creditors' access to disclosed environmental information can impact their

respective investment and lending decisions. Recent empirical studies have also applied stakeholder theory to examine environmental disclosure practices in the Chinese context, confirming the significant influence of stakeholder expectations on corporate behaviour (Yao, 2023; W. T. Zhao et al., 2024; Wang et al., 2025).

While stakeholder theory provides a useful lens for analysing these relationships, it is not without limitations. One key limitation of stakeholder theory is that it may overlook the economic constraints firms face when attempting to balance conflicting stakeholder interests (Banerjee, 2008). Therefore, this study incorporates legitimacy theory, agency theory, and signalling theory as complementary perspectives to address these limitations.

2.2.2 Legitimacy Theory

Weber (1937) introduced the concept of legitimacy into sociological research, arguing that a social order is legitimate only if it conforms to established norms and rules, such as social authority and political systems. Building on this foundation, Parsons (1960) extended the concept to organisational sociology. The author proposed that legitimacy can be achieved not only by adhering to formal laws and regulations but also by aligning organisational behaviour and the social values it represents with the requirements of the broader social value system.

As a type of social entity, companies also have a need for legitimacy. Najah's (2012) analysis highlighted that societal perceptions of organisational legitimacy are dynamic and evolve with changing circumstances. The introduction of stringent environmental laws and rising public demand for environmental protection have raised the threshold for corporate legitimacy. Growing societal attention to environmental issues has further positioned environmental performance as a pivotal facet of corporate legitimacy (Shen & Feng, 2012). Recent empirical evidence in the Chinese context shows that firms respond to increased regulatory pressure by improving corporate environmental disclosure to maintain their legitimacy (Wei et al., 2024).

In addition, legitimacy theory assumes that organisations must consider not only the rights of their investors, but also the rights of the public at large (Deegan & Rankin, 1996). Thus, on one hand, as China continues to introduce more stringent and comprehensive corporate environmental disclosure requirements⁷, legal and policy pressure from governmental departments exerts legitimacy stress on companies. On the other hand, as environmental issues become more frequent, the public holds higher expectations and demands for corporate environmental protection. This public pressure, often channelled through media exposure (Luo, 2012), intensifies the legitimacy demands on businesses in China. Recent studies such as Jiang et al. (2023) provide empirical

⁷ Detailed policy requirements included in Appendix A.

evidence that media exposure increases stakeholder scrutiny, prompting firms to enhance environmental disclosure as a means of maintaining legitimacy.

Therefore, it is possible to interpret corporate environmental disclosure as a response to environmental pressures (including political, social, and economic pressures) (Deegan & Rankin, 1996). Only through the disclosure of environmental information can a company showcase its commitment to environmental responsibility, demonstrate its determination to adhere to social norms, ensure compliance with environmental laws and regulations, and respond to public concerns. This process supports the company's legitimacy strategy (Li, 2012) and secures the various essential resources needed for corporate development.

In conclusion, based on legitimacy theory (Parsons, 1960), corporations strive to achieve legitimacy goals by disclosing environmental information under the supervisory pressure of government and media (Chen & Tao, 2022). Hence, this is supported by recent empirical studies on Chinese firms, which confirm that legitimacy considerations and stakeholder expectations significantly shape corporate disclosure behaviours.

2.2.3 Signalling Theory

Signalling theory, originally introduced by Spence (1978), suggests that market participants often possess unequal access to information, leading to

asymmetry in decision-making. To address this issue and enhance market efficiency and fairness, the more informed party can convey credible signals to reduce uncertainty for the less informed counterpart. Without such information transfer, serious asymmetry may arise.

Information asymmetry exists between companies and investors and creditors (Zhang et al., 2003; Yan, 2012). Firms hold more internal information, placing them at an advantage, whereas investors and creditors, with limited access, are disadvantaged. This asymmetry may lead to adverse selection and inefficient resource allocation in capital markets (Chen, 2011). As a result, companies with superior performance often disclose more information on the capital market, to communicate their positive attributes to the market and attract potential investors and creditors. Conversely, poorly managed firms may conceal unfavourable information.

This pattern also applies to environmental performance: firms can reduce information asymmetry by voluntarily disclosing relevant environmental information. Therefore, companies with favourable environmental performance willingly disclose more information voluntarily, conveying favourable signals to stakeholders, enhancing their reputation, and safeguarding stakeholders' right to access accurate and timely environmental information (Cao & Qiao, 2023). In essence, corporate environmental disclosure functions as a communication bridge between businesses and stakeholders, signalling the company's

commitment to social responsibility and its high value to investors and creditors.

Based on signalling theory (Spence, 1978), companies can disclose environmental information to demonstrate their fulfilment of environmental responsibilities to investors. This helps mitigate problems of adverse selection and moral hazard arising from asymmetric information, thereby enhancing stock liquidity, lowering transaction costs, and ultimately reducing the cost of equity (Luo, Cai, et al., 2020). Recent empirical studies in China also confirm this relationship on the equity side. Lyu et al. (2022) showed that high-quality voluntary environmental disclosure lowers the cost of equity by enhancing transparency and investor confidence. From the perspective of debt financing, enhanced corporate environmental disclosure enables creditors to better assess company operational risks, thereby minimizing unnecessary monitoring costs. As a result, creditors may offer a lower cost of debt to the company (Guan & Xiao, 2019). Recent empirical studies on Chinese heavily polluting firms also support this view. Luo et al. (2025) found that the high-quality disclosure functions as a strong signal that mitigates information asymmetry and enhances financing access.

2.2.4 Agency Theory

The agency theory proposed by Jensen and Meckling (1976) suggests that if both principals (shareholders) and agents (managers) are focused on maximising their own interests, conflicts between them make it challenging for

principals to observe and monitor agents' actions, leading agents to act against principal interests.

Agency conflicts also affect corporate environmental disclosure. This is because information disclosure helps reduce information asymmetry among parties and prevents the intensification of conflicts among stakeholders, thereby lowering agency costs (Feng & Li, 2015). Given the global scope of environmental issues, environmental information has become one of the most emphasised aspects of information disclosure (Bi et al., 2012). Principals desire more environmental information to regulate agents' behaviours and reduce agency costs. However, improved corporate environmental disclosure requires additional corporate expenditure (Blankespoor et al., 2020), which may impact current profits. Managers aim to meet operational targets (Ponlantz, 2017) to receive expected compensation. In the presence of principal-agent conflicts, managers may prioritise personal interests at the expense of those of the principals (Ross, 1973). Therefore, only managers in more profitable firms, who have already met their own interests, are more likely to invest in activities in corporate environmental disclosure. Recent evidence from Chinese heavy-polluting firms also supports this view. Zheng and Yue (2020) found that financial pressure and information asymmetry incentivize managers to reduce agency risks through disclosure.

Within the agency theory framework, corporate governance operates as

a key internal mechanism for aligning managerial actions with shareholder interests. By establishing formal oversight and control systems, it complements voluntary and mandatory disclosure requirements and ensures that environmental reporting meets stakeholder expectations. In this way, grounded in agency theory (Gao, 2016), corporate governance encourages agents, who are inherently driven by personal interests, to make decisions that prioritise principals' long-term objectives (Denis & McConnell, 2003). Therefore, based on agency theory (Jensen & Meckling, 1976), corporate governance can shape corporate environmental disclosure through two interrelated theoretical pathways: (1) a direct influence on disclosure behaviour; and (2) a moderating influence on both (a) the relationships between regulatory pressure, media exposure and firm profitability and the disclosure, and (b) the relationship between the disclosure and financing costs (cost of equity and cost of debt).

First, the direct influence stems from the role of corporate governance in addressing agency problems. It has been shown that there can be an information asymmetry between shareholders and managers as a result of which managers might proceed in a manner in conflict with the shareholders' interests (Berle & Means, 1932). Healy and Palepu (2001) also argued that one motivation for voluntary corporate information disclosure is to prevent adverse selection and moral hazard arising from agency issues between shareholders and management. Consequently, companies with effective corporate governance are more likely to

provide transparent and accurate information, reducing information asymmetry and agency costs (Zhang & Liao, 2010). Recent empirical research in China also affirms this agency perspective. Feng and Hong (2024) found that more effective corporate governance significantly enhanced corporate environmental disclosure by mitigating information asymmetry and aligning managerial interests. This implies that firms with effective corporate governance are generally more likely to comply with environmental regulations and enhance corporate environmental disclosure. Well-governed companies are also less likely to engage in selective or deceptive environmental reporting that could mislead external stakeholders. Having established this theoretical basis for the direct influence of corporate governance on such disclosure, the following sections examine its moderating role in different contextual relationships.

Second, corporate governance can shape how regulatory pressure, media exposure, and firm profitability, influence corporate environmental disclosure by enhancing internal oversight and aligning managerial decisions with stakeholder interests.

One important dimension involves firms' responses to external pressure. When companies face significant external pressures, such as regulatory interventions or media scrutiny, they tend to be more motivated to enhance environmental disclosure. Although the Chinese government has increased regulatory efforts (Liu, 2022), and scholars have recognised the role of media

exposure in promoting disclosure (X. Wang, et al., 2022), the overall quality of disclosure remains inadequate. In particular, listed pharmaceutical companies in China perform poorly compared to other heavily polluting industries (Mu, 2021). This suggests that external pressure alone is insufficient. It must be complemented by robust internal governance mechanisms to improve disclosure practices. In this context, effective corporate governance can empower the board of directors and supervisory board to perform stronger internal oversight functions (Liu & Liu, 2001), thereby encouraging the formulation and enforcement of rigorous disclosure requirements. Furthermore, corporate governance serves as a system of internal control that ensures organizational compliance with laws, regulations, and institutional norms (Cui, 2022). When regulatory requirements are in place, effective corporate governance can guide employees to prioritize disclosure tasks and coordinate implementation across departments. As a result, firms with effective governance are better positioned to respond to regulatory pressure and media exposure by enhancing corporate environmental disclosure.

Another dimension is how corporate governance shapes the influence of firm profitability on corporate environmental disclosure. While shareholders demand comprehensive environmental information to monitor management and reduce agency costs, disclosure decisions are made and implemented by managers (Bi et al., 2012). In China's current regulatory environment, where

mandatory disclosure requirements remain underdeveloped, many firms still exhibit reluctance to disclose or selectively report favourable information (Bai & Gu, 2023). This indicates a lack of internal enforcement and insufficient managerial commitment to disclosure integrity. Corporate governance helps address this issue by balancing the interests of shareholders, boards, and managers (Dang & Lu, 2012), thereby promoting more impartial and stakeholder-aligned decision-making. Additionally, effective governance enhances decision-making efficiency (Liu, 2003). Disclosure quality depends not only on policy formulation but also on effective implementation. Firms with strong governance can better allocate resources, reward contributors appropriately, and ensure disclosure-related tasks are carried out effectively. As a result, profitable firms with sound governance structures tend to improve disclosure quality, particularly when stakeholder alignment and operational efficiency are achieved.

Third, corporate governance can shape the extent to which corporate environmental disclosure impacts the cost of equity and cost of debt by balancing stakeholder interests and strengthening oversight functions. As noted above, effective corporate governance can balance stakeholders' interests (Dang & Lu, 2012), enabling well-governed companies to prevent certain internal stakeholders from manipulating the timeliness and accuracy of disclosed information for short-term gain. Similarly, effective governance enhances the

internal oversight roles of the board of directors and the supervisory board (Liu & Liu, 2001). With stronger internal oversight, companies are more likely to fulfil their social responsibilities and enhance corporate environmental disclosure, avoiding selective disclosure that might mislead external parties due to management or shareholder interests. By ensuring the accuracy, completeness, and credibility of environmental information, corporate governance helps such disclosure become a reliable signal to investors and creditors. Therefore, high-quality corporate environmental disclosure builds greater trust among stakeholders, such as investors and creditors, who in turn are more likely to reduce transaction costs, ultimately lowering both cost of equity and cost of debt.

In summary, based on agency theory (Jensen & Meckling, 1976), both enhanced firm profitability and effective corporate governance can improve corporate environmental disclosure. Moreover, corporate governance plays critical roles in monitoring, decision-making, and stakeholder balancing (Liu & Liu, 2001; Liu, 2003; Dang & Lu, 2012; Cui, 2022). These functions enable corporate governance to reinforce both (1) the influence of regulatory pressure, media exposure, and firm profitability on disclosure, and (2) the impact of disclosure on the cost of equity and the cost of debt.

2.3 Theoretical Framework

The review of the theoretical foundation in the preceding sections suggests that the stakeholder theory, agency theory, legitimacy theory and

signalling theory collectively offer the theoretical framework to analyse the influencing factors of corporate environmental disclosure and its impact on the financing costs of enterprises. While stakeholder theory serves as the core framework, the integration of additional theories provides complementary explanatory depth.

Stakeholder theory (Freeman, 1984) serves as a key theoretical foundation for studying factors influencing corporate environmental disclosure (Elijido-Ten, 2004). It posits that companies need to manage relationships with various stakeholders to gain a competitive edge and achieve corporate objectives (Harrison et al., 2010). Since corporate development relies on these stakeholders, companies must actively respond to their concerns and take responsibility for their interests (Freeman & Velamuri, 2023). Given that stakeholders placed significant emphasis on corporate environmental disclosure (Lu & Abeysekera, 2014), such disclosure becomes a primary mechanism for companies to meet the environmental information needs of key stakeholder groups.

Further, corporate environmental disclosure is a complex phenomenon that cannot be explained by a single theory alone (Cormier et al., 2005). Scholars, such as Zhang et al. (2016) and Odoemelam and Okafor (2018), opt to employ stakeholder theory (Freeman, 1984), legitimacy theory (Parsons, 1960) and agency theory (Jensen & Meckling, 1976) and delve deeper into the factors influencing corporate environmental information. This theoretical pluralism

reflects the need to capture both external institutional forces and internal managerial behaviours.

Combining stakeholder theory (Freeman, 1984) and legitimacy theory (Parsons, 1960), corporate environmental disclosure is viewed as a response to environmental pressures (Deegan & Rankin, 1996). To safeguard external stakeholders' interests and maintain legitimacy, companies must meet their demands and expectations, ultimately disclosing environmental information (Campbell, 2003). The government and media, as critical external stakeholders, often require corporate environmental disclosures. The resulting regulatory pressure from the government and media exposure from public attention pressure encourage corporate environmental disclosure practices. In this respect, legitimacy theory complements stakeholder theory by emphasising the normative and institutional forces behind stakeholder expectations.

Agency theory (Jensen & Meckling, 1976) posits that individuals within modern corporate systems are primarily self-interested-driven. Managers aim to achieve operational goals (Ponlantz, 2017). Under this framework, managers, motivated by self-interest, are likely to disclose more environmental information only after achieving their target profits. Thus, managers in more profitable companies, after satisfying their personal interests, are more inclined to increase corporate environmental disclosures. Additionally, by combining stakeholder theory (Freeman, 1984) with agency theory (Jensen & Meckling, 1976), there

appears to be an information asymmetry between management and shareholders that may result in managerial behaviour that conflicts with shareholders' interests (Berle & Means, 1932). Effective corporate governance plays a crucial role in mitigating this issue by promoting heightened transparency and reducing information asymmetry and agency costs (Zhang & Liao, 2010). Therefore, effective corporate governance fosters better corporate environmental disclosure. Here, agency theory extends stakeholder theory by explaining why internal misalignment may hinder firms from fulfilling external disclosure demands.

Signalling theory (Spence, 1978) posits corporate environmental disclosure behaviour may lead to capital market reactions⁸ (Xiang et al., 2011). In addition, integrating insights from stakeholder theory (Freeman, 1984), equity financing involves shareholders and potential investors, while debt financing involves creditors. Both the providers of funds are stakeholders and close attention to the corporate environmental information in investment decisions (Clarkson et al., 2010) and borrowing decisions (Eliwa et al., 2021). Hence, enhanced corporate environmental disclosure contributes to reduce information asymmetry between companies and investors as well as creditors (Pedron et al., 2021). As a result, companies convey a signal of responsibility, trustworthiness, and social accountability to investors and creditors. This, in turn, reduces risk

⁸ According to Xiang et al. (2011), in the face of different disclosure of environmental information by enterprises, the stock market will exhibit abnormal yield fluctuations. In other words, the Chinese stock market will react to the disclosure of environmental information by listed companies in heavy pollution industries.

for investors and creditors, ultimately leading to a decrease in financing costs (Li et al., 2019; Atasel et al., 2020). Signalling theory therefore serves as a complementary perspective to stakeholder considerations by focusing on how disclosure behaviour is interpreted by financial audiences.

By integrating agency theory (Jensen & Meckling, 1976), stakeholder theory (Freeman, 1984), and legitimacy theory (Parsons, 1960), corporate governance can further influence corporate environmental disclosure through its roles in oversight, enhancing decision-making efficiency, balancing stakeholder interests, and ensuring the effective operation of the firm (Liu & Liu, 2001; Liu, 2003; Dang & Lu, 2012; Cui, 2022). It also serves as the operational bridge between internal incentives (agency theory), institutional demands (legitimacy theory), and market signalling outcomes (signalling theory).

First, when companies face external supervisory pressures from government agencies and media agencies, corporate governance can promote corporate environmental disclosure through the internal supervisory functions of the board of directors and the board of supervisors (Liu & Liu, 2001), and through management systems and mechanisms that ensure the effective operation of the company and employee compliance with their duties (Cui, 2022). To be specific, effective corporate governance can encourage the board of directors and supervisory board to oversee corporate managers, thereby prompting managers to react to external institutional and societal demands by

enhancing corporate environmental disclosure. In addition, effective corporate governance can ensure the efficient operation of the company while ensuring that company employees fulfil their responsibilities in accordance with laws, regulations, and corporate policies, leading to more efficient managerial decision-making and improved environmental disclosure. Therefore, effective corporate governance can strengthen the positive influence of regulatory pressure and media exposure. Thus, corporate governance moderates the relationship between institutional-level stakeholder pressures (i.e., regulation and media) and actual disclosure behaviour, serving as an internal enabler.

Second, as firm profitability increases, enterprises gain more financial resources to engage in enhanced corporate environmental disclosure (Li & Zhang, 2017). Enhanced firm profitability gives companies the ability and tendency to improve corporate environmental disclosure. However, this improvement can only be reflected in the final disclosure process after the implementation of a series of internal management mechanisms. Effective corporate governance can also enhance the efficiency of corporate decision-making (Liu, 2003), which means a sound decision can only achieve its intended outcomes when it is effectively implemented. In addition, agency problems between managers and shareholders can potentially hinder a company from implementing enhanced corporate environmental disclosure, while effective corporate governance can better balance the interests of stakeholders (Dang &

Lu, 2012), ensuring that a company considers the interests of different stakeholders rather than favouring one particular group, thereby reducing agency costs. Therefore, corporate governance not only facilitates the execution of disclosure strategies but also moderates the link between firm profitability and the disclosure, ensuring that financial capacity translates into concrete disclosure outcomes.

Third, combining agency theory (Jensen & Meckling, 1976) and signalling theory (Spence, 1978), corporate governance can also strengthen the impact of corporate environmental disclosure on both cost of equity (Li, 2019), and cost of debt (Shan, 2018). Companies that actively engage in enhanced corporate environmental disclosure can be seen as sending signals to information users (e.g., investors and creditors) to gain their recognition and support. However, the credibility of this type of disclosure by Chinese enterprises is subject to certain doubts due to the lack of detailed and unified standards, as well as third-party audits and certifications (Cao & Xu, 2019). In that case, effective corporate governance can balance the interests of stakeholders (Dang & Lu, 2012), thereby preventing certain internal stakeholders from manipulating the timeliness and accuracy of disclosed information for short-term gains. Similarly, effective corporate governance enables the dual board system to exercise better internal oversight (Liu & Liu, 2001). This ensures that companies better fulfil their social responsibilities and fully and accurately disclose environmental

information, showcasing the company's efforts and achievements in environmental protection (Li, 2014). Accordingly, corporate governance moderates the relationship between corporate environmental disclosure and capital market responses by enhancing the reliability of the signals being transmitted. When corporate governance is effective, investors and creditors are more likely to trust disclosed information and adjust their risk expectations, thereby reducing financing costs.

Taken together, corporate governance constitutes an essential integrative element in the theoretical framework by connecting institutional stakeholder demands (stakeholder and legitimacy theory), internal behavioural alignment (agency theory), and capital market signalling (signalling theory). It not only exerts a direct influence on disclosure decisions but also moderates multiple key relationships within the disclosure-finance nexus, thereby reinforcing the explanatory power of the integrated theoretical model.

Grounded in stakeholder theory (Freeman, 1984), legitimacy theory (Parsons, 1960), agency theory (Jensen & Meckling, 1976), and signalling theory (Spence, 1978), this study develops an integrated framework to examine both the influencing factors and financial consequences of corporate environmental disclosure. Specifically, stakeholder theory provides the overarching perspective for identifying key drivers and stakeholder pressures, while legitimacy theory and agency theory offer institutional and managerial

explanations for how external and internal factors influence disclosure behaviour. In parallel, signalling theory and stakeholder theory support the link between corporate environmental disclosure and financing costs, with agency theory highlighting the moderating role of corporate governance in enhancing the credibility and effectiveness of disclosure. Altogether, the framework conceptualises the process through which corporate environmental disclosure is driven by both external and internal factors and, in turn, influences financing costs. It further highlights the intermediary function of corporate governance in shaping the dynamics of both stages in this process. The selection of these variables is informed by their theoretical relevance and empirical significance as key external and internal factors shaping disclosure behaviour and its financial consequences. Based on the preceding discussion, the theoretical framework is presented in Figure 2.1.

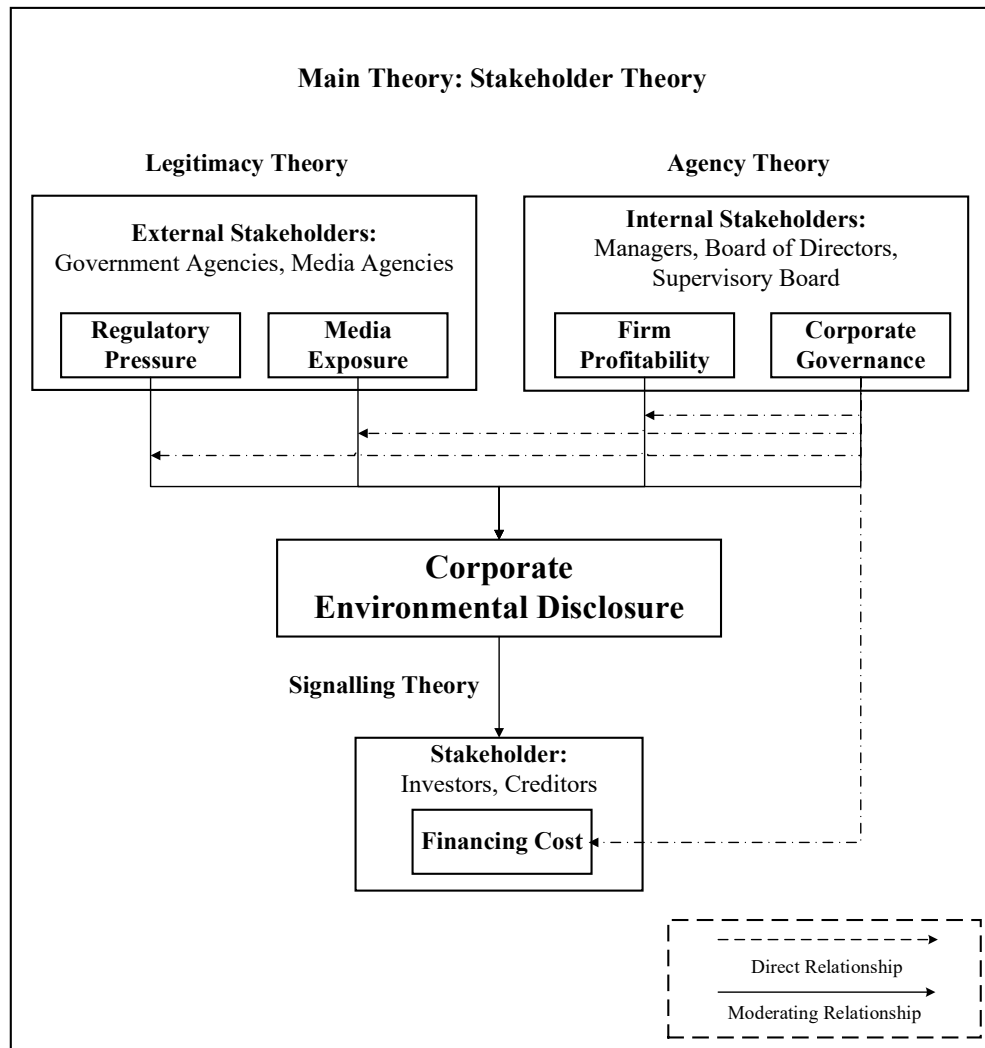


Figure 2.1 Theoretical Framework

2.4 Overview of Corporate Environmental Disclosure

2.4.1 Quality of Corporate Environmental Disclosure

The term "environment" in the context of environmental information refers to the potential impact of an organisation's operations on the environment (Campbell, 2004). In addition, corporate environmental disclosure involves the collection, identification, classification, measurement, calculation or estimation, recording, verification and subsequent disclosure of environmental data within the accounting system (Schaltegger & Burritt, 2017). In China, corporate

environmental disclosure is defined as the practice whereby companies make their environmental performance and corresponding environmental responsibilities publicly available through various channels (X. Wang, et al., 2022). Thus, it is also considered a primary method by which companies communicate their fulfilment of environmental responsibilities to the outside world (Cai & Jin, 2019).

An increasing number of Chinese listed companies are opting to engage in corporate environmental disclosure⁹, while companies have a great deal of freedom in deciding what information to include in their corporate environmental disclosure (Chen et al., 2022). Furthermore, Li and Wang (2018) also corroborated the assertion and contended that, based on the disclosed content, many companies selectively disclose environmental information, primarily relying on qualitative textual descriptions. These authors also concluded that the disclosed content exhibits a self-serving bias, with a higher tendency to disclose positive information while downplaying negative information. In addition, Chen and Wang (2021) also found that the majority of environmental information disclosed by Chinese listed companies is descriptive in nature, with minimal coverage of negative indicators. Simultaneously, the disclosure rate of environmental indicators is low, and companies exhibit limited engagement with critical indicators in their corporate environmental disclosure

⁹ As illustrated in Figure 1.1

process.

Therefore, when studying Chinese listed companies' corporate environmental disclosure, it is essential to focus not only on the quantity of disclosed information but also on its quality. To better and more accurately reflect the actual condition of corporate environmental disclosure in China, it is necessary to adopt a comprehensive assessment approach that incorporates both qualitative and quantitative evaluations.

2.4.2 Access to Corporate Environmental Disclosure Data

Currently, regulatory policies in China have mandated key polluting units to disclose their corporate environmental information and encourage other companies to voluntarily disclose environmental information¹⁰. However, there is a lack of consistency in corporate environmental disclosure standards among companies, resulting in significant variations in disclosure practices (Zhou, 2020). Additionally, policies have not explicitly stipulated whether environmental information should be disclosed in a qualitative or quantitative manner (Zhu et al., 2019). This inconsistency makes it difficult to directly compare disclosure across firms, leading researchers to adopt two main approaches to collect data: obtaining it from third-party organizations or conducting content analysis of company reports.

¹⁰ the 2017 Guidelines (CSRC, 2017)

First, direct data from third-party organizations include several categories, such as responsibility ratings from Rankins Global, ESG ratings from Bloomberg, ESG ratings from Huazheng, and listed company social responsibility indicators from Hexun.com. There are some scholars who have used direct data from third-party organizations to measure and research corporate environmental disclosure (Fan, 2019; Wang & Li, 2024; Zhang & Ge, 2021; Liu et al., 2024). However, in the absence of a widely recognised authoritative database for corporate environmental disclosure in China (Lu et al., 2020), and the lack of clarity regarding the calculation processes and indicator selection of third-party organization direct data, many scholars choose to use the second method to access the data of corporate environmental disclosure.

Second, content analysis is the mainstream method (Clarkson et al., 2008). It is useful for corporate environmental disclosure research, because it can quantify qualitative descriptions in disclosure information, facilitating subsequent research and discussion (Bi et al., 2012). In China, many scholars use the content analysis method to obtain the data on the disclosure quality. Scholars evaluate disclosure quality based on two dimensions: the amount of disclosed information and the specificity of the reported content. However, since there is no universally recognised evaluation system for corporate environmental disclosure quality, the processes employed by scholars using the content analysis method vary. These differences are primarily reflected in the selection of

classification indicators for environmental information.

Based on the current practices of corporate environmental disclosure by Chinese companies and the requirements of relevant policies and regulations, some Chinese scholars have developed evaluation indicator systems tailored to China's specific context. These systems categorize and assign values to disclosed environmental information according to individual analyses and judgments. Representative examples include the approaches of Shen et al. (2012) and Bi et al. (2012). However, these authors' methods still have two notable shortcomings. First, manual processing approach involves significant workload and low efficiency, leading to small sample sizes in empirical studies. Second, the reliance on scorers' subjective judgment in assigning values makes it difficult to ensure analysis results accuracy (Zhang et al., 2016).

Therefore, an increasing number of scholars have chosen to use environmental information data from databases that have been processed and categorized according to standardised criteria to conduct content analysis and evaluate this type of disclosure.

Chen, He, et al. (2023) and Wei et al. (2024) both chose to collect corporate environmental disclosure data from the CSMAR database and assigned scores based on five aspects: disclosure carrier, environmental management, environmental supervision and institutional certification,

environmental liabilities, and environmental performance and governance. For disclosure carrier, environmental management, and environmental supervision and certification, since their quantitative disclosure content was limited and primarily qualitative, the authors assigned a score of 1 for disclosure cases or relevant events and 0 otherwise. For environmental performance and governance, as well as environmental liabilities, scores of 2, 1, and 0 were assigned based on the level of information disclosure. The scores were then summed to obtain the total score for each company's environmental disclosure.

Therefore, using database-provided environmental information for content analysis not only significantly reduces the subjective influence inherent in researchers categorizing and assigning values to data themselves but also effectively ensures the objectivity and reproducibility of the research data.

2.5 Factors Influencing Corporate Environmental Disclosure

Based on the theoretical framework presented in Figure 2.1, regulatory pressure, media exposure, firm profitability, and corporate governance can be key factors influencing corporate environmental disclosure, and corporate governance can be a moderating variable in the influence of regulatory pressure, media exposure and firm profitability on corporate environmental disclosure. Existing empirical studies examining these influencing factors have been conducted in different national contexts. In China, corporate environmental disclosure is closely shaped by regulatory requirements and policy arrangements,

suggesting that the roles of regulatory pressure, media exposure, firm profitability, and corporate governance warrant particular attention in this institutional setting.

2.5.1 Regulatory Pressure

Regulatory pressure refers to the utilization of compulsory measures by the government to impose constraints and limitations on individuals, legal entities, and enterprises, among other micro-level entities, to achieve public policy objectives, thereby generating benefits or potential benefits for the public (Feng, 2021). Regulatory pressure concerning environmental issues serves as a fundamental mechanism and institutional guarantee for safeguarding the ecological environment and achieving sustainable development. By promoting compliance with environmental regulations and standards among all stakeholders, it contributes significantly to improving environmental quality, fostering sustainability, and ensuring both business continuity and effective environmental protection (Luo et al., 2023).

2.5.1.1 The Influence of Regulatory Pressure on Corporate Environmental Disclosure

In China, government policy has an influence on companies, so regulatory pressure from government has also become an important influencing factor in studying corporate environmental disclosure.

There is currently limited research on Chinese listed pharmaceutical companies, and Zhao (2019) found that regulatory pressure significantly enhances corporate environmental disclosure. To be specific, based on the implementation of the *Environmental Protection Law of the People's Republic of China* (National People's Congress Standing Committee, 2014), Zhao (2019) found that intensified regulatory pressure increased the corporate environmental disclosure by Chinese listed pharmaceutical companies. Moreover, compared to the period before the enforcement of the revised *Environmental Protection Law*, this positive influence did not show a clear improvement after the implementation of the revised law (Zhao, 2019).

Many scholars have focused their research on multiple heavily polluting industries, and found that intensified regulatory pressure significantly enhances corporate environmental disclosure (He & Ren, 2020; Zhu & Jia, 2020; Chen et al., 2021; Qian et al., 2022; Lei & Huang, 2024). Among them, Chen et al. (2021) selected listed firms from six heavily polluting industries (chemical, coal, petroleum, textile, paper, and electricity) and found a statistically significant positive relationship between regulatory pressure and disclosure practices. Similarly, He and Ren (2020) analysed 16 categories of heavily polluting industries, and found that intensified regulatory pressure, aimed at preventing companies from crossing the "red line" of corporate environmental disclosure, compels enterprises to increase investments in environmental management,

resulting in substantial corporate environmental information disclosure. In line with this, Zhu and Jia (2020) also concluded that regulatory pressure is positively correlated with corporate environmental information disclosure quality. Qian et al. (2022) further argued that provincial environmental regulatory pressure in China has a significant positive influence on the disclosure quality by heavily polluting enterprises. Additionally, Lei and Huang (2024) used annual report data from 20 heavily polluting listed companies in Jiangxi Province and applied a multiple linear regression model. These findings demonstrated a clear positive relationship between regulatory pressure and this type of disclosure.

Further heterogeneity analysis based on corporate ownership revealed that regulatory pressure influences corporate environmental disclosure in state-owned enterprises (SOEs), as suggested by Zhang and Duan (2019) and Su and Zhang (2020).

In the meantime, some scholars have expanded their research to include differences across industries. Luo, Xiao, et al. (2020), using a sample of 37 listed companies across various industries in Jiangsu Province, found that although the regulatory pressure on corporate environmental disclosure varies significantly across different regions of Jiangsu, overall, intensified regulatory pressure is positively correlated with higher-quality corporate environmental disclosure. Additionally, He (2024) further extended the sample to all Chinese listed companies. The empirical results showed that corporate environmental

disclosure scores increase as regulatory pressure increases, which is proxied by the intensity of environment-related terms identified in provincial government work reports. Additionally, the findings highlighted that non-state-owned enterprises (non-SOEs) and firms with stronger market orientation exhibit greater improvements in corporate environmental disclosure scores.

However, some scholars have differing opinions. Ji et al. (2019), using a sample of 315 listed companies from eight heavily polluting industries (including chemical and plastics, utilities, metal and non-metal, mining, paper and printing, food and beverage, textile and apparel, and biopharmaceuticals), argued that regulatory pressure is not significantly correlated with either the volume or the quality of disclosure. When further analysing three sub-indicators of corporate environmental disclosure quality (relevance, quantitateness, and timeliness), the authors found that relevance and timeliness were significantly positively and negatively correlated with regulatory pressure, respectively, while quantitateness showed no significant relationship.

Empirical research examining the influence of regulatory pressure in countries other than China is relatively limited, and the findings are also inconsistent. Nguyen et al. (2020), in the study of 120 listed companies in Vietnam, found that corporate environmental disclosure was influenced mostly by legal documents from the government. In contrast, Mchavi (2017), focusing on South African banks, concluded that regulatory pressure had no significant

impact on this type of disclosure in the study.

Therefore, summarising the above literature, it can be found that many scholars believe that regulatory pressure can positively influence corporate environmental disclosure, but some still hold different opinions. Meanwhile, there is a lack of literature targeting Chinese listed pharmaceutical companies as the main unit of analysis. However, the influence of regulatory pressure on such disclosure may vary across different industries, making it essential to conduct specific research within the pharmaceutical industry. Meanwhile, little existing literature focuses on the influence of regulatory pressure faced by firms after the introduction of a partially mandatory environmental disclosure policy in 2018. This gap in the literature can lead to disparities in evaluating regulatory pressure and its alignment with the realities of the real world, potentially affecting research outcomes accuracy.

2.5.1.2 Hypothesis Development

Environmental problems have clear externalities and are typical examples of market failure. Intensifying regulatory pressure is a crucial way to mitigate environmental externalities. In China, the government's supervision of environmental disclosure regulations has increased over time. It has actively established and improved real-time environmental monitoring systems and environmental disclosure policies, thus continuously improving environmental regulation. The government's attitude towards enforcing these regulations and

policies is firm and clear. This attitude is considered to be an important influencing factor in improving Chinese companies' environmental disclosure practices (Situ et al., 2020; Qian et al., 2022).

According to the stakeholder theory (Freeman, 1984), strong stakeholder demands have led to external pressure on businesses to publish environmental information. Government pressure as the direct and important source of external pressure has a particularly important impact on companies. In addition, according to legitimacy theory (Parsons, 1960), to ensure that companies fulfil their environmental responsibilities, the government exercises supervision and evaluation by establishing environmental regulations, laws and systems, which exerts regulatory pressure on companies. Government documents in China regarding corporate environmental disclosure are prolific, not only demanding increased participation in environmental disclosure from a wide range of industries but also stipulating high-quality corporate environmental disclosure content. Therefore, in order to fulfil stakeholder requirements as well as legitimacy requirements, companies need to make environmental disclosures. Failure to comply with relevant requirements not only leads to penalties from government regulators, but also damages the company's public image and reduces public recognition. Zhao (2019), Zhang and Duan (2019), He and Ren (2020), Su and Zhang (2020), Luo, Xiao, et al. (2020), Zhu and Jia (2020), Chen et al. (2021), Qian et al. (2022), Lei and Huang (2024), and He (2024) all found

that intensified regulatory pressure leads to enhanced corporate environmental disclosure.

In light of the preceding discussion, the first hypothesis (H1) is formulated as follows:

H1: Regulatory pressure has a positive influence on corporate environmental disclosure.

2.5.2 Media Exposure

Media is a specialized social institution with distinct functions, possessing media and communication platforms and channels, involved in the selection and dissemination of information (Liu & Dong, 2019). According to McCombs and Shaw (1972), the media, through repeated reporting on a particular event or subject, can guide the public's understanding and discussion of the event or subject, thereby influencing public awareness and also serving as a constraint on irrational phenomena within society. In addition, media reports are an effective information intermediary for all parties involved in the market economy, able to collect information quickly and provide timely feedback to the outside world by virtue of its unique advantages, effectively alleviating the problem of information asymmetry in the capital market (Cui et al., 2022).

Media exposure refers to the level of focus media directs towards a

specific company, indicating the quantity of news articles related to the company published or shared by media outlets (Ji, 2020). Therefore, a higher quantity of media reports on a company suggests a higher media exposure directed towards that company.

2.5.2.1 The Influence of Media Exposure on Corporate Environmental Disclosure

In China, media exposure, as a representation of external public pressure, has been proven to be a significant factor influencing corporate environmental disclosure, which has been demonstrated by scholars from both a game theory perspective (K. Z. Zhang et al., 2019) and an empirical perspective (Li & Zeng, 2020; Zhang & Zhang, 2019; Long, 2021; Yi & Zhou, 2023; Jiang et al., 2023).

K. Z. Zhang et al. (2019) utilised evolutionary game theory, taking a perspective of media exposure, to establish an asymmetric evolutionary game model between the government and companies in the context of corporate environmental disclosure and found that increasing media exposure can encourage corporations to engage in environmental disclosure practices.

In addition, empirical studies with Chinese pharmaceutical companies as research subjects are relatively limited. Li and Zeng (2020) used multiple regression methods to empirically test that in pharmaceutical industry, media exposure can significantly enhance the corporate environmental disclosure

during 2013-2018.

Moreover, many scholars have focused their research on whole heavily polluting industries. Zhang and Zhang (2019) argued that, to cope with legitimacy pressures and maintain corporate reputation, companies with high media exposure are more likely to disclose more environmental information. Long (2021) also observed that firms, motivated by reputational concerns, disclose environmental information primarily to highlight favourable developments, thereby cultivating a positive image of strong environmental management. As a result, media exposure tends to exert a positive influence on corporate environmental disclosure. Yi and Zhou (2023) empirically found that improving corporate environmental disclosure quality significantly promotes media exposure. Media outlets tend to report more on companies actively engaged in corporate environmental disclosure, thereby reducing information asymmetry. Similarly, Jiang et al. (2023) also concluded that media exposure, as an effective external supervisory mechanism, can significantly enhance the quality of corporate environmental disclosure.

Some scholars have further divided media exposure into newspaper media exposure and online media exposure for analysis, and similarly reached positive correlation conclusions. Pan (2019), using heavily polluting companies listed on SSE as a sample, found through multilinear regression analysis that online media exposure is weakly negatively correlated with corporate

environmental disclosure, while newspaper media exposure is positively correlated. Similarly, Li and Zeng (2020) discovered that online media promote corporate environmental disclosure more strongly than newspaper media. Liang and Fang (2023) divided media exposure into policy-oriented and market-oriented media exposure, concluding that both types positively influence corporate environmental disclosure, with policy-oriented media having a stronger effect than market-oriented media.

However, some scholars argue that media exposure does not significantly influence such disclosure (Zhang et al., 2016), or that higher media exposure may even lead to a reduction (Li & Zhai, 2018; Luo, Xiao, et al., 2020; Pan, 2021; Chen et al., 2023). Zhang et al. (2016) reported no statistically significant association between social pressure, measured by media exposure, and environmental disclosure. Furthermore, Li and Zhai (2018) found a negative relationship between public pressure (measured by media exposure) and corporate environmental disclosure. With high media exposure, corporate actions are more likely to attract further public scrutiny. As a result, domestic companies tend to be more conservative and cautious in disclosing relevant information to avoid significant negative effects caused by improper disclosure. Similarly, Luo, Xiao, et al. (2020) discovered that increased media exposure can actually decrease the level of environmental disclosure by companies. One possible reason for this result is that the study only considered the number of

news articles on the Zhongzheng website, which may not fully reflect the extent of media exposure received by listed companies in Jiangsu province. Also, Pan (2021) proposed that reporting on severe environmental misconduct by heavily polluting companies may harm their economic performance, potentially leading to their inability to engage in better corporate environmental disclosure practices. In addition, Chen, Fang, et al. (2023) focused on online media exposure, finding a negative correlation between online media exposure during the annual report period and corporate environmental disclosure quality. This could be explained by the relatively low credibility of online media, which could undermine public trust and weaken the effectiveness of its supervisory role.

Scholars from other countries have conducted relatively limited research on the influence of media exposure on corporate environmental disclosure, and the findings are inconsistent. Tadros and Magnan (2019), who studied 78 environmentally sensitive companies in the United States, found that companies with higher media exposure tend to have higher levels of environmental disclosure. Merina et al (2020), focusing on 29 mining companies in India, found a positive influence of media exposure on corporate environmental disclosure, because the media represents public interest in companies and serves as a valuable source of corporate information for the public. Therefore, media exposure of corporate environmental disclosure not only contributes to enhancing a company's public reputation, but also increases external pressure

and public expectations regarding its environmental responsibilities. This, in turn, serves as an important external incentive, motivating companies to adopt more comprehensive and transparent environmental disclosure practices, thereby strengthening their overall environmental accountability and legitimacy as perceived by stakeholders. Wichianrak et al. (2021), using a sample of 108 listed companies in Thailand, found a positive correlation between media exposure and environmental disclosure. However, Kurniansyah et al. (2021), drawing on a dataset comprising 135 listed companies from the Indonesia Stock Exchange, found that media exposure has no significant influence on this type of disclosure. These authors argued companies do not consider media exposure when increasing corporate environmental disclosures to maintain legitimacy.

In conclusion, a number of studies have found that media exposure, as a reflection of public pressure, has a positive influence on corporate environmental disclosure. Moreover, differences in the medium and orientation of media coverage may also lead to variations in the degree of positive impact. However, some scholars believe that media exposure and corporate environmental disclosure are inversely related. Meanwhile, in the digital information era, with the development of information and communication technology and the emergence of digital new media, the penetration and influence of the media have been further enhanced (Zhou & Li, 2023). In this case, the lack of literature based on media exposure data in the last 5 years, with Chinese pharmaceutical

companies as the research sample, may also affect the accuracy of research results.

2.5.2.2 Hypothesis Development

The media, as a supervisory force representing the public consciousness in society, plays a critical role in supervising the process of information disclosure. Due to network technology, the media industry has been growing rapidly, and it has delivered important information about enterprises to the public in a timely manner with certain credibility (He & Zhang, 2021). Therefore, with the development of various media, the media exposure of various behaviours of listed companies in front of the social public is gradually strengthened, and the social public cannot only be informed of the related information from the traditional media such as TV and paper media, but also obtain the detailed reports of the enterprise more quickly from the new media such as websites and forums. Therefore, the intangible pressure generated by media exposure caused by public attention is more and more significant in the influence of such disclosure.

Drawing on stakeholder theory (Freeman, 1984), stakeholders include not only the government, but also the public and the media. Therefore, enterprises not only face regulatory pressure from the government, but also pressure from the public and the media. As the Chinese government attaches great importance to the balance between economic growth and sustainable development (X. D. Wang et al., 2021), this pressure from stakeholders will be

transmitted to enterprises through public opinion or reaction to their market behaviour. In this context, the media serves the public at large, and out of social responsibility, it will pay more attention to ecological and environmental issues and report on corporate environmental disclosures. Media reports provide more perspectives and entry dimensions for stakeholders to observe enterprises, and through various types of news reports, stakeholders can have a more in-depth and comprehensive understanding of enterprises (Zhou & Li, 2023). Similarly, based on the legitimacy theory (Parsons, 1960), by fulfilling the legitimacy requirements of corporate environmental disclosure, enterprises can gain more social recognition, enhance market acceptance and trust, maintain the image and reputation of the enterprise, and enhance the value of the enterprise, and then finally obtain more resources. Therefore, the news reports of the media on the enterprise in terms of policy, environmental pollution and internal development will bring legitimacy pressure to the enterprise, prompting them to disclose higher-quality environmental information more voluntarily, and with the help of the media as a mechanism of information dissemination to make the enterprise's environmental information a matter of widespread social concern, and ultimately establish a good image of the company to satisfy the legitimacy requirements. In addition, empirical analyses by Pan (2019), Zhang and Zhang (2019), Li and Zeng (2020), Merina et al. (2020), Long (2021), Wichianrak et al. (2021), Yi and Zhou (2023), Jiang et al. (2023) and Liang and Fang (2023) on firms in different countries and markets all concluded that that higher media exposure enhances

corporate environmental disclosure.

Based on the above discussion, the following hypothesis (H2) is proposed:

H2: Media exposure has a positive influence on corporate environmental disclosure.

2.5.3 Firm Profitability

Firm profitability refers to a company's ability to generate profits, also known as its capacity for capital or wealth accumulation. It is manifested by the amount of earnings generated by the company within a specific period and the level of those earnings. Firm profitability is commonly assessed using metrics such as Earnings Per Share (EPS) (Kalola, 2021), Return on Assets (ROA) (Ardi & Yulianto, 2020), and Return on Equity (ROE) (Qiu & Liu, 2020; Wang & Li, 2021; Lin & Zhou, 2022).

2.5.3.1 The Influence of Firm Profitability on Corporate Environmental Disclosure

Firm profitability, as a key financial indicator of a company, has been included in the discussion of factors influencing corporate environmental disclosure. However, in China, research on the influence of the profitability of listed pharmaceutical companies is limited, and the conclusions vary among

studies. Firstly, Cao and Sun (2021) conducted research based on 95 Chinese listed pharmaceutical companies and found that firm profitability is a key factor influencing corporate environmental disclosure quality. Secondly, however, Zheng et al. (2019) studied 82 listed pharmaceutical companies and found no significant relationship between firm profitability and corporate environmental disclosure. Lastly, Xu (2021b) focused on 67 listed pharmaceutical companies and, after establishing a multiple linear regression model, found a negative influence of firm profitability on corporate environmental disclosure.

There are many studies about Chinese heavily polluting companies. Firstly, Deng et al. (2020) observed a positive influence of firm profitability on this type of disclosure in Chinese liquor companies. This is because companies with higher firm profitability are more willing to disclose environmental information to establish a positive corporate image, enabling stakeholders and investors to better understand their strengths. In addition, Zeng et al. (2021) focused on 16 categories of heavily polluting industries in China. The authors used variance analysis and the Fama-French three-factor extended model and found that companies with better profitability (ROA) tend to have better corporate environmental disclosure. Also, Zhang and Li (2020), with a focus on listed firms in the paper industry, also found that the higher a firm profitability, the better its corporate environmental disclosure. Liu and Gao (2022) also concluded that the enhanced firm profitability of coal listed companies can

increase the disclosure quality. Moreover, a similar study by Lei and Huang (2024) on 20 heavily polluting listed firms in Jiangxi Province identified a positive relationship between firm profitability and this type of disclosure. This may be because stronger companies are better equipped to efficiently utilise and allocate resources to generate higher profits, and they are also more willing to disclose more environmental information to the public.

Secondly, in China, some scholars proposed that firm profitability can actually lead to inferior environmental disclosure. Qi et al. (2018) focused on mining companies and found a negative correlation between firm profitability and corporate environmental disclosure. Moreover, Qiu and Liu (2020) also discovered a negative correlation between profitability and corporate environmental disclosure among renewable energy listed companies. These scholars (Qi et al., 2018; Qiu & Liu, 2020) claimed that the negative correlation arises because enhanced profitable companies tend to prioritize corporate interests over environmental protection. As a result, they neglect corporate environmental disclosure, leading to lower disclosure levels in such companies.

Finally, several studies have reported an insignificant association between firm profitability and corporate environmental disclosure. Huang and Zhou (2020) conducted an empirical study and found no relationship between firm profitability and such disclosure in the building materials industry. Also, Wang and Li (2021), using data from Chinese energy enterprises as a sample,

undertook an empirical study and found no significant relationship between firm profitability and corporate environmental disclosure quality, which suggested that companies allocate a relatively small proportion of resources to environmental issues, preferring instead to invest their profits in corporate development.

Recently, several international studies have examined the pharmaceutical industry specifically. Demir and Min (2019) analysed global pharmaceutical firms and revealed that companies with enhanced financial performance exhibited more consistent and comprehensive sustainability disclosures, driven by stakeholder demands and legitimacy concerns. Moreover, Dănescu and Popa (2020) explored pharmaceutical companies in Romania and concluded that profitable firms were more proactive in corporate social responsibility activities, including environmental transparency, as profitability enabled greater investment in Corporate social responsibility practices to enhance corporate reputation and stakeholder satisfaction.

In addition to pharmaceutical industry studies, there is a wealth of research on the influence of firm profitability on corporate environmental disclosure across countries and industries. First of all, some scholars pointed out that there is a significant influence of firm profitability. In the Nigerian food and beverage industry, Ezeagba et al. (2017) identified firm profitability as a significant factor influencing corporate environmental disclosure. Maulia and

Yanto (2020) conducted research in Indonesia across different sectors (agriculture, consumer goods and basic chemical industries) and observed that firm profitability has a positive influence. In the Sri Lankan context, higher firm profitability corresponds to greater corporate environmental disclosure, as documented by Nuskiya et al. (2021).

In the second place, some scholars have suggested that firm profitability may even have a negative influence on this type of disclosure. Chandok and Singh (2017) discovered a negative correlation between firm profitability and corporate environmental disclosure among the top 100 listed companies in Mumbai. Drawing on data from Vietnam and Thailand, Nguyen et al. (2020) and Wichianrak et al. (2021) identified a negative association between firm profitability and the extent of corporate environmental disclosure. Similarly, Solikhah et al. (2021) argued that firm profitability negatively influences corporate environmental disclosure. This is because firms with enhanced profitability may feel no need to disclose additional information to demonstrate their legitimacy to stakeholders, while less profitable companies may seek to highlight positive environmental news to gain more attention.

Finally, some scholars have found that firm profitability does not influence corporate environmental disclosure in Indonesia. Wahyuningrum et al. (2020) reported no statistically significant association between firm profitability and this form of disclosure among Indonesian companies, noting that highly

profitable firms may perceive limited incentives to disclose environmental information, as such disclosure could divert attention away from their financial performance. Similarly, Ardi and Yulianto (2020), also studying Indonesian companies, reached the same conclusion. The authors suggested that high firm profitability indicates financial success, which reduces the urgency for corporate environmental disclosures, as the company's strong financial status is already sufficient to attract investor attention. Kurniansyah et al. (2021) also concluded that firm profitability has no significant influence on such disclosure in Indonesian listed companies.

Overall, the existing literature presents mixed conclusions regarding the influence of firm profitability on corporate environmental disclosure, with evidence of positive, negative, and insignificant relationships. These inconsistencies may stem from differences in research samples, industry characteristics, and time periods. In particular, studies on Chinese listed pharmaceutical companies remain inconclusive. While international research (e.g., Demir & Min, 2019; Dănescu & Popa, 2020) suggests that firm profitability enhances disclosure through improved stakeholder engagement and legitimacy-building, such evidence in the Chinese context is limited and fragmented. Theoretically, firm profitability influences both the capacity and willingness of a company to engage in environmental disclosure. According to stakeholder theory, profitable firms face greater stakeholder expectations and are

incentivized to enhance transparency. Agency theory further suggests that once performance targets are met, managers may be more inclined to invest in non-financial disclosures (such as environmental responsibility), particularly when these efforts support long-term value creation. Therefore, it is timely and necessary to re-examine this relationship using recent data from all listed pharmaceutical companies in China to provide updated insights into the financial determinants of disclosure in this heavily scrutinized sector.

2.5.3.2 Hypothesis Development

The primary business goal for most companies is profit generation (Smulowitz et al., 2020). Only after a company meets its basic profitability requirements will it consider issues related to corporate legitimacy, reputation, social responsibility, and invest more time and resources into environmental responsibility and other aspects. It is particularly true for pharmaceutical companies, as they often involve high-pollution and high-emission activities (Liu & Zhang, 2023), and enhanced firm profitability signifies more financial resources, which can be used to invest in energy-efficient technologies, environmental equipment upgrades, and other environmental measures.

Based on stakeholder theory (Freeman, 1984), both managers and shareholders are stakeholders in the enterprises. Furthermore, according to agency theory (Jensen & Meckling, 1976), conflicts between shareholders and managers may result in managerial actions that serve personal interests at the

expense of shareholder value (Ross, 1973). The goal of managers is to fulfil business objectives (Ponlantz, 2017) and thus obtain desired compensation. Based on self-interest, managers will only consider incurring costs to disclose more environmental information to owners once they have achieved their target profit. Similarly, the collection and disclosure of environmental information inevitably costs more, and enhanced corporate environmental disclosure requires firms to invest more costs (Blankespoor et al., 2020). If there is a lack of strong financial support, even if companies have the intention to make enhanced corporate environmental disclosure, they will not be able to do so due to insufficient firm profitability leading to insufficient capital investment. Therefore, enhanced firm profitability is an important prerequisite for enhanced corporate environmental disclosure. Studies conducted by Maulia and Yanto (2020), Deng et al. (2020), Cao and Sun (2021), Nuskiya et al. (2021), Liu and Gao (2022) and Lei and Huang (2024) on companies in different industries in different countries all concluded that enhanced firm profitability leads to enhanced corporate environmental disclosure.

Building on the preceding discussion, the following hypothesis (H3) is advanced:

H3: Firm Profitability has a positive influence on corporate environmental disclosure.

2.5.4 Corporate Governance

With the emergence of agency theory, Fama and Jensen (1983) suggested that corporate governance studies should address agency problems arising by the division of ownership and management. Cochran and Wartick (1988) further clarified that corporate governance issues encompass specific problems arising from the interactions between shareholders, the board of directors, top management, and other stakeholders.

In China, Lin et al. (1995) defined corporate governance structure as a comprehensive system of arrangements through which owners supervise and control the operation, management and performance of a firm. Furthermore, corporate governance in China has distinctive features. While the board of directors is established to handle decision-making responsibilities, a separate supervisory board is also instituted to monitor the behaviour of both the directors and senior managers, thereby ensuring effective oversight (Ye, 2003).

In summary, this study argues that corporate governance stems from the agency problem and is a set of institutional arrangements to coordinate the economic relationships between the relevant stakeholders of an enterprise, including shareholders, the board of directors, the supervisory board, creditors, managers and employees.

Concerning the role corporate governance plays in shaping this specific

disclosure practice, research has followed two major approaches to conceptualize corporate governance: (1) specific variables, and (2) construction of a comprehensive index.

2.5.4.1 The Influence of Specific Corporate Governance Variables on Corporate Environmental Disclosure

The relationship between specific corporate governance factors and corporate environmental disclosure has been predominantly examined across the following three categories: ownership characteristics, board of directors and supervisory board characteristics, and executive¹¹ characteristics.

(1) Ownership Characteristics

Due to China's unique national conditions, considerable research has been conducted on ownership structure and ownership nature influence on corporate environmental disclosure.

First, the equity balance, defined as the ratio of the sum of the shareholdings of the top five shareholders to that of the largest shareholder, reflects equity balance, which means the smaller the equity balance, the more concentrated the ownership in listed companies. Li and Zhang (2019) and Gao (2024) argued that the equity balance is positively correlated with corporate

¹¹ In the context of this study, executives refer to individuals such as the general manager, president, chief executive officer, vice general manager, vice president, board secretary, and other management personnel disclosed in the annual report (excluding directors and supervisors) (CSMAR, 2023).

environmental disclosure, while Wang and Chang (2020) suggested that no significant relationship exists between the two. Li and Zhang (2019) found that a higher equity balance improves corporate environmental disclosure, because equity balance strengthens oversight of corporate decision-making, facilitating long-term beneficial decisions. Furthermore, checks and balances among shareholders enhance executive incentives and supervision, encouraging them to consider the interests of multiple stakeholders, thereby reducing selective disclosure behaviours and improving corporate environmental disclosure. Similarly, Gao (2024), focusing on listed manufacturing companies, concluded that higher equity balance correlates with enhanced corporate environmental disclosure. However, empirical evidence from Wang and Chang (2020) indicated that equity balance does not significantly influence corporate environmental disclosure. While a higher equity balance can reduce corporate governance issues and lead to more comprehensive and accurate disclosure (Wang & Chang, 2020), the lack of robust regulations in China often results in companies opting for superficial disclosures to avoid stringent environmental penalties, thus neutralizing the influence of equity balance.

Second, the influence of institutional shareholding on such disclosure remains inconclusive (Hu & Chen, 2017; Li & Zhang, 2019; Feng & Hong, 2024). Hu and Chen (2017) showed that because the number of institutional investors in China is currently small and dispersed, and their influence is

relatively limited, the shareholding ratio of institutional investors in heavily polluting listed companies in China has only a limited contributing influence on corporate environmental disclosure, but it is not significant. Conversely, Li and Zhang (2019) posited that institutional investors, acting as additional supervisors alongside balancing shareholders, can enhance governance and thereby enhance corporate environmental disclosure. Similarly, Feng and Hong (2024), examining all listed manufacturing firms, empirically demonstrated that institutional investor shareholding enhances corporate environmental disclosure. External investors, particularly banks and funds, exert supervisory pressure, compelling firms to implement national environmental policies more comprehensively and disclose more environmental information.

Third, executive shareholding can enhance corporate environmental disclosure (Feng & Hong, 2024), while the influence of board shareholding remains contested (Huo, 2019; Luo, Huang, et al., 2020). One aspect of internal governance relates to managerial incentives. Feng and Hong (2024) empirically found that executive shareholding positively influences corporate environmental disclosure, as it functions as an active corporate policy that attracts external attention, which in turn shapes executives' managerial behaviour. This feedback mechanism creates a virtuous cycle of supervision and incentives, ultimately enhancing disclosure practices. Similarly, Huo (2019) argued that appropriate compensation incentives for directors encourage them to fulfil their

responsibilities by actively supervising managerial activities, thereby improving the quality and credibility of environmental disclosure. However, Luo, Huang, et al. (2020), focusing on manufacturing companies listed in Jiangsu Province, found a negative correlation between board shareholding and corporate environmental disclosure. High levels of board shareholding may consolidate shareholder power and lead to excessive centralization, creating information asymmetry that disadvantages minority shareholders. Consequently, boards may direct management to selectively disclose environmental information to protect their own interests.

Fourth, regarding the ownership nature and its influence on corporate environmental disclosure, scholars (Yu et al., 2018; H. Y. Zhang et al., 2019; Li & Zhang, 2019) consistently found that SOEs tend to disclose environmental information more comprehensively. Yu et al. (2018), analysing listed companies identified as key pollutant emitters, observed that SOEs outperform non-SOEs in corporate environmental disclosure. Similarly, H. Y. Zhang et al. (2019) empirically demonstrated that listed SOEs play a more significant role in complying with and promoting environmental disclosure regulations than their non-SOEs. Li and Zhang (2019) attributed this to SOEs' distinctive nature, which bears greater social responsibilities. This finding suggests that the more a company fulfils its social responsibilities, the more enhanced its environmental disclosure. Additionally, the unique executive appointment and evaluation

mechanisms in SOEs drive executives to prioritize environmental issues alongside political objectives.

In addition, scholars focusing on other countries have also frequently used ownership characteristics as variables to study the influence of corporate governance on such disclosure. For example, Dintimala and Amril (2018), examining firms in Indonesia, found that executive ownership negatively affects corporate environmental disclosure, whereas institutional ownership enhances it. Gerged (2021) demonstrated that in Jordanian companies, executive ownership, institutional ownership, and ownership concentration are all negatively correlated with corporate environmental disclosure, which means higher executive ownership, institutional shareholding, and ownership concentration lead to poorer environmental information disclosure. However, foreign ownership significantly increases corporate environmental disclosure. Similarly, Rabi (2021), focusing on Jordanian listed firms, found that increased board shareholding significantly enhances corporate information disclosure. Using companies across 72 countries as a sample, Acar et al. (2021) concluded that SOEs tend to provide superior corporate environmental disclosure, whereas higher institutional shareholding tends to reduce it.

(2) Board of Directors and Supervisory Board Characteristics

In China, scholars have examined the influence of the dual board system (board and supervisory board) characteristics.

First, the relationship between board independence (defined by "the proportion of independent directors") and corporate environmental disclosure remains inconclusive. Prior studies have reported positive associations (Ma, 2020; Sun & Ye, 2020; Xu, 2021b), negative associations (Wang & Chang, 2020), or no significant relationship (H. Y. Zhang et al., 2019; Xu & Zeng, 2020; Zhang & Li, 2020). Notably, Xu (2021b), who examined Chinese pharmaceutical firms listed on the stock exchange, identified a positive link between board independence and environmental disclosure. Similarly, Ma (2020), aiming to enhance transparency within corporate governance systems, and Sun and Ye (2020), from the perspective of effective supervision over disclosure, both concluded that an increase in board independence significantly enhances such disclosure. In contrast, Wang and Chang (2020) observed a negative influence, arguing that firms may reduce their environmental disclosure to avoid oversight and intervention from independent directors with technical expertise. However, H. Y. Zhang et al. (2019) found no significant relationship between board independence and this type of disclosure, attributing this to the strong externalities of environmental pollution in China. Companies often prioritize immediate profits, focusing on post-pollution mitigation rather than proactive measures, which limits the role of independent directors in implementing disclosure policies. Similarly, Xu and Zeng (2020) and Zhang and Li (2020), using mining and paper companies respectively, also found that board independence exerts no statistically significant impact on the disclosure level.

Second, the influence of board size has also yielded mixed results, with some studies finding a positive influence (Zhang, 2020; Wang & Xiong, 2021) and others reporting no significant influence (Huo, 2019; Ma, 2020). Zhang (2020), and Wang and Xiong (2021) empirically showed that larger boards enhance corporate environmental disclosure. In contrast, Huo (2019) suggested that, in environmentally sensitive industries in China, board size does not significantly influence disclosure levels. Ma (2020) similarly found that board size has no significant influence, attributing this to the lack of rigorous board systems and structural arrangements.

Third, the influence of supervisory board size on corporate environmental disclosure remains debatable. H.Y. Zhang et al. (2019), using data from 16 categories of heavily polluting listed companies, found that larger supervisory boards promote the implementation of environmental disclosure policies. Luo, Huang, et al. (2020) reached a similar conclusion. However, Deng et al. (2020) and Zhang (2020) found no significant correlation between supervisory board size and corporate environmental disclosure. This may be because supervisory boards exert an indirect rather than direct influence on information disclosure quality, limiting their effectiveness in guiding environmental disclosure practices.

The influence of board composition on corporate environmental disclosure has been the focus of research in various international contexts as well.

First, studies on board independence and corporate environmental disclosure also show mixed results. Baalouch et al. (2019), analysing SBF120-listed companies in France, found that board independence was negatively associated with disclosure quality. However, Rabi (2021) and Raimo et al. (2022) found no significant relationship. Conversely, Gerged (2021), focusing on industrial and service companies in Jordan, observed a positive correlation, arguing that independent directors serve as effective monitors protecting shareholder interests. Similarly, Nuskiya et al. (2021) concluded that independent directors can encourage firms to participate more actively in sustainable development and environmental initiatives, significantly enhancing corporate environmental disclosure.

Second, the positive influence of board size has been widely recognised (Nuskiya et al., 2021; Rabi, 2021; Raimo et al., 2022). A larger board size can effectively mitigate agency conflicts between managers and shareholders (Ntim, 2016), thereby significantly enhancing disclosure levels (Nuskiya et al., 2021). Rabi (2021) found a favourable correlation between board size and such disclosure in Jordanian listed companies, suggesting that a larger board provides diverse expertise and knowledge, reduces agency problems, and enhances board capabilities. Similarly, Raimo et al. (2022), studying 129 international companies reporting on the International Integrated Reporting Council website, confirmed that board size positively influences such disclosure.

Third, some scholars also argue that board diversity can influence corporate environmental disclosure. Baalouch et al. (2019), using SBF120-listed companies in France as a sample, found that board diversity, particularly gender diversity, significantly enhances the disclosure quality. Similarly, Raimo et al. (2022), based on a study of 129 international companies, also concluded that gender diversity on the board together with the establishment of a corporate social responsibility committee positively contributes to corporate environmental disclosure.

(3) Executive Characteristics

In China, executive characteristics (e.g., Chief Executive Officer (CEO) duality and executive compensation), as critical components of corporate governance, may significantly influence corporate environmental disclosure.

First, the relationship between CEO duality and corporate environmental disclosure has been studied with mixed conclusions, including negative influence (Ma, 2020; Sun & Ye, 2020) and no significant influence (Deng et al., 2020; Luo, Huang, et al., 2020). For instance, Sun and Ye (2020), focusing on China's steel industry, argued that CEO duality significantly reduces corporate environmental disclosure. Similarly, Ma (2020), studying heavily polluting companies in China, suggested that separating managerial and operational roles helps mitigate risks associated with managerial self-interest, and thus, CEO duality leads to lower corporate environmental disclosure. Conversely, Deng et

al. (2020), examining Chinese brewing firms, and Luo, Huang, et al. (2020), focusing on manufacturing firms in Jiangsu Province, found no significant relationship between CEO duality and corporate environmental disclosure.

Second, executive compensation is also considered a key factor influencing corporate environmental disclosure (Fang et al., 2018; Li & Liang, 2018; Cao, 2020; Wang & Xiong, 2021). Executive compensation acts as a natural mechanism to mitigate agency problems, preventing executives from reducing corporate environmental disclosure to lower short-term costs (Wang & Xiong, 2021). It also enhances management efficiency, improving business operations (Li & Liang, 2018), thereby promoting transparency and reducing agency costs (Lu & Zhou, 2013). Accordingly, higher executive compensation often contributes to enhanced corporate environmental disclosure (Li & Liang, 2018; Cao, 2020; Wang & Xiong, 2021). However, Fang et al. (2018), analysing 148 firms with voluntary environmental disclosures, found a negative correlation between short-term executive compensation and voluntary environmental disclosure levels, as higher short-term pay can drive myopic behaviours that hinder sound environmental disclosure systems. Meanwhile, long-term compensation showed no significant influence, possibly due to its underutilization in China's corporate landscape.

Third, some scholars have also focused on the influence of other executive characteristics (e.g., gender, tenure, age, and educational background)

on corporate environmental disclosure. Zhang and Xiao (2016) found that senior management gender and tenure influence corporate environmental disclosure. Specifically, the presence of female executives significantly reduces corporate environmental disclosure, whereas longer executive tenure is associated with higher levels of corporate environmental disclosure. Similarly, Cao (2020), based on an empirical study of listed companies in the Chinese coal industry, found that the proportion of female executives and executive age are positively correlated with corporate environmental disclosure quality. Moreover, Ma et al. (2019) identified that executive age and educational background affect environmental disclosure. The study suggests that older executives and those with a Master of Business Administration background are more capable of making flexible judgments when addressing environmental issues and disclosure. This leads to more proactive environmental reporting. Additionally, Li and Liang (2018) found that the education level of executives is significantly and positively correlated with the disclosure quality. Higher educational attainment enhances environmental awareness and long-term strategic focus, which in turn improves corporate environmental information disclosure.

In other countries, studies on executive characteristics and corporate environmental disclosure also reveal inconsistent findings. Nuskiya et al. (2021) highlighted how CEO duality may increase conflicts of interest, negatively affecting disclosure transparency. Similarly, Oware and Awunyo-Vitor (2021)

argued that CEO duality can lead to communication inefficiencies and suboptimal strategic decisions, thereby reducing disclosure quality. In contrast, Gerged (2021), studying Jordanian non-financial firms, found that CEOs in dual roles may enhance corporate environmental disclosure to secure higher evaluations and compensation (Jizi et al., 2014).

(4) Summary

In summary, based on the above literature, it can be observed that many scholars have explored the influence of corporate governance on corporate environmental disclosure from the perspectives of ownership structure (equity balance, institutional ownership proportion, shareholding by directors, supervisors, and executives, and ownership nature), board and supervisory committee characteristics (proportion of independent directors, board size, supervisory committee size), and executive characteristics (CEO duality, executive compensation).

However, several issues remain. First, under different national contexts and sample selections, the conclusions regarding the influence of specific corporate governance variables on corporate environmental disclosure vary. Second, there is a relative lack of literature conducting empirical studies using the Chinese pharmaceutical industry as a research sample. Third, research on specific variables does not provide a general conclusion about how corporate governance influences corporate environmental disclosure. It is only by

evaluating corporate governance as an indicator that one can comprehensively assess its levels from an overall corporate perspective (Kaur & Vij, 2018).

2.5.4.2 The Influence of Corporate Governance Index on Corporate Environmental Disclosure

Corporate governance is not only a structural arrangement but also a key internal control mechanism that guides managerial behaviour and strategic decision-making. Based on agency theory, effective governance can mitigate conflicts of interest, reduce information asymmetry, and ensure responsible corporate conduct. Therefore, corporate governance is expected to play a significant role in shaping the quality and transparency of environmental disclosure.

(1) Construction of Corporate Governance Index

Corporate governance is a comprehensive mechanism that cannot be effectively measured by a single indicator (Tian et al., 2019). The construction of composite index to measure corporate governance for research use has been well established over time. Presently, it has been employed in the research of corporate financial matters (Younas et al., 2021), investment opportunities, and firm performance (Al-Gamrh et al., 2020), as well as topics related to the costs of equity (Srivastava, 2019).

In China, Bai et al. (2005) selected eight governance variables and then

used PCA to construct the "G Index", which reflects the overall level of corporate governance with Chinese characteristics. However, with the continuous improvement of China's modern business system, a number of sectors are paying attention to corporate governance and there have been more research results in corporate governance index comprehensive evaluation. Different scholars have selected different indicators for measurement. Zhou et al. (2020) proposed a composite evaluation of corporate governance based on seven indicators: executive compensation and executive shareholding ratio as proxies for incentive mechanisms in governance; the percent of independent directors and board size to represent the board's supervisory role; institutional ownership and equity balance as measures of ownership structure oversight; and whether there is a separation between the positions of chairman and CEO, indicating the extent of independent decision-making power held by the CEO. In addition, Wang and Yuan (2022) developed a corporate governance index for heavily polluting enterprises using eight indicators: ownership type, ownership concentration, CEO duality, equity balance, shareholding ratio of directors, supervisors, and executives, board size, supervisory board size, and board independence.

(2) The Influence of Corporate Governance Index on Corporate Environmental Disclosure

In China, although there is a lack of studies specifically targeting the pharmaceutical industry, existing research consistently demonstrates that

effective corporate governance can enhance corporate environmental disclosure (Feng & Li, 2015; Li & Wang, 2017; Wang & Yuan, 2022; Wang & Sun, 2023).

Li and Wang (2017), focusing on Chinese listed companies in the manufacturing, mining, agriculture, forestry, fishery, water conservancy, environmental public facilities, and electricity industries from 2011 to 2015, conducted an empirical study examining multiple aspects, such as equity balance, alignment between independent directors and the company's registered location, and equity structure stability. The results showed that firms with more effective corporate governance structures tend to engage in higher levels of disclosure.

Some scholars have also paid attention to heavily polluting industries. Feng and Li (2015) categorized heavily polluting industries into eight groups (metals and non-metals, water, electricity, and gas, mining, petrochemicals and plastics, food and beverages, textiles and leather, paper and printing, and biopharmaceuticals), and found that corporate governance played a more successful function in SOEs, and that the corporate governance index was positively associated with disclosure quality.

Similarly, Wang and Yuan (2022) found that during 2016-2020, corporate governance significantly and positively influenced corporate environmental disclosure quality in heavily polluting listed companies. Expanding the research scope, Wang and Sun (2023) investigated all Chinese listed enterprises from

2017 to 2021 and confirmed the positive influence of corporate governance on such disclosure.

In other countries, the literature on corporate governance index and its influence on corporate environmental disclosure is also relatively limited, but the conclusions are not uniform. On the one hand, Ezhilarasi (2019) conducted a study on 130 heavily polluting companies in India, selecting a total of 41 specific corporate governance scoring criteria across four categories. Each company was then assigned a score, which was calculated as a proportion of the maximum score, serving as corporate governance indicator. The research revealed a positive correlation between corporate governance and this type of disclosure, with it particularly influenced by the previous year's corporate governance. Similarly, Moalla et al. (2021) focused on a sample of French companies, selecting 51 governance indicators to synthesize into eight main categories to calculate a composite governance index, and discovered more effective corporate governance can enhance corporate environmental disclosure.

On the other hand, Kurniansyah et al. (2021) used the ratio of "the total number of principles applied by sample companies to the full set of 8 principles and 25 recommendations" (as outlined in the Financial Services Authority Circular Letter No. 32/SEOJK.04/2015) as an indicator to measure corporate governance. This study found that corporate governance negatively influences corporate environmental disclosure. This may be because the eight principles

and 25 recommendations do not address governance aspects related to environmental issues or corporate social responsibility. As a result, corporate governance cannot serve as a driver to enhance firm value through corporate environmental disclosure.

Overall, the above literature generally constructs composite indexes to assess corporate governance comprehensively. However, research findings remain inconsistent. Some studies suggest that corporate governance positively influences corporate environmental disclosure (e.g., Moalla et al., 2021; Wang & Yuan, 2022; Wang & Sun, 2023), while others report a negative influence (e.g., Kurniansyah et al., 2021). Moreover, no studies have specifically focused on a single industry, particularly the pharmaceutical industry. Consequently, there is a lack of research investigating whether corporate governance, as measured by index, can serve as a significant factor influencing the such disclosure of listed pharmaceutical companies in China.

2.5.4.3 Hypothesis Development

Underpinning the stakeholder theory (Freeman, 1984), if a company has strong corporate governance capabilities, its decision-making processes are likely to be more scientific, rational, and beneficial to stakeholders. Long-term investments in environmental initiatives and fulfilling social environmental responsibilities can enhance a company's reputation and benefit stakeholders (Lyu & Feng, 2021). Consequently, companies that are committed to

environmental responsibility are more inclined to voluntarily disclose a comprehensive and compliant set of information, resulting in better corporate environmental disclosure.

From the perspective of agency theory (Jensen & Meckling, 1976), the underlying source of conflicts between corporate owners and managers lies in the misalignment of their respective interests. One of the motivations for firms to voluntarily disclose information is to mitigate adverse selection and moral hazard arising from agency problems between shareholders and management (Healy & Palepu, 2001). Consequently, companies with effective corporate governance are more likely to provide accurate and transparent information to reduce information asymmetry and agency costs (Zhang & Liao, 2010). Under disclosure pressure, firms are more inclined to strictly comply with environmental laws and regulations and enhance corporate environmental disclosure quality. Therefore, effective corporate governance can significantly enhance corporate environmental disclosure.

Further, scholars such as Ezhilarasi (2019), Moalla et al. (2021), Wang and Yuan (2022), and Wang and Sun (2023) found a positive influence of corporate governance on this type of disclosure in India, France, and China using the corporate governance index.

Therefore, the following hypothesis (H4) is proposed:

H4: Corporate governance has a positive influence on corporate environmental disclosure.

2.5.5 The Moderating Role of Corporate Governance

Apart from focusing on the direct influence, the existing literature also examines the influence of corporate governance as a moderating variable on corporate environmental disclosure.

2.5.5.1 The Moderating Role of Corporate Governance on the Relationship between Regulatory Pressure and Corporate Environmental Disclosure

In China, research on the moderating role of corporate governance index in the influence of regulatory pressure on corporate environmental disclosure is relatively limited. Only Tao (2022), in a study focused on listed pharmaceutical companies, found that comprehensive corporate governance positively moderates the influence of regulatory pressure on corporate environmental disclosure. In other words, the better the corporate governance, the larger the influence of regulatory pressure on this type of disclosure.

Some Chinese scholars have demonstrated that individual variables within corporate governance, such as executives' environmental awareness, ownership structure, and management incentives, positively moderate the relationship between regulatory pressure and corporate environmental disclosure (Pan & Guo, 2018; Sun, 2020; J. W. Zhang, 2021). Using a sample of listed

companies in the textile, mining, printing, electricity, heat, and gas production and supply industries with a high propensity to pollute, Pan and Guo (2018) found that executive's environmental protection consciousness positively moderates the intensity of regulatory pressure and the level of corporate environmental disclosure. Similarly, Sun (2020) focused on Chinese resource-based listed companies and empirically found that a highly concentrated ownership structure would inhibit the positive influence of regulatory pressure on carbon information disclosure, while board size could promote the positive influence of regulatory pressure on carbon information disclosure. Similarly, J. W. Zhang (2021), expanding the sample to all heavily polluting listed companies, empirically found that management incentives positively moderated the relationship between regulatory pressure and such disclosure.

Thus, there is a dearth of literature from other countries examining the moderating role of corporate governance on the influence of regulatory pressure on this type of disclosure.

2.5.5.2 The Moderating Role of Corporate Governance on the Relationship between Media Exposure and Corporate Environmental Disclosure

In China, the existing literature only focuses on the influence of some single indicators of corporate governance (e.g., executive incentives, equity concentration, nature of equity) as moderating variables on the relationship between media exposure and corporate environmental disclosure, and there is no

literature focusing on pharmaceutical industry firms. Li and Zhai (2018), in the study of heavily polluting Chinese enterprises, empirically found that executive incentives had a positive moderating effect on the influence of media exposure on the such disclosure, while ownership concentration had a negative moderating effect; and ownership nature, however, did not moderate it.

Furthermore, in Indonesia, Solikhah and Maulina (2021), using a sample of 135 listed manufacturing companies, created a Corporate Governance Principles Implementation Index and found that the implementation of corporate governance principles could enhance how media exposure contributes to improvements in disclosure quality.

Thus, there is a gap in research that calculates corporate governance as a composite indicator and examines its use as a moderating variable in the relationship between media exposure and such disclosure.

2.5.5.3 The Moderating Role of Corporate Governance on the Relationship between Firm Profitability and Corporate Environmental Disclosure

In the Chinese context, there is a notable gap in the literature regarding the moderating role of corporate governance in the relationship between firm profitability and corporate environmental disclosure.

In other countries, Solikhah and Maulina (2021) found that the Corporate

Governance Principles Implementation Index did not have a significant moderating effect on the relationship between firm profitability and the quality of environmental disclosure in Indonesia.

Studies that use specific variables to measure corporate governance and investigate its moderating effect on the influence of firm profitability on corporate environmental disclosure are scarce and yield inconsistent conclusions (Ardi & Yulianto, 2020; Solikhah et al., 2021). Furthermore, no research has specifically focused on the pharmaceutical industry. Ardi and Yulianto (2020) found that in Indonesian agricultural and mining listed companies, board independence could moderate the effect of firm profitability on this type of disclosure. However, Solikhah et al. (2021) revealed that corporate governance, which is measured by the number of board members, board meetings, audit committee members, and audit committee meetings, does not demonstrate a statistically significant moderating role in the association between firm profitability and such disclosure.

Thus, there is a research gap in measuring corporate governance as an index using PCA and examining its role as a moderating variable in the influence of firm profitability on this type of disclosure. This gap is particularly evident in studies of China's pharmaceutical industry.

2.5.5.4 Summary of the Moderating Role of Corporate Governance

To sum up, prior studies have predominantly examined the positive moderating effects of factors such as executives' environmental awareness, ownership structure, and management incentives on the relationship between regulatory pressure and this type of disclosure (Pan & Guo, 2018; Sun, 2020; J. W. Zhang, 2021). It has also clarified that executive incentives and ownership concentration moderate the influence of media exposure (Li & Zhai, 2018). Additionally, it has been found that board independence can moderate the effect of firm profitability on such disclosure (Ardi & Yulianto, 2020).

However, corporate governance is an overall mechanism rather than a single variable (Tian et al., 2019). Thus, as a governance mechanism for regulating and overseeing corporate behaviour, corporate governance can influence this type of disclosure through multiple channels. This highlights the importance of examining how corporate governance moderates the effects of regulatory pressure, media exposure, and firm profitability on corporate environmental disclosure in pharmaceutical companies. Unfortunately, only Tao (2022) discussed the moderating role of corporate governance index in the influence of regulatory pressure on this type of disclosure.

Thus, there is a gap in the existing literature regarding whether the corporate governance index can moderate the influence of media exposure and firm profitability on this type of disclosure, and whether such moderating effects

exist in Chinese pharmaceutical companies.

2.5.5.5 Hypotheses Development

(1) Moderating Effects of Corporate Governance on the Influence of Regulatory Pressure and Media Exposure to Corporate Environmental Disclosure

According to stakeholder theory (Freeman, 1984), both the government and the media are significant stakeholders of a company and are concerned about corporate environmental disclosure. Likewise, underpinned by the legitimacy theory (Parsons, 1960), companies are motivated to disclose a high level of environmental information when they receive policy requirements and pressure from the government and face media pressure driven by public opinion. As a result, when regulatory pressure becomes increasingly stringent and media exposure rises, such supervisory pressure tends to steer businesses towards a predisposition to disclose a greater volume of environmental information (Qian et al., 2022; He, 2024; Wichianrak et al., 2021; Yi & Zhou, 2023). However, although the Chinese authority has strengthened its regulatory pressure on corporate environmental disclosure (Liu, 2022), and scholars have emphasised the importance and influence of media exposure (X. Wang, et al., 2022), this type of disclosure of Chinese listed companies remains insufficient. Therefore, under such external pressures, companies may have the intention to provide enhanced corporate environmental disclosure, but still require more effective internal

operations to ultimately achieve the objective.

A set of processes known as corporate governance coordinates the interaction between a firm and its stakeholders (Li & Dai, 2013). Based on agency theory (Jensen & Meckling, 1976), companies can monitor management behaviour through mechanisms such as establishing a board of directors. This means that, in accordance with the *Chinese Company Law* requiring the establishment of a supervisory board, effective corporate governance can enable the dual board system to perform a better internal oversight function (Liu & Liu, 2001), when the company faces external pressures from regulatory pressure and media exposure. This, in turn, promotes managers' formulation of corporate environmental disclosure requirements. In addition, corporate governance serves as an internal management system to ensure the effective operation of the company and to guarantee that managers and employees fulfil their duties in compliance with laws, regulations, and corporate policies (Cui, 2022). Under the premise that corporate managers formulate relevant disclosure requirements, employees will pay more attention to the handling of environmental disclosure-related business, and thus the various departments of the enterprise will be more efficient in formulating and executing a series of environmental disclosure processes. Therefore, these behaviours can ultimately lead to further improvement in corporate environmental disclosure.

Tao (2022) demonstrates that corporate environmental disclosure and

regulatory pressure are significantly positively correlated, and that this link is positively moderated by overall corporate governance levels. Moreover, Solikhah and Maulina (2021) found that the implementation of corporate governance principles enhances the influence of media exposure on this type of disclosure.

Based on the above discussion, the hypotheses (H5a and H5b) are proposed:

H5a: Corporate governance has a complementary moderating effect on the influence of regulatory pressure on corporate environmental disclosure.

H5b: Corporate governance has a complementary moderating effect on the influence of media exposure on corporate environmental disclosure.

(2) Moderating Effects of Corporate Governance on the Influence of Firm Profitability to Corporate Environmental Disclosure

Based on stakeholder theory (Freeman, 1984) and agency theory (Jensen & Meckling, 1976), managers of highly profitable companies may disclose more environmental information to present a more positive and socially responsible image to stakeholders, provided their personal interests are met (Nuskiya et al., 2021; Lei & Huang, 2024). However, highly profitable firms may sometimes prioritize corporate interests excessively at the expense of environmental

protection (Qiu & Liu, 2020). Furthermore, due to the underdeveloped mandatory disclosure system in China, companies often avoid voluntarily disclosing environmental information or disclose only information favourable to them (Bai & Gu, 2023). This indicates that many companies, regardless of their firm profitability, fail to establish robust systems for corporate environmental disclosure.

Furthermore, based on agency theory (Jensen & Meckling, 1976), corporate governance is a system designed to balance the relationships among stakeholders, including shareholders, the board of directors, and management (Dang & Lu, 2012). Similarly, effective corporate governance can enhance corporate decision-making efficiency (Liu, 2003). A sound decision can only achieve its intended outcomes when effectively implemented. Therefore, while highly profitable companies have the ability and inclination to improve corporate environmental disclosure quality, they still need to balance stakeholder interests and enhance decision-making efficiency to ultimately achieve enhanced corporate environmental disclosure.

According to Ardi and Yulianto's (2020) research, the number of independent directors, as a measure of corporate governance, can moderate the influence of firm profitability on environmental disclosure. In addition, corporate governance is a comprehensive mechanism, and different aspects of corporate governance can be simultaneously employed or used interchangeably

to some extent (da Silva & Leal, 2005). Therefore, based on the role of corporate governance in balancing stakeholder interests and enhancing corporate decision-making efficiency (Dang & Lu, 2012; Liu, 2003), corporate governance index that captures governance performance at the company-wide level can also exert a positive moderating effect on the influence of firm profitability on corporate environmental disclosure.

Drawing upon the above analysis, the study puts forward the following hypothesis (H5c):

H5c: Corporate governance has a complementary moderating effect on the influence of firm profitability on the corporate environmental disclosure.

2.5.6 Conceptual Framework 1: Factors Influencing Corporate Environmental Disclosure

Based on stakeholder theory (Freeman, 1984), legitimacy theory (Parsons, 1960) and agency theory (Jensen & Meckling, 1976), this study firstly examines the influence of regulatory pressure, media exposure, firm profitability and corporate governance on corporate environmental disclosure. Secondly, the moderating role of corporate governance on the influence of regulatory pressure, media exposure, and firm profitability on the disclosure is examined. The conceptual framework illustrating the proposed hypotheses H1 to H5 is presented in Figure 2.2.

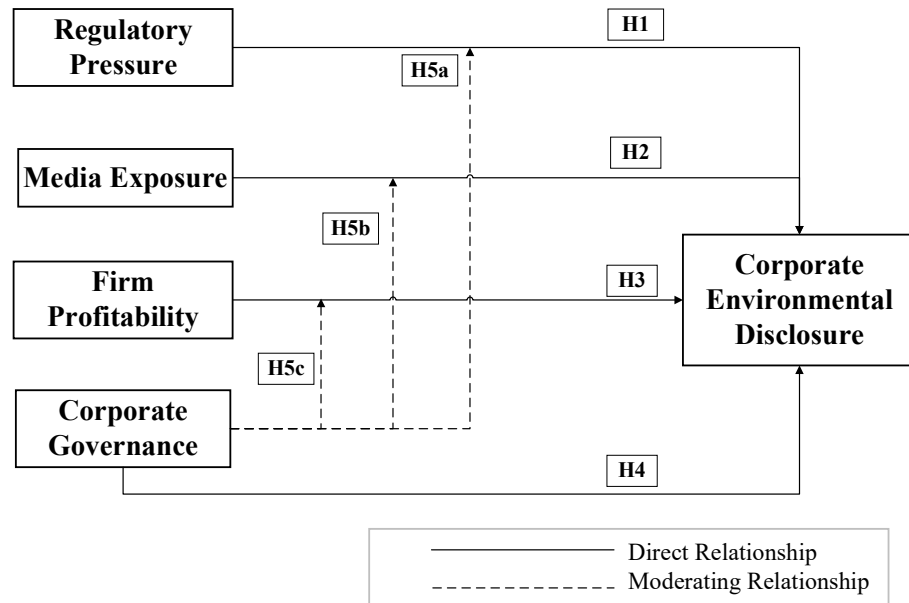


Figure 2.2 Conceptual Framework 1

2.6 Impact of Corporate Environmental Disclosure on Financing Costs

Financing cost refers to the expense borne by a company in obtaining a stable source of funding during the financing process. It represents the compensation paid by the funds' recipient to the funds' provider and encompasses both the opportunity cost of relinquishing the right to use the funds by the funds' provider and the fees incurred by the funds' recipient for utilizing the funds.

Public listed companies' financing methods can be divided into two categories: internal financing achieved through retained earnings and depreciation, and external financing including equity financing and debt financing. Due to the limitations imposed by firm size and profitability on internal financing, external financing has become the predominant component of a company's financing structure (Huang & Zhang, 2001). Therefore, this study

will focus on external financing, and accordingly categorize financing costs into two types: cost of equity and cost of debt.

2.6.1 Cost of Equity

Cost of equity refers to the minimum required rate of return demanded by shareholders when investing in a company, taking into account the assessment of operational risks and profit potential. It represents the investment return that shareholders expect to receive in exchange for assuming the risk of investing in the company's shares (Modigliani & Miller, 1958).

The cost of equity can be measured using two main categories of models: ex-post models and ex-ante models (Jiao, 2023). Ex-post models for measuring the cost of equity include the Capital Asset Pricing Model (Markowitz, 1952; Sharpe, 1964), the Arbitrage Pricing Theory (Ross, 2013) and the Three-Factor Model (Fama & French, 1992). Ex-ante valuation models include the Dividend Discount Model (Malkiel, 1979; Gordon & Gordon, 1997), the Gebhardt-Lee-Swaminathan Model (Gebhardt et al., 2001), and the Residual Income Valuation Model, which includes the PEG model by Easton (2004) and the Ohlson-Juettner-Nauroth model by Ohlson and Juettner-Nauroth (2005).

2.6.1.1 The Impact of Corporate Environmental Disclosure on Cost of Equity

In China, numerous studies have examined the impact of corporate environmental disclosure on the cost of equity, but no consensus has been reached.

On the one hand, several scholars, after analysing various enterprise samples, have found that enhanced corporate environmental disclosure lowers the cost of equity (Luo, Cai, et al., 2020; Su & Zhang, 2020; Wu & Qin, 2022). This is because corporate environmental disclosure mitigates information asymmetry between enterprises and the public (Fan & Fu, 2021). In particular, corporate environmental disclosure allows investors to understand a company's environmental governance, creating an effective communication mechanism that ultimately guides investors to make better decisions (Luo, Cai, et al., 2020). Specifically, Luo, Cai, et al. (2020), focusing on listed companies in Jiangsu Province, found a negative correlation between corporate environmental disclosure and the cost of equity in the same period. Furthermore, enhanced corporate environmental disclosure in the current period can lower cost of equity in the subsequent period. Similarly, Su and Zhang (2020), narrowing their research scope to key polluting enterprises listed on the SSE, demonstrated a significant correlation between enhanced corporate environmental disclosure and reduced cost of equity, with this relationship being more pronounced in SOEs. Likewise, Wu and Qin (2022), expanding the sample to listed companies

in heavily polluting industries in China, provided empirical evidence of a negative correlation between cost of equity and corporate environmental disclosure quality.

On the other hand, some scholars found that there is no significant relationship between corporate environmental disclosure and cost of equity (Fang & Guo, 2018; Ren & Hong, 2017; Yan et al., 2023). Fang and Guo (2018), using the event study methodology, selected listed companies and their subsidiaries in heavily polluting industries, focusing on cases of environmental penalties as the research sample. The authors found that, due to the low costs associated with violating environmental and accounting requirements, the cost of equity did not change significantly even after being exposed to negative environmental news. Similarly, other empirical studies have shown that the cost of equity is not impacted by this type of disclosure in China (Ren & Hong, 2017; Yan et al., 2023). Specifically, Ren and Hong (2017) analysed heavily polluting industries and found that corporate environmental disclosure was unrelated to cost of equity. This result could be attributed to differences in corporate environmental disclosure metrics or variations in methods used to estimate the cost of equity, which may have led to deviations from the expected outcomes. Yan et al. (2023), expanding the sample to include all listed companies in China, further concluded that corporate environmental disclosure did not significantly influence their cost of equity.

In other countries, the research conclusions are also inconsistent. Some studies have specifically examined the pharmaceutical industry. Ime et al. (2024), focusing on listed pharmaceutical firms in Nigeria, found a non-significant positive link between corporate environmental disclosure and capital costs. While other corporate social responsibility dimensions had significant financial implications, environmental reporting alone showed limited effects. Similarly, Yang and Yulianto (2022), analysing environmental-sensitive industries including pharmaceutical and chemical firms, observed a negative but statistically insignificant relationship between environmental responsibility and cost of equity. These findings suggest that although pharmaceutical companies may adopt environmental disclosures to enhance legitimacy and stakeholder trust, such efforts have not consistently translated into measurable capital cost advantages.

Similar patterns have been observed in other sectors. For instance, Tarulli et al. (2023), focusing on 73 agricultural enterprises from various countries, found that the cost of equity is not significantly impacted by corporate environmental disclosure.

Nevertheless, several cross-national studies have reported significant negative associations. Atasel et al. (2020), using Turkish BIST100¹² enterprises

¹² The BIST100, known as the Borsa Istanbul 100 Index, is a capitalisation-weighted index of 100 companies listed on the Istanbul Stock Exchange.

as their research sample, found that increasing corporate environmental disclosure levels reduces information asymmetry between companies and investors, enhances stock liquidity, and ultimately lowers cost of equity by increasing stock demand. Similarly, Ould Daoud Ellili (2020) analysed a sample of 30 companies listed on the UAE financial markets (Abu Dhabi Securities Exchange and Dubai Financial Market). The study revealed that greater corporate environmental disclosure (as part of ESG indicators) also reduces the cost of equity also by improving information transparency and decreasing information asymmetry.

Moreover, broader cross-country evidence also supports a negative relationship. El Ghouli et al. (2018) expanded their sample to include manufacturing enterprises from 30 countries, demonstrating that enhancing environmental disclosure quality effectively reduces the cost of equity. Similarly, Garzón-Jiménez and Zorio-Grima (2021), using a sample of 929 companies included in the Morgan Stanley Capital International Emerging Markets Index, revealed that better corporate environmental disclosure lowers cost of equity using GMM estimation.

Overall, the inconsistencies in conclusions regarding the impact of corporate environmental disclosure on cost of equity can be attributed to differences in the metrics used to measure cost of equity, variations in disclosure practices, and policy environments across countries. In particular, studies

focusing on Chinese listed companies, including those in heavily polluting industries, have yielded mixed results. Some studies have identified a negative and statistically significant link, whereas others report non-significant or inconclusive findings. Although several international studies have investigated this issue in the pharmaceutical industry (e.g., Ime et al., 2024; Yang & Yulianto, 2022), their results are also statistically insignificant, suggesting that the capital market response to corporate environmental disclosure among pharmaceutical firms remains weak and inconsistent. Therefore, a notable research gap remains in understanding how corporate environmental disclosure impacts the cost of equity in China's pharmaceutical sector. Given the evolving regulatory requirements, the generally poor disclosure performance of pharmaceutical firms (Mu, 2021), and the sector's high financing needs (Chinese Society of Biotechnology & Firestone Technology, 2022), further investigation is both timely and necessary.

2.6.1.2 Hypothesis Development

According to stakeholder theory (Freeman, 1984), shareholders and potential investors are stakeholders of an enterprise. The more specific and transparent a firm's publicly disclosed information is, the more it can reduce information asymmetry between the firm and investors (Healy & Palepu, 2001). Thus, disclosing environmental information can enable stakeholders to have a more comprehensive understanding of a company's environmental protection

concepts, responsibility practices and possible environmental risks, and can also alleviate information asymmetry. Moreover, under the supervision of external stakeholders, managers' opportunistic behaviours are suppressed, the agency problem is alleviated, and the risk of related violations is diminished (Verheyden et al., 2016). As a result, firms' active disclosure of high-quality environmental information reduces stakeholder investment risks and improves return stability (Wang & Jiang, 2004). Furthermore, active disclosure of environmental information by enterprises helps foster a favourable public perception and strengthen their reputation for credibility. Corporate reputation, as a valuable intangible asset, can bring capital premiums for enterprises (Wu, 2012). Therefore, better corporate environmental information disclosure can enhance investor confidence, attract more investment, and reduce the cost of equity.

Similarly, at present, following the principle of mandatory disclosure, Chinese pharmaceutical listed companies still have many disclosure items and contents that fall within the scope of voluntary disclosure. In this context, companies can choose to be proactive in fulfilling their environmental responsibilities, improving environmental sustainability and other behaviours and making disclosures, or they can choose to remain passive and only meet the minimum legal requirements. The different choices will leave different impressions on investors. Based on signalling theory (Spence, 1978), firms use active and improved disclosure to convey positive information to stakeholders,

thereby encouraging favourable evaluations and building stakeholder confidence. By adequately disclosing the company's environmental information, the company can send quality signals to external investors that it is in good operating and financial condition. These signals can attract more capital inflows, increase investor confidence, reduce investor uncertainty, lower the return anticipated by investors in compensation for assumed risk, and enable the company to obtain equity financing at a lower cost (Zhu, 2021). At the same time, enhanced corporate environmental disclosure helps convey environmentally friendly signals to stakeholders and supports the cultivation of a credible and respected reputation (Xu & Liang, 2024). A well-established corporate reputation, serving as a valuable intangible asset, can translate into capital market benefits such as premium pricing (Wu, 2012).

Scholars have analysed firms across various countries and industries and the findings indicated that enhanced corporate environmental disclosure can lower the cost of equity (Ould Daoud Ellili, 2020; Luo, Cai, et al., 2020; Garzón-Jiménez & Zorio-Grima, 2021; Wu & Qin, 2022).

Drawing from the above arguments, the following hypothesis(H6) is developed:

H6: Corporate environmental disclosure is negatively associated with the cost of equity.

2.6.2 Cost of Debt

The cost of debt is the cost to a firm of using funds from creditors (Modigliani & Miller, 1958).

In measuring the cost of debt, scholars from different countries lack consistent measurement standards. At present, the measurement methods adopted mainly include the following: (1) using credit ratings provided by major rating agencies as the basis for measuring the cost of debt (Apergis et al., 2022); (2) measuring the cost of debt by calculating the difference between the weighted average yield of bonds with the same maturity and the yield of government bonds (Raimo et al., 2021); (3) using disclosed accounting data in companies' annual reports to measure the cost of debt. This includes measuring the dependent variable using the value of interest expense divided by the average of long- and short-term liabilities (Zhao & Yuan, 2024), or using the value of financial expenses divided by total liabilities at the end of the period (Peng & Sun, 2024).

2.6.2.1 The Impact of Corporate Environmental Disclosure on Cost of Debt

In China, numerous studies have examined the impact of corporate environmental disclosure on the cost of debt, yet no consensus has been reached.

First, scholars from various perspectives have found that improvements in corporate environmental disclosure leads to a reduction in the cost of debt. One key explanation is that corporate environmental disclosure can mitigate

information asymmetry between creditors and enterprises, enhance creditors' confidence in lending, and consequently lower the cost of debt (Shan, 2018; Fonseka et al., 2019; Guan & Xiao, 2019; Fonseka et al., 2020; Zhao & He, 2021; Q. Li et al., 2022). For instance, Shan (2018) suggested that releasing high-quality environmental information reduces uncertainty regarding an enterprise's future environmental performance and lowers the probability of asset impairment for creditors after fund allocation. Consequently, such enterprises can obtain financing at a lower cost, leading to a significant negative correlation between corporate environmental disclosure and the cost of debt. Similarly, Guan and Xiao (2019), Zhao and He (2021), as well as Q. Li et al. (2022) focused on heavily polluting listed companies in China and empirically found that enhanced corporate environmental disclosure is associated with a lower cost of debt. In addition, Fonseka et al. (2019), as well as Fonseka et al. (2020), examined Chinese energy and real estate companies, respectively. These findings indicated that enhanced corporate environmental disclosure reduces information asymmetry and adverse selection issues, enabling creditors to more accurately assess the environment-related operational risks of enterprises. Consequently, creditors are more likely to offer loans with lower interest rates to companies with favourable disclosure.

Complementing this view, some scholars have reached similar conclusions from the perspective of signalling theory (Wang & Guo, 2019; Wang

& Yang, 2020; Guo & Qin, 2022). Wang and Guo (2019), as well as Wang and Yang (2020), focused on heavily polluting enterprises listed on the SSE and chemical product manufacturing companies, respectively. These studies suggested that, according to signalling theory, enterprises with better environmental performance are more likely to voluntarily disclose environmental information to convey a "green" signal to stakeholders. This helps mitigate creditors' adverse selection issues and allows such enterprises to secure more favourable loan terms, thereby reducing their cost of debt. Similarly, Guo and Qin (2022), using listed textile companies in China as their sample, argued that improving the quality of corporate environmental disclosure serves as a form of self-monitoring of production processes. It aids in brand promotion, shapes a better public image, enhances public trust, and ultimately lowers the cost of debt.

Second, some scholars have proposed that enhanced corporate environmental disclosure may, conversely, lead to a higher cost of debt (Zhu & Cai, 2017; Yao & Pan, 2018). Zhu and Cai (2017) argued that enterprises should avoid "over-polishing" environmental information. The authors found that only moderate corporate environmental disclosure can effectively convey authentic corporate signals, improve banks' informational disadvantage in debt financing, and assist banks in making accurate judgments regarding corporate environmental management and operational performance. Consequently, excessive corporate environmental disclosure may result in a higher cost of debt.

Similarly, Yao and Pan (2018), using listed manufacturing enterprises in China as their sample, concluded that corporate environmental disclosure is positively correlated with cost of debt. This may be due to two reasons: (1) creditors may perceive enterprises disclosing environmental information as having higher potential risks, leading to higher interest rates and increased costs; and (2) while enterprises may disclose more information, the disclosed content may lack substantial value. As a result, creditors struggle to extract meaningful insights from the information due to persistent asymmetry, prompting them to raise lending rates.

Third, some scholars indicated that corporate environmental disclosure has no significant impact on the cost of debt (Gao et al., 2018; Du et al., 2022; W. C. Li et al., 2022). Gao et al. (2018) found that corporate environmental disclosure quality by heavily polluting enterprises in China does not significantly reduce their cost of debt. This is because banks and other financial institutions, which account for the majority of debt financing, follow standardised processes and procedures when granting loans, with profit maximization being their primary goal. Environmental risks are not considered a key factor in their decision-making process. Similarly, Du et al. (2022), as well as W. C. Li et al. (2022), also focused on heavily polluting enterprises in China. Using multiple regression models for in-depth analysis, the authors concluded that corporate environmental disclosure does not significantly influence the cost of debt. The

possible reasons include: (1) heavily polluting listed companies face higher environmental risks compared to other firms. Therefore, whether these enterprises disclose environmental information or not does not affect whether banks and financial institutions offer preferential loan rates. (2) In China, the corporate environmental disclosure system is still underdeveloped, and the mechanisms for evaluating its quality are inadequate. This results in issues such as selective disclosure (disclosing positive information while omitting negative information) or inaccurate data presentation. Consequently, these deficiencies fail to exert substantial pressure on enterprises regarding their environmental disclosures, leading to no significant impact on their cost of debt.

In other countries, scholars have also demonstrated the positive impact of corporate environmental disclosure on the reduction in cost of debt (Hamrouni et al., 2020; Febrinalda & Hasnawati, 2022; Morrone et al., 2022; Tarulli et al., 2023). For instance, Hamrouni et al. (2020), using a sample of 120 French companies listed on the SBF 120 index¹³, and Febrinalda and Hasnawati (2022), focusing on Indonesian real estate companies, both found that higher-quality corporate environmental disclosure reduces the cost of debt. In addition, Morrone et al. (2022), adopting a stakeholder perspective, studied 61 energy companies listed on the S&P 500 and found that increased environmental information disclosure lowers corporate debt financing costs. This is because

¹³ The SBF 120 Index is a composite index that includes the 120 largest companies listed on the Paris Euronext Exchange, ranked by market capitalization and trading volume.

stakeholders can use the information to reduce information asymmetry and better assess a company's creditworthiness. Additionally, banks, when analysing corporate environmental information, may consider the sustainable relationship between organisational activities and the broader environmental context, thereby directly lowering the risk associated with specific companies. Similarly, Tarulli et al. (2023) analysed 73 agricultural companies from different countries and concluded that corporate environmental disclosure enhances credibility, reduces information asymmetry, and mitigates risks. As a result, increased corporate environmental disclosure leads to a lower cost of debt.

Overall, while there is extensive literature focusing on the impact of corporate environmental disclosure on cost of debt for Chinese enterprises, the conclusions remain inconsistent. This inconsistency may be attributed to differences in the assessment of corporate environmental disclosure, the measurement of cost of debt, as well as the specific characteristics of different countries and industries. Furthermore, no existing studies have specifically examined the Chinese pharmaceutical industry. With the issuance of policies by the CSRC requiring bond-issuing companies to disclose environmental information (e.g., *Guiding Opinions on Building a Green Financial System* (People's Bank of China et al., 2016)) and the high financing demand in the pharmaceutical sector (Chinese Society of Biotechnology & Firestone Technology, 2022), it is increasingly important to study the impact of corporate

environmental disclosure on cost of debt in pharmaceutical listed companies. Thus, selecting appropriate indicators to measure corporate environmental disclosure and cost of debt, while focusing on Chinese pharmaceutical listed companies, is essential. This research gap represents a valuable area for further investigation.

2.6.2.2 Hypothesis Development

According to stakeholder theory (Freeman, 1984), creditors are critical stakeholders in enterprises. At the same time, as environmental protection awareness continues to improve, environmental issues are widely of concern to all sectors of society. Enterprise environmental problems also have a significant impact on their future development, so creditors are also highly concerned about them. However, there is a lack of professional environmental rating agencies and scientific and efficient environmental performance disclosure mechanisms in China (Li, 2023), and creditors can only evaluate the possible environmental risks of enterprises based on the corporate environmental disclosures provided by them, which leads to the aggravation of information asymmetry. The higher the degree of information asymmetry, the higher the degree of risk premium (Zhang & Hu, 2020), and thus the higher the cost of debt financing for enterprises. Active disclosure of environmental information by firms can alleviate the information asymmetry problem between creditors and firms to a certain extent and reduce the perceived risk of creditors (Goss & Roberts, 2011).

This also means that enhanced disclosure mitigates asymmetries in information access between external stakeholders and the company to a certain extent, and it is easier to win stakeholders' support and trust (Zhang et al., 2020). In addition, within firms, executives who act as agents of shareholders are of higher ethical quality in those firms that have a better fulfilment of environmental protection responsibilities (part of social responsibilities), and they value long-term mutually beneficial partnerships with creditors more, so they are less detrimental to the interests of creditors (Choi et al., 2017). Thus, enterprises taking the initiative to disclose environmental information can improve information asymmetry, so that creditors can timely and comprehensively understand the actual situation of the enterprise, make a reasonable evaluation of the environmental risk, and accurately predict the risk of the enterprise's future operation, which is conducive to enhancing the creditor's trust in the enterprise, and ultimately reducing the creditor's required rate of return.

According to signalling theory (Spence, 1978), increased corporate environmental disclosure is a way of sending signals externally. In order to show the difference between itself and other enterprises, enterprises usually take a series of actions to convey the corresponding characteristics of the information to the market. Such actions often require enterprises to pay the corresponding cost, so that other enterprises are difficult to imitate and investors can identify those enterprises that release the corresponding signals. Enterprises release

signals most directly by disclosure information about themselves. Therefore, companies with favourable environmental protection tend to voluntarily report this type of information. This allows them to convey favourable signals to stakeholders, thereby shaping a positive reputation and social image (Cao & Qiao, 2023). Ultimately, disclosing more environmental protection related information will alleviate the consideration of creditors, such as lending institutions, to avoid credit risk, and thus reduce the risk premium, with a view to achieving the goal of reducing the cost of debt (Wang et al., 2023).

Scholars have conducted analyses on enterprises across various countries and industries and the findings indicated that an enhanced corporate environmental disclosure significantly lowers the cost of debt (Guan & Xiao, 2019; Hamrouni et al., 2020; Zhao & He, 2021; Febrinalda & Hasnawati, 2022; Guo & Qin, 2022; Tarulli et al., 2023).

Based on the above discussion, the following hypothesis(H7) is proposed:

H7: Corporate environmental disclosure is negatively associated with the cost of debt.

2.6.3 The Moderating Role of Corporate Governance

2.6.3.1 The Moderating Role of Corporate Governance on the Impact of Corporate Environmental Disclosure on Cost of Equity

In China, in addition to examining the impact of corporate environmental disclosure on the cost of equity, some studies have explored the moderating role of corporate governance in this relationship. However, these studies have only focused on specific governance variables, such as directors with environmental experience (Li, 2019) and institutional investor ownership (Zhu, 2021), without discussing the issue from a comprehensive corporate governance index perspective.

Li (2019) found that directors with environmental experience significantly and positively moderate the relationship between corporate environmental disclosure and the cost of equity. Specifically, the higher the proportion of board members with environmental experience, the greater the disclosure level, leading to a reduced cost of equity. On the other hand, Zhu (2021) argued that institutional investor ownership strengthens the negative impact of corporate environmental disclosure quality on the cost of equity. Institutional investors, as both beneficiaries of listed companies and agents for external investors, are more inclined to promote the transmission of environmental information, thereby amplifying the value effect of corporate environmental disclosure.

In other countries, research specifically addressing corporate environmental disclosure remains limited, with limited research exploring the moderating function of corporate governance. Jafar et al. (2024) examined the moderating effects of board independence and board size on the relationship between ESG disclosure and the cost of equity. The findings suggested that increases in the percentage of independent directors and board size reduce the negative impact of ESG disclosure on the cost of equity. This implies that independent directors and board size have a substitutive rather than complementary effect on ESG disclosure. Therefore, when a company discloses ESG information and simultaneously has greater board independence or a larger board size, the role of ESG disclosure in reducing the cost of equity becomes less significant, as other mechanisms may already mitigate company risks and lower cost of equity.

2.6.3.2 The Moderating Role of Corporate Governance on the Impact of Corporate Environmental Disclosure on Cost of Debt

In China, some scholars have studied corporate governance as an index and found that it can enhance the negative impact of corporate environmental disclosure on the cost of debt (Shan, 2018). Shan (2018) used PCA to construct a corporate governance index as a moderating variable, focusing on heavily polluting listed companies from 2011 to 2016 and revealed that effective corporate governance strengthens the relationship between corporate

environmental disclosure and the cost of debt.

Additionally, some scholars have examined specific corporate governance variables and their moderating effects on the relationship between this type of disclosure and the cost of debt.

First, ownership concentration (Song, 2023) and state ownership (Zhao & He, 2021; Zhao, Qu, & Wang, 2023) can strengthen the negative impact of corporate environmental disclosure on debt financing costs. Song (2023) found that corporate environmental disclosure impacts cost of debt significantly more for companies with lower ownership concentration. This indicates that banks and creditors pay closer attention to environmental disclosures and environmental risks when dealing with heavily polluting companies with dispersed ownership, leading to a significant influence of disclosure quality on cost of debt. Similarly, Zhao and He (2021) concluded that the impact of corporate environmental disclosure on the cost of debt is more pronounced in SOEs than in privately-owned enterprises. This is because SOEs benefit from natural political connections, making it easier to access resources and policy support. At the same time, SOEs face higher societal expectations and responsibilities, which amplifies the impact of disclosure quality on the cost of equity compared to non-SOEs.

Second, internal controls (Guo & Qin, 2022) and whether audits are

conducted by Big Four accounting companies (Big Four) (Dai & Dong, 2015) have not shown significant moderating effects on the relationship between corporate environmental disclosure and the cost of debt. One possible reason is that the overall corporate environmental disclosure quality among the sample companies is relatively low, with most disclosures consisting of non-financial and narrative information. The lack of financial, quantifiable, or monetized environmental information diminishes the oversight role of third-party auditing institutions on corporate environmental disclosures.

Across different national settings, corporate environmental disclosure has received insufficient scholarly attention. Only Latvala (2022) examined listed companies in Denmark, Finland, and Sweden and found that female board members enhance the negative relationship between ESG disclosure and the cost of debt. Because female directors are perceived to be better at managing multiple stakeholders and ESG practices, which improves ESG performance and reduces internal risks, thereby lowering the cost of debt.

2.6.3.3 Summary of the Moderating Role of Corporate Governance

First, research on the moderating effect of corporate governance on the impact of corporate environmental disclosure and the cost of equity has primarily focused on specific governance variables, such as directors' environmental experience (Li, 2019) and institutional investor ownership (Zhu, 2021). However, as a system designed to regulate and control companies, corporate governance is

instrumental in shaping how this relationship unfolds. This broader perspective on corporate governance is currently absent from the literature. Furthermore, there is a lack of studies that focus on the pharmaceutical industry as a specific research context.

Second, Shan (2018) found that corporate governance positively moderates the impact of corporate environmental disclosure and the cost of debt. However, this research primarily used data from 2011 to 2016, predating the *2017 Guidelines* (CSRC, 2017). These findings are limited in timeliness due to the evolution of disclosure requirements since 2018. Additionally, listed companies' annual disclosure practices have undergone continuous development, further emphasising the need for updated studies. Moreover, the pharmaceutical industry, despite its unique characteristics and high financing needs, remains underexplored in this context.

In summary, given the high financing demands of the pharmaceutical industry (Chinese Society of Biotechnology & Firestone Technology, 2022), there is a pressing need to examine the moderating role of corporate governance on the impact of corporate environmental disclosure and the cost of equity and cost of debt, especially in the post-2018 mandatory disclosure regime for pharmaceutical companies. However, there remains a notable research gap in this topic.

2.6.3.4 Hypothesis Development

Based on signalling theory (Spence, 1978), active high-level corporate environmental disclosure can be viewed as a signalling behaviour towards information users (such as investors and creditors) to gain their recognition and support. Such disclosure is a good signal that involves significant costs and is difficult for other companies to imitate. Therefore, corporate environmental disclosure can, on one hand, increase investor confidence, reduce investor uncertainty, and lower the expected return rate demanded by investors, thus enabling the company to obtain equity financing at a lower cost (Zhu, 2021). On the other hand, it can also alleviate concerns from lenders and other creditors about credit risk, thereby reducing the risk premium and aiming to lower cost of debt (Wang et al., 2023). However, at the current stage in China, there is a lack of detailed and standardised criteria for such disclosure, and a lack of third-party audits and certifications, leading to questions about the credibility of the information (Cao & Xu, 2019). In this context, investors and creditors may question the possibility of exaggeration or concealment in the disclosed environmental information, doubting the authenticity of such signals and thus raising their risk assessment of the company, which in turn could lead to higher financing costs.

The credibility of the information a company communicates to external parties is closely linked to corporate governance, may shape how investors and

creditors perceive the reliability of the company's environmental disclosures. Corporate governance serves as a mechanism for coordinating relationships between the company and its stakeholders (Li & Dai, 2013). On one hand, effective corporate governance can balance the interests of stakeholders (Dang & Lu, 2012), ensuring that the company considers the interests of various stakeholders rather than favouring a particular group. This helps prevent internal stakeholders from manipulating the timeliness and accuracy of disclosure for short-term gains. On the other hand, effective corporate governance enables the board of directors and supervisory board to perform better internal oversight (Liu & Liu, 2001). Strong internal supervision leads to better fulfilment of social responsibilities by the company and more comprehensive and accurate corporate environmental disclosure, reflecting the company's efforts and achievements in environmental protection (Li, 2014). As the effectiveness of corporate environmental disclosure increases, stakeholders (such as investors and creditors) are more likely to trust the company, ultimately leading to reduced transaction costs, including lower cost of equity and cost of debt.

Existing research has demonstrated that corporate governance index positively moderates the impact of corporate environmental disclosure and the cost of debt (Shan, 2018). At the same time, specific aspects of corporate governance, such as directors' environmental experience and institutional investor ownership, can moderate the impact of the disclosure on cost of equity

(Li, 2019; Zhu, 2021). However, corporate governance is an integrated mechanism where various aspects can be simultaneously or alternatively adopted to some extent (da Silva & Leal, 2005). Therefore, based on the ability of corporate governance to balance stakeholder interests and enhance internal oversight, an indicator reflecting the overall level of corporate governance will also positively moderate the impact of corporate environmental disclosure on cost of equity and cost of debt.

Based on the above discussion, the following hypotheses (H8a & H8b) are proposed:

H8a: Corporate governance has a complementary moderating effect on the impact of corporate environmental disclosure on the cost of equity.

H8b: Corporate governance has a complementary moderating effect on the impact of corporate environmental disclosure on the cost of debt.

2.6.4 Conceptual Framework 2: Impact of Corporate Environmental Disclosure on Financing Costs

Grounded in stakeholder theory (Freeman, 1984) and signalling theory (Spence, 1978), this study firstly investigates the impact of corporate environmental disclosure on the cost of equity, and then examines its effect on the cost of debt. Finally, this study analyses whether corporate governance

moderates the impact of corporate environmental disclosure on the cost of equity and the cost of debt. The conceptual framework illustrating the proposed hypotheses H6, H7, and H8 is presented in Figure 2.3.

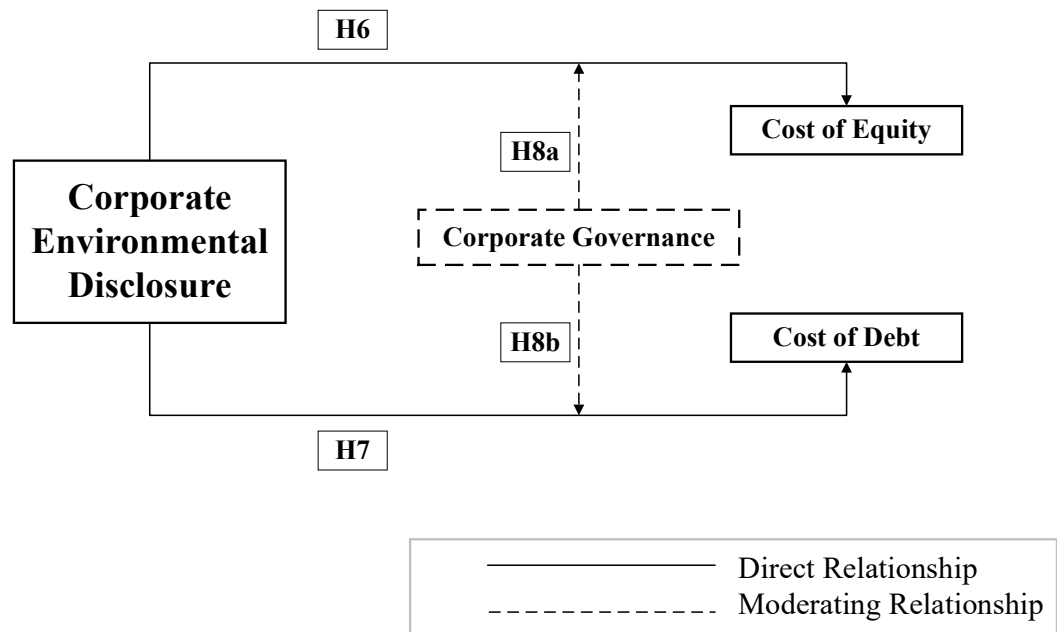


Figure 2.3 Conceptual Framework 2

2.7 Summary of Literature Review

In summary, scholars have devoted considerable efforts to researching corporate environmental disclosure, its influencing factors, and its impact on financing costs. Over time, these studies have yielded meaningful research outcomes. The perspectives, methodologies, and conclusions in existing literature have opened up new research horizons and provided essential theoretical support for subsequent investigations. However, several important shortcomings remain in the existing research, limiting both theoretical advancement and practical relevance.

(1) Insufficient Industry-Specific Research

Most existing studies on corporate environmental disclosure have focused on heavily polluting industries as a whole, without distinguishing between different sectors. However, the pharmaceutical industry in China exhibits particularly weak disclosure performance (Mu, 2021), despite its significant environmental impact due to high pollutant emissions (Wang, 2020) and sustained industrial growth (Lin & Yang, 2020). Moreover, the sector's substantial financing demands (Chinese Society of Biotechnology & Firestone Technology, 2022) highlight the urgency of enhancing disclosure practices. Although some international and domestic studies have explored corporate environmental disclosure in the pharmaceutical industry or related sectors, the findings remain fragmented and inconclusive, both in terms of its influencing factors and its financial implications. In the Chinese context, empirical research focusing specifically on listed pharmaceutical companies remains limited, creating a critical research gap.

(2) Outdated Empirical Evidence

Since December 2017, when the CSRC introduced mandatory corporate environmental disclosure requirements for heavily polluting listed companies, pharmaceutical firms have also been subject to these regulations. Under this new policy context, both the efficiency and content of disclosure are likely to have changed. However, existing research has not kept pace with these developments

and often fails to reflect the current state of disclosure practices in the Chinese market. This limitation applies not only to studies on the influencing factors of disclosure, but also to research examining its financial implications, such as its impact on the financing cost. As a result, the applicability and relevance of earlier findings are limited.

(3) Gaps in Research on Corporate Governance

Existing studies have primarily focused on how particular aspects of corporate governance such as board size and ownership configuration affect corporate disclosure practices. However, few studies adopt an integrated index designed to reflect corporate governance as a holistic and interrelated system, thereby overlooking its integrated and multi-dimensional nature. Based on the theories discussed above, corporate governance has both direct and indirect effects on corporate environmental disclosure. Specifically, it can influence the transformation of disclosure behaviour into effective disclosure through mechanisms such as enhancing internal supervision (Liu & Liu, 2001), ensuring operational efficiency and employee accountability (Cui, 2022), balancing stakeholder interests (Dang & Lu, 2012), and improving decision-making efficiency (Liu, 2003). These mechanisms shape how companies respond to external pressures (e.g., regulatory enforcement, media attention) and internal operational factors (e.g., firm profitability), ultimately affecting the quality and effectiveness of environmental disclosure. However, most existing research

tends to focus on isolated pathways, and empirical investigations into how corporate governance moderates multiple influencing factors of disclosure remain limited.

(4) Limited Understanding of Financing Implications

While some studies explore the relationship between this type of disclosure and financing costs, few focus on how corporate governance may moderate this relationship. Corporate governance can help balance stakeholder interests (Dang & Lu, 2012) and strengthen internal oversight (Liu & Liu, 2001), thereby enhancing the credibility of disclosed environmental information. This increased credibility may affect both the cost of equity and the cost of debt. However, existing studies rarely incorporate a comprehensive corporate governance index into models assessing the economic impacts of disclosure. This omission makes it difficult to evaluate how corporate governance interacts with environmental transparency to influence financing outcomes. Consequently, this limits our understanding of how governance mechanisms shape the economic outcomes of disclosure and restricts the formulation of effective policies related to both disclosure and capital access.

To address the above limitations, this study focuses on Chinese listed pharmaceutical companies, a sector characterised by high environmental sensitivity, substantial financing needs, and evolving regulatory requirements. Using data from 2018 to 2022, it provides updated empirical evidence under

China's mandatory environmental disclosure regime. In response to the fragmented treatment of corporate governance in prior research, corporate governance is conceptualised as a holistic internal mechanism through the construction of a composite governance index, allowing both its direct role and moderating effects to be systematically examined. Furthermore, by jointly analysing the cost of equity and the cost of debt, this study offers a more comprehensive assessment of the financing implications of corporate environmental disclosure and clarifies how corporate governance shapes the influencing factors and economic consequences of such disclosure in the Chinese pharmaceutical context.

2.8 Chapter Conclusion

This chapter is structured as follows. First, it introduces the key theoretical foundations relevant to corporate environmental disclosure, including stakeholder theory, legitimacy theory, agency theory, and signalling theory, and presents the corresponding theoretical framework.

Second, it clarifies the definition of corporate environmental disclosure quality and describes the data sources used to measure it.

Third, it reviews the literature on the influencing factors of corporate environmental disclosure, which are classified into four categories: regulatory pressure, media exposure, firm profitability, and corporate governance. Based

on the theoretical analysis, four corresponding sets of hypotheses are proposed. In addition, drawing on the theoretical framework and identified research gaps, the analysis explores how corporate governance moderates the link between the influencing factors and such disclosure, which forms the basis for proposing three additional hypotheses.

Fourth, the chapter explores the impact of corporate environmental disclosure on financing costs, which include the cost of equity and the cost of debt. Two sets of hypotheses are formulated accordingly. Furthermore, to address gaps in the existing literature, the moderating role of corporate governance in the relationship between corporate environmental disclosure and financing costs is examined, resulting in two further hypotheses.

Finally, the research gaps identified in the existing literature are summarised to highlight the contribution and originality of this study.

Chapter Three

RESEARCH METHODOLOGY

3.1 Overview of the Chapter

This chapter outlines the methodological framework of the study. Section 3.2 details the research design employed. Section 3.3 describes the firms selected for the sample. Section 3.4 outlines the data sources and data processing procedures. Section 3.5 defines and measures all explanatory, dependent, moderating, and control variables. Section 3.6 analyses the empirical model to be employed in the study, and Section 3.7 discusses the analytical model employed in the data analysis process. Finally, Section 3.8 summarises the chapter.

3.2 Research Design

This study aimed to examine the influencing factors of corporate environmental disclosure and its impact on financing costs. To address these research questions, the study adopted a positivist research philosophy, took a deductive approach, and relied on quantitative research methods to derive conclusions and make relevant recommendations.

Positivism in the social sciences assumes that there are relationships between different phenomena that can be established as scientific laws (Smith, 1998). Consistent with the empiricist tradition in accounting (Watts &

Zimmerman, 1986), this study hypothesised the existence of a single reality in which regulatory pressure, media exposure, firm profitability, and corporate governance influence corporate environmental disclosure. Likewise, it hypothesised that there is a single reality in which corporate environmental disclosure impacts both the cost of equity and the cost of debt.

In the deductive approach, theories and hypotheses are proposed, and research strategies are designed for hypothesis testing, with the primary goal being to formulate research hypotheses (Saunders et al., 2009). Accordingly, this study constructed conceptual frameworks and proposed eight sets of hypotheses in Chapter 2, based on the review and analysis of theories and literature.

Moreover, a quantitative methodology was employed in this study to collect and analyse numerical data, as well as to apply statistical tests (Collis & Hussey, 2009). This involved measuring variables and conducting quantitative analysis of unbalanced panel data from Chinese listed pharmaceutical companies.

Chinese listed pharmaceutical firms observed during the 2018-2022 period served as the empirical basis for this study. Relevant corporate data were collected from databases such as the CSMAR database, Chinese Research Data Services (CNRDS) database, and provincial government websites. A series of empirical tests were conducted using unbalanced panel data from these companies. These tests included descriptive statistics, correlation analyses,

preliminary analysis (including variance inflation factor [VIF] analysis, panel model estimation method selection, and heteroskedasticity analysis), regression analyses, and system GMM estimation. In addition, regression analysis employed the Fixed Effects model, while two-step system GMM estimation was used to ensure robustness and address endogeneity issues.

3.3 Population and Sample Size

The target population of this study consisted of all pharmaceutical companies listed on the SSE and SZSE, China. The sampling technique adopted was a census method, in which all eligible firms within the defined population were included. After screening, the final sample comprised 326 companies from 2018 to 2022.

As defined by the *Guidelines for Industry Classification of Listed Companies* (CSRC, 2012), enterprises with industry code C27 are categorized as pharmaceutical companies. Furthermore, Appendix B provides details of the specific classification and description of the pharmaceutical industry in China.

The rationale for selecting all Chinese listed pharmaceutical companies as the target population was as follows: (1) Chinese pharmaceutical companies have been experiencing rapid growth. In addition, with continuous expansion, environmental pollution issues have become increasingly significant (Lin & Yang, 2020). (2) Pharmaceutical companies are classified as heavily polluting

enterprises, and their production processes generate large quantities of active pharmaceutical ingredients, wastewater, exhaust gases, and solid waste (Bengtsson-Palme et al., 2018). (3) These companies also have substantial financing needs (Chinese Society of Biotechnology & Firestone Technology, 2022), and their environmental disclosure practices may influence their financing opportunities. (4) Corporate environmental disclosure in the Chinese pharmaceutical sector remains among the poorest across all heavily polluting industries (Mu, 2021).

This study selected 2018-2022 as the observation period. This period was chosen because, starting from December 2017, the *2017 Guidelines* (CSRC, 2017) required key polluting companies to disclose this type of information mandatorily. Accordingly, the objective of this study was to investigate the corporate environmental disclosure practices of Chinese pharmaceutical companies under the context of mandatory disclosure. Consequently, the year 2018, when this policy came into effect, was selected as the starting point for the study, and data from Chinese listed pharmaceutical companies for the years 2018 to 2022 were used as the observation period.

From 2018 to 2022, there were a total of 327 pharmaceutical listed companies in China. After excluding one company that remained under the Special Treatment (ST) or Delisting Risk Warning (*ST)¹⁴ status throughout the

¹⁴ ST refers to listed firms that have experienced losses for two consecutive years and are

observation period, the final sample size for this study was 326 companies. Although this exclusion may limit the generalisability of the findings, it helps preserve the internal validity of the analysis by focusing on firms with relatively stable disclosure mechanisms. Consistent with prior research (e.g., Fan & Fu, 2021; Ding et al., 2022; Zhang et al., 2022), this study excluded ST and *ST companies to avoid potential noise and ensure the comparability of observations. As not all firms were listed throughout the entire observation period, and some experienced changes in industry classification or listing status, the dataset constituted an unbalanced panel due to the structural characteristics of the sample.

3.4 Data Collection and Processing

The empirical analysis was based on secondary data drawn from multiple sources, including CSMAR, CNRDS, and provincial government websites. Secondary data refer to quantitative or qualitative data collected by individuals other than the researcher for purposes other than the current study (Ellram & Tate, 2016). Compared to data obtained through other research methods, such as experimental methods, surveys, or interviews, secondary data offer several distinct advantages, including: (1) providing large-sample evidence with a temporal span to support research perspectives; (2) enhancing the objectivity and

placed under special regulatory treatment. *ST refers to stocks of listed companies that have incurred losses for three consecutive years and may face delisting risk. These firms are typically under financial distress and subject to stricter regulatory scrutiny, and their environmental disclosure behaviour may be influenced more by compliance pressure than by strategic considerations.

validity of research findings; and (3) improving the replicability of research results, thereby making the conclusions more robust (W. M. Liu et al., 2022).

The specific data sources for each variable in this study were as follows:

(1) Corporate environmental disclosure: collected through content analysis, with the primary data source being the CSMAR database (Chen, He, et al., 2023; Wei et al., 2024). (2) Corporate governance: the governance index was constructed using PCA, and the basic data source was the CSMAR database (Zhou et al., 2020; Wang & Yuan, 2022). (3) Regulatory pressure: collected through text-based approach, with the basic data source being the websites of provincial governments (Chen & Chen, 2018; Yin et al., 2022; He, 2024). (4) Media exposure: data were obtained from the CNRDS database (F. S. Wang et al., 2022; Liu et al., 2023). (5) Cost of equity: measured using the PEG model, with the main data source being the CSMAR database (Chen & Hu, 2023; Yao et al., 2024). (6) Cost of debt: measured as the Financial Cost Ratio, with the basic data source being the CSMAR database (Wu et al., 2020; Peng & Sun, 2024). (7) Other data (firm profitability and various control variables): the basic data sources were the CSMAR database (Ye et al., 2015; Deng et al., 2020; Li et al., 2019; Su & Zhang, 2020; Qiu & Yin, 2019; J. Yang et al., 2020).

3.5 Measurement of Variables

3.5.1 Corporate Environmental Disclosure

This study used the corporate environmental disclosure score to measure

the quality of corporate environmental disclosure. To ensure the authority of the environmental information classification indicators and the objectivity of assigning values to the classified environmental information, this study referenced the indicator settings in the *China Environmental Research Database* (CSMAR, 2018-2022) for content analysis, drawing on the studies of Chen, He, et al. (2023) and Wei et al. (2024). This was because the environmental information data in the CSMAR database were processed and classified according to a unified standard, which not only greatly reduced the subjective influence of individual researchers during the classification and value assignment process, but also effectively ensured the objectivity and reproducibility of the research data.

In particular, five primary indicators were selected, including environmental certification, environmental management, environmental regulatory disclosure, environmental liabilities, environmental performance, and environmental governance. Among these, the sections on environmental certification, environmental management, and environmental regulatory disclosure consisted of 14 secondary indicators in total, all of which were classified as descriptive information. For these 14 secondary indicators, if the information was publicly disclosed, it received a score of 1; if it was not relevant, it received a score of 0. In addition, the sections on environmental liabilities and environmental performance and governance (12 secondary indicators combined)

involved both descriptive and numerical types of information. Consequently, for these two sections, if the evaluation item contained both numerical and descriptive type of information, it was awarded 2 points. If an evaluation item just contained only descriptive information, it received 1 point. If an item was not disclosed, it received a score of 0.

The detailed process for calculating ED was as follows. First, corporate environmental disclosure was calculated for each Chinese pharmaceutical listed company based on the CSMAR database (see Table 3.1). Second, the scores of the 26 indicators for each company were summed to obtain the corporate environmental disclosure score (0 being the lowest and 38 the highest). Finally, the scores were standardised as $ED = \text{Actual corporate environmental disclosure score} / \text{Maximum corporate environmental disclosure score}$.

Table 3.1 Corporate Environmental Disclosure Indicators

Level 1 Indicators	Level 2 Indicators	Evaluation methods
Environmental Management	Environmental Philosophy	Whether to disclose the company's environmental philosophy, yes=1, no=0
	Environmental Objectives	Whether to disclose the company's environmental objectives, yes=1, no=0
	Environmental Management System	Whether to disclose the company's environmental management system, yes=1, no=0
	Environmental Education and Training	Whether to disclose the company's environmental education and training, yes=1, no=0
	Environmental Initiatives	Whether to disclose the company's special environmental initiatives, yes=1, no=0
	Environmental Contingency	Whether to disclose the company's emergency response mechanism for environmental matters, yes=1, no=0
	Environmental Honours and Awards	Whether to disclose the company's environmental honours or awards, yes=1, no=0
Disclosure of Environmental Regulation	Three simultaneous	Whether to implement the "three simultaneous" system, yes=1, no=0
	Pollutant discharge compliance	Whether the pollutant discharge meets the standard, yes=1, no=0
	Sudden environmental accidents	Whether there is an unexpected major environmental pollution incident, yes=1, no=0
	Environmental Violations	Whether there is an environmental violation, yes=1, no=0
Environmental Certification	Environmental petition cases	Whether there is an environmental petition, yes=1, no=0
	ISO14001 Certification	ISO14001 Certification or not, yes=1, no=0
Environmental Liabilities	ISO9001 Certification	ISO9001 Certification or not, yes=1, no=0
	Wastewater emissions	0=no description, 1=descriptive information 2=Descriptive information and numerical type of information
	COD emissions	
	SO2 emissions	
	CO2 emissions	
	Soot and dust emissions	
	Industrial solid waste emissions	
	Exhaust emission reduction treatment	

Environmental Performance and Governance	Wastewater abatement treatment
	Control of dust and smoke
	Solid waste utilization and disposal
	Noise, light pollution, radiation and other governance
	Implementation of Cleaner Production

Note. Date from CSMAR Database (2023)

3.5.2 Regulatory Pressure

Regulatory pressure refers to the government's use of coercive means to impose constraints and restrictions on individuals, legal persons, enterprises and other micro subjects to achieve public policy objectives, thereby creating welfare or potential welfare for the public (Feng, 2021). In this study, regulatory pressure referred to local governments' supervision and control of the environment. Its aim was to actively promote corporate environmental responsibility through regulation and restraint. It also aimed to maximise corporate environmental disclosure to the public and achieve harmonious development between the economy, society, and nature.

In China, many scholars have chosen the Pollution Information Transparency Index (PITI) to measure the intensity of regulatory pressure (Zhang & Duan, 2019; He & Ren, 2020; Qian et al., 2022). PITI, developed and released jointly by the Institute of Public and Environmental Affairs and several non-profit environmental organizations, indicates that a higher PITI score reflects stronger government regulation (Su & Zhang, 2020). However, PITI updates ceased after 2019. Consequently, in recent years, some scholars have employed counts of environmental-related terms drawn from government work reports to proxy for regulatory pressure (He, 2024).

This study built on the work of Chen and Chen (2018), Yin et al. (2022), and He (2024), by using a text-based approach, which calculated the frequency

of relevant vocabulary in government work reports as a proxy variable for regulatory pressure. At the beginning of each year, government officials at various levels reported on their work achievements over the past year and also outlined future work schedules. These reports represent the culmination of various social demands and consensus, and serve as a key reference for guiding the government's work for the year. Therefore, the level of attention given to the environment in government work reports reflected the government's environmental supervision efforts and the overall landscape of government policies for that year.

This study, based on word frequency rather than the number of individual characters, aimed to more accurately preserve the semantic meaning of the source text (Chen & Chen, 2018). When selecting environmental-related words, this study drew upon the research of Deng and Yang (2019), Yin et al. (2022), as well as Zheng and Xue (2024) and selected 15 words: "environmental, environmental protection, pollution, energy consumption, ecology, green, low carbon, discharge, emission reduction, air, chemical oxygen demand (COD), sulphur dioxide (SO₂), carbon dioxide (CO₂), Particulate Matter (PM)₁₀, and PM_{2.5}", to comprehensively reflect the government's emphasis on environmental protection.

These keywords were widely used in existing literature to capture environmental policy signals across industries. At the same time, many of them

are particularly relevant to the pharmaceutical sector. General environmental terms such as "environmental protection," "environmental," "pollution," "energy consumption," "ecology," "green," and "low carbon" are highlighted as core principles in official guidelines for the pharmaceutical industry. For instance, the *Technical Guidelines for Pollution Prevention and Control* (Ministry of Ecology and Environment, 2023) treat these concepts as fundamental principles guiding the industry's green transition and ecological governance. In contrast, sector-specific terms such as "discharge" and "emission reduction" are specifically addressed in the *Good Manufacturing Practice Guidelines* (National Medical Products Administration, 2020), reflecting regulatory focus on wastewater and gas treatment. Additionally, terms including "air," "COD," "SO₂," "CO₂," "PM₁₀," and "PM_{2.5}" are incorporated in the *Emission Standard of Air Pollutants for the Pharmaceutical Industry* (Ministry of Ecology and Environment, 2017) as core indicators for air pollution control in this industry.

The specific steps for constructing the regulatory pressure variable (GOV) in this study were as follows: (1) collected 31 provincial government work reports from 2018 to 2022 from official provincial websites; (2) segmented the text into words using word segmentation techniques; (3) counted the frequency of environment-related words and calculated their proportion to the total number of words in the report.

3.5.3 Media Exposure

In this study, media exposure referred to the level of focus that the media directed towards a specific enterprise, quantified by the quantity of news reports published or republished by the media regarding a given enterprise (Ji, 2020). Consequently, an increased volume of media reports directed at a particular enterprise signified a higher media exposure attributed to that enterprise.

Media exposure is another major source of external pressure on enterprises, and many existing studies use the number of reports in printed newspapers to measure the extent to which companies were monitored by the media (Huang et al., 2020). However, in the information age where the Internet is highly prevalent, modern media is not limited to just television and newspapers, but also includes websites, forums, and other new forms of communication. As printed newspapers required high production costs and longer dissemination times, online media have gradually entered the public eye, and its development momentum cannot be ignored. Accordingly, scholars have chosen to define media exposure as the degree of attention from online media in their research (Xiao & Zhou, 2021).

Hence, this study proposed that by combining the total number of printed newspapers and online media, a more comprehensive reflection of enterprises' media exposure could be achieved. Referring to G. Q. Yang et al. (2020) and Yuan and Xiong (2021), this study used the total number of quantified financial

news reports in newspapers and the quantity of quantified news reports on the internet to measure the intensity of media exposure received by companies. Taking reference from the studies by F. S. Wang et al. (2022) and Liu et al. (2023), the data on relevant media reports were obtained from the CNRDS database, which encompassed over 400 online media outlets¹⁵.

The construction of the media exposure variable (MEDIA) proceeded as follows: (1) collected relevant media information mentioning the company in both print and online sources from the CNRDS database; (2) applied a logarithmic transformation to stabilize the data, calculating media exposure as the natural logarithm of "1 + total media report count," following F. S. Wang et al. (2022), to account for zero values and enhance interpretability.

3.5.4 Firm Profitability

Firm profitability refers to a company's ability to generate profits, also known as its ability to grow its funds or capital. It is typically measured by the level of earnings a company generates within a specified timeframe. Firm profitability is commonly assessed using metrics such as Earnings Per Share (EPS) (Kalola, 2021), Return on Assets (ROA) (Ardi & Yulianto), and Return on

¹⁵ Including publications such as "China Securities Journal," "Shanghai Securities News," "Securities Times," "Securities Daily," "21st Century Business Herald," "First Financial Daily," among others. Additionally, the database covers more than 600 newspapers and periodicals, including entities like "Financial News," "Hexun.com," "Huaxun.com," "Sina.com," "Phoenix Finance," "Sohu Finance," "NetEase," "Zhongjin Online," and "Eastmoney.com," among others

Equity (ROE) (Qiu & Liu, 2020; Wang & Li, 2021; Lin & Zhou, 2022).

The pharmaceutical industry typically requires large amounts of capital for research and development of new drugs, the construction of production facilities, and market expansion, etc. ROE can assess a company's ability to use capital efficiently by measuring the profit generated per unit of net assets. At the same time, the research and development process in the pharmaceutical industry is long, costly and risky, and the successful development of new drugs does not always ensure high returns. By taking into account not only the level of profit but also a firm's financial leverage and risk exposure, ROE provides a broader evaluation of corporate performance and helps investors to better understand the risks of a company.

In this study, firm profitability was measured using ROE, which was calculated as "net profit divided by average equity". The data for the company's profit capability indicators were obtained from the CSMAR database.

3.5.5 Corporate Governance

Corporate governance refers to a comprehensive system of arrangements through which owners oversee and control a company's operational management and performance (Lin et al., 1995). Corporate governance arises from agency problems and comprises institutional arrangements that coordinate economic relationships among stakeholders, including shareholders, the board, creditors,

management, and employees. Focusing solely on specific indicators does not sufficiently reflect overall governance status, so multiple corporate governance indicators are incorporated into a unified research framework. However, this can lead to multicollinearity issues, potentially compromising the reliability of research outcomes. If some variables are excluded, model specification bias due to omitted variables may arise, further introducing endogeneity issues. To address this, many scholars both domestically and internationally have begun applying different methodologies or econometric techniques to reduce the dimensionality of multiple variables that describe corporate governance levels. This approach enables the development of a corporate governance index that reflects overall governance quality while retaining the integrity of the original data (Jolliffe, 2011).

Many scholars have employed PCA to construct corporate governance indices that reflect the comprehensive governance status of companies (Shan, 2018; Wang & Yuan, 2022; Wang & Sun, 2023). PCA consolidates variables related to each determinant into a composite score, leveraging the concept of dimensionality reduction (Jolliffe, 2011). This method effectively avoids multicollinearity and minimises measurement errors (Arena et al., 2015).

As a result, this study used a corporate governance index to measure the overall level of corporate governance. Based on the indicators identified in Chapter 2 that influence corporate environmental disclosure and drawing on the

selection criteria used by Zhou et al. (2020) and Wang and Yuan (2022), this study employed PCA and selected nine indicators across three dimensions to measure corporate governance levels.

First, ownership characteristics were determined by equity balance, institutional shareholding, nature of ownership, and shareholding by directors, supervisors, and executives. Second, for board of directors and supervisory board characteristics, three indicators were chosen: board independence, board of director size, and supervisory board size. Lastly, regarding executive characteristics, two indicators were used: CEO-chairman duality and executive compensation.

Based on the above nine variables (see Table 3.2 for details of specific variable descriptions), the PCA method was used to construct the corporate governance index. The first principal component from PCA served as an aggregate proxy for corporate governance performance. The larger the CG, the better the level of corporate governance, and vice versa.

Table 3.2 Corporate Governance Index Construction

Variables	Acronym	Definition	Measurement	Source
Equity Balance	Balance	Concentration of the company's shareholding structure	the ratio of the shareholding ratio of the second to the fifth largest shareholders and the ratio to the shareholding ratio of the first largest	CSMAR Database

shareholder			
Institutional Shareholding	INST	Proportion of shares held by institutional investors to the total share capital of the company	Shares held by institutional investors/total company share capital
Shareholding by Directors, Supervisors, and Executives	Mshare	Proportion of shares held by directors, supervisors, and executives of the company	Number of shares held by executive, directors and supervisors / Number of total share capital
Nature of Ownership	NOw	Whether the enterprise is a state-controlled enterprise	When the enterprise is state-controlled enterprises, assign a value of 1; otherwise, assign a value of 0
Board Independence	Indep	Proportion of the number of independent directors to the total number of board members	Number of independent directors/total number of board members
Board of Directors Size	Board	Number of members of the Board of Directors	Number of members of the Board of Directors
Supervisory Board Size	Supervisory	Number of members of the Supervisory Board	Number of members of the Supervisory Board
Duality	Dual	Combination of the positions of chairman and CEO	When the chairman and chief executive officer is the same, assign a value of 1; otherwise, assign a value of 0
Executive Compensation	MComp	Compensation of top three executives	Natural log of total compensation paid to the three highest-paid executives

The specific steps for calculating the corporate governance in this study

are as follows:

(1) Feasibility Tests

To determine the feasibility of PCA for corporate governance-related variables, this study conducted commonly used tests for data feasibility: the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. Bartlett's test of sphericity indicates the suitability of PCA for evaluating corporate governance, while higher KMO values indicate better analysis effectiveness. When the KMO result exceeds 0.5 and the significance result from Bartlett's test is less than 0.05, it indicates that the test can proceed.

As shown in Table 3.3, the KMO analysis yielded a result of 0.603 (greater than 0.5), indicating an acceptable level of overlap among variables. Additionally, the Bartlett's test of sphericity resulted in a significance value of 0.000 (less than 0.05), signifying significance at the 5% level. This outcome suggested a certain degree of correlation among the nine selected corporate governance variables, validating the use of PCA for evaluating corporate governance.

Therefore, this study adopted PCA in Stata to conduct dimensionality reduction on the data, thereby obtaining a comprehensive corporate governance index.

Table 3.3 KMO and Bartlett Sphericity Tests for Corporate Governance

Test Methods		Test results
KMO Measure of Sampling Adequacy		0.603
Bartlett test of sphericity	Chi-square	1886.171
	Degrees of freedom	36
	p-value	0.000

(2) Principal Component Extraction

As shown in Table 3.4, this study first standardised the original values of the nine selected variables. In extracting the principal components, the Kaiser criterion (Kaiser, 1960) was applied, whereby only components with eigenvalues greater than 1 were retained (Wu, 2010). In this study, the first three components met this criterion, with a cumulative variance contribution of 56.40%. According to standard practices in PCA, a cumulative variance exceeding 50% is generally considered sufficient to ensure interpretability and construct validity (Wu, 2010).

Furthermore, several prior studies have also adopted the Kaiser criterion (Kaiser, 1960) when constructing a corporate governance index. For example, Li and Guan (2024), in their study of Chinese listed companies, and Arifin, Raharja, Nugroho, and Aligarh (2022), based on data from Indonesian listed firms, both employed PCA and retained only components with eigenvalues greater than 1 for index construction. These examples illustrate that using the Kaiser criterion for component extraction is a widely accepted and common approach in corporate governance research. Following this practice, this study retained the first three principal components to comprehensively reflect the key

dimensions of corporate governance.

Table 3.4 Standardisation of PCA

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.4047	.938273	0.2672	0.2672
Comp2	1.46642	.261872	0.1629	0.4301
Comp3	1.20455	.235121	0.1338	0.5640
Comp4	.969431	.109529	0.1077	0.6717
Comp5	.859902	.136486	0.0955	0.7672
Comp6	.723416	.113164	0.0804	0.8476
Comp7	.610252	.182567	0.0678	0.9154
Comp8	.427685	.0940437	0.0475	0.9629
Comp9	.333641	.	0.0371	1.0000

(3) Principal Component Calculation

With the nine components for constructing the corporate governance index identified, the next step was to determine the linear combinations constituting each component. Table 3.5 presents the loading matrix of the nine components. From the table, it can be observed that the loading values of Principal Component 1 (Comp1) are relatively high for institutional ownership, property rights nature, and management ownership, suggesting it reflects the shareholder ownership aspect of governance. Principal Component 2 (Comp2) has higher loading values for board size and the proportion of independent directors, indicating it reflects the board governance aspect of the company. Principal Component 3 (Comp3) shows relatively high loading values for equity balance, supervisory board size, and management compensation, suggesting it reflects aspects of equity governance, supervisory board governance, and

executive management governance. In addition, the signs of the loading values (positive or negative) indicate the direction of each variable's contribution to corporate governance. A positive loading suggests that a higher value of the corresponding variable is generally associated with effective corporate governance, whereas a negative loading implies a potential adverse influence. This is consistent with standard interpretations of PCA, where a positive loading reflects a positive correlation between the variable and the principal component, and a negative loading reflects a negative correlation (Holland, 2008; Greenacre et al., 2022).

Based on this loading matrix, expressions and scores for the principal components can be derived:

$$\text{Comp1} = -0.1024 * \text{Balance} + 0.4498 * \text{INST} + 0.378 * \text{NOw} + 0.3515 * \text{Board} + 0.3304 * \text{Supervisory} - 0.1759 * \text{Indep} - 0.2829 * \text{Dual} - 0.4495 * \text{Mshare} + 0.3026 * \text{Mcomp}$$

$$\text{Comp2} = 0.2041 * \text{Balance} - 0.2366 * \text{INST} - 0.1806 * \text{NOw} + 0.566 * \text{Board} + 0.1969 * \text{Supervisory} - 0.6184 * \text{Indep} + 0.1472 * \text{Dual} + 0.324 * \text{Mshare} + 0.0387 * \text{Mcomp}$$

$$\text{Comp3} = 0.5919 * \text{Balance} + 0.25 * \text{INST} - 0.3516 * \text{NOw} + 0.0145 * \text{Board} - 0.3558 * \text{Supervisory} + 0.0919 * \text{Indep} - 0.0212 * \text{Dual} - 0.0783 * \text{Mshare} + 0.5672 * \text{Mcomp}$$

Table 3.5 Component Loading Matrices

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9
Balance	-0.1024	0.2041	0.5919	0.2257	0.6016	-0.4177	0.062	-0.0686	0.0409
INST	0.4498	-0.2366	0.25	-0.4144	0.0314	0.0302	-0.1971	-0.3036	0.6121
NOw	0.387	-0.1806	-0.3516	0.1609	0.2265	-0.1398	0.7615	-0.0157	0.1309

Board	0.3515	0.566	0.0145	0.0209	-0.0662	0.036	-0.0518	0.68	0.2909
Supervisory	0.3304	0.1969	-0.3558	0.2569	0.5168	0.3628	-0.4057	-0.2682	-0.1557
Indep	-0.1759	-0.6184	0.0919	0.2979	0.2603	0.3298	-0.124	0.4946	0.2301
Dual	-0.2829	0.1472	-0.0212	-0.6846	0.4352	0.3801	0.2706	0.1235	-0.0827
Mshare	-0.4495	0.324	-0.0783	0.3108	-0.1033	0.3131	0.1834	-0.3113	0.5925
MComp	0.3026	0.0387	0.5672	0.1765	-0.2155	0.5665	0.2965	-0.1085	-0.2949

Whereby: Balance = Equity Balance; INST = Institutional Ownership Ratio; NOw = Property Rights Nature; Board = Board Size; Supervisory = Supervisory Board Size; Indep = Board Independence; Dual = Dual Role Combination; Mshare = Management Shareholdings; MComp = Compensation of the Top Three Management Positions

(4) Construction of Corporate Governance Index

After obtaining the linear combinations of the retained principal components, this study constructed the composite corporate governance index using a weighted average approach based on principal component analysis. Specifically, the retained principal components were combined by assigning weights according to their respective proportions of explained variance. These weights were calculated as the variance contribution of each retained component relative to the cumulative variance explained by all retained components. This weighting scheme ensures that components with greater explanatory power contributed more to the overall corporate governance index.

The normalization by the cumulative variance of the retained components standardised the composite score and facilitated comparability across firms. It should be noted that rotation does not alter the total variance explained by the retained components, but rather improves the interpretability of the component structure. Accordingly, the corporate governance index was

calculated as follows:

$$\text{CG} = (\text{Comp1} * 0.2672 + \text{Comp2} * 0.1629 + \text{Comp3} * 0.1338) / 0.5640$$

As PCA standardises input variables around a mean of zero, the resulting component scores, and therefore the composite corporate governance index, may include negative values. A negative CG simply indicates that a firm's governance characteristics fall below the sample average based on the selected dimensions, and does not imply invalidity or reversed governance performance.

3.5.6 Control Variables for Factors Influencing Corporate Environmental Disclosure

This study selected financial leverage, price-to-book ratio, accounts receivable ratio, book-to-market ratio, holding bank shares, and Big Four audit as control variables for examining the influencing factors of corporate environmental disclosure.

3.5.6.1 Financial Leverage

Financial leverage refers to the strategy used by companies to adjust return on equity through debt, and it serves as a key indicator of financial structure. When a company has a lower financial leverage, meaning it relies more on equity financing, managements may have more flexibility to focus on environmental issues and may be more willing to disclose related information.

This is because management is likely to prioritize long-term sustainability and social responsibility. Hence, financial leverage can influence corporate environmental disclosure (Baldini et al., 2018; Zheng et al., 2019; Liu et al., 2019). This study used the asset-liability ratio as a measure of financial leverage, which was expressed as "total liabilities divided by total assets".

3.5.6.2 Price-to-Book Ratio

The price-to-book ratio of a listed company's stock reflects the ratio of the market price per share to the net asset value per share. It indicates the company's future profitability and development capabilities (R. Q. Liu et al., 2022). Corporate environmental disclosure serves as a signal to the market that the company values environmental protection and fulfils its corporate social responsibility, indicating that the company faces minimal ongoing environmental risks. Moreover, the higher the price-to-book ratio of a company, the more incentive it has to strictly implement internal environmental management decisions, turn waste into treasure, promote resource recycling, and reduce energy consumption and pollution costs. Therefore, the price-to-book ratio of a company can influence corporate environmental disclosure (Shi, 2018; Su et al., 2023). In this study, the price-to-book ratio was calculated as "market price per share divided by net asset value per share".

3.5.6.3 Accounts Receivable Ratio

The accounts receivable ratio reflects a company's ability to collect

payments and its financial condition, making it one of the indicators used to assess financial health. A high accounts receivable ratio may indicate higher credit and liquidity risks for the company. In such cases, investors, creditors, and other stakeholders may be more concerned about the company's financial stability and transparency. To enhance transparency, companies may be inclined to provide more detailed environmental information to demonstrate the sustainability of their finances and operations. Research by Qiu et al. (2016) also suggested that an increase in corporate slack, including accounts receivable, significantly affects the quality of social and environmental disclosure. Therefore, the accounts receivable ratio was included as a control variable, and was calculated in this study as "net accounts receivable divided by total assets at the end of the period".

3.5.6.4 Book-to-Market Ratio

The book-to-market ratio is used to assess the extent to which a company's accounting value diverges from its market price. Companies with a high book-to-market ratio typically have stronger financial stability and more resources to assume environmental protection responsibilities. At the same time, companies with a high book-to-market ratio often prioritize corporate social responsibility and sustainable development, as well as place greater emphasis on maintaining a positive brand image. Therefore, the book-to-market ratio can influence corporate environmental disclosure (Chen et al., 2018; Wei & He,

2022). In this study, the book-to-market ratio was calculated as "book value divided by total market value".

3.5.6.5 Holding Bank Shares

When companies hold bank shares, it may weaken the independence of commercial banks to some extent, and even reduce the likelihood of bank supervision through means such as related-party loans (Kroszner & Strahan, 2001; Charumilind et al., 2006). Additionally, due to the relatively late development of green finance¹⁶ in China and the lack of experience, the specific details of green finance policies need to be gradually explored (Wang & Dong, 2019). In this situation, due to trust in stable relationships with companies, affiliated banks may reduce the requirements for corporate environmental disclosure. This could potentially hinder the improvement of corporate environmental disclosure (Zhai & Cheng, 2023). Therefore, this study selected whether the company holds bank shares as a control variable. If the company holds shares of listed or unlisted banks, the value was assigned as 1; otherwise, it was assigned as 0.

3.5.6.6 Audited by Big Four¹⁷

The Big Four face higher litigation risks and bear greater liability for

¹⁶ Green finance refers to the practice where banks incorporate environmental-related information about projects and their operating companies into the scrutiny criteria during the loan process and make final lending decisions based on this mechanism (He et al., 2019).

¹⁷ Big Four includes the four major accounting firms: Deloitte Touche Tohmatsu, Ernst & Young, PricewaterhouseCoopers, and Klynveld Peat Marwick Goerdeler.

investor damages. Consequently, these accounting firms tend to adopt more stringent audit procedures and increasingly integrate non-financial considerations into corporate reporting processes, which enhances the reliability of corporate social responsibility-related information and improves the overall quality of financial disclosures (Huang et al., 2017). Environmental information, as an important component of social responsibility information, is also subject to the influence of Big Four audits. Therefore, in the process of studying the influencing factors of corporate environmental disclosure, this study selected Big Four audit status as a control variable (Yao et al., 2016; Yao & Zhao, 2024). If a company was audited by a Big Four in a given year, the value was assigned as 1; otherwise, it was assigned as 0.

3.5.7 Cost of Equity

The cost of equity represents the return investors anticipate in exchange for bearing ownership risk, taking into account factors such as operational uncertainty and the firm's earning potential. It reflects the expected return that shareholders expect to receive for bearing the risk of investing in the firm's shares (Modigliani & Miller, 1958).

As mentioned in Chapter 2, the cost of equity can be measured using two main categories of models: ex-post models and ex-ante models. In this context, ex-post models estimate the cost of equity using historical data, with the underlying assumption that risk can be accurately priced. However, in reality,

market noise is significant, and risk estimation can be challenging due to interference from random factors, which can lead to substantial discrepancies between calculated results and actual outcomes. This often results in less accurate findings from such models (Qian & Yang, 2022). The analysis of the cost of equity for Chinese listed companies also indicates that ex-ante models generally provide more accurate measures than ex-post models. Among these, the PEG model is more effective in accurately reflecting various market risks compared to other models (Mao et al., 2012).

The PEG model proposed by Easton (2004) is a method that comprehensively assesses both value and growth potential. It estimates a company's cost of equity based on earnings forecasts for the next two periods and the company's stock price. The PEG model continuously estimates the cost of equity on an annual basis, significantly reducing the impact of abnormal earnings growth and dividend payout rate variations on the accuracy of cost of equity estimates. Compared with other models, the PEG model does not rely on market risk premium estimates or stable dividend policies, which are often unavailable or unreliable in the Chinese capital market. This further supports its suitability in this context.

Furthermore, the PEG model offers notable benefits in cost of equity estimation. First, it is more effective in addressing diverse risk factors (Mao et al., 2012), thereby mitigating distortions caused by irregular earnings expansion

and fluctuations in dividend policies. Second, its application aligns more closely with the characteristics of the Chinese capital market, as it simultaneously reflects firm valuation and anticipated growth (Li & Liu, 2016). Finally, with respect to dividend policy, the PEG model does not have restrictive assumptions and can better explain the expected return and risk of individual enterprises (Zhao et al., 2017). Therefore, the PEG model better incorporates firm value, growth, and risk factors, making its cost of equity estimates more robust compared to those of other models (Zhao & Zhong, 2021).

Therefore, drawing on the studies of Saci and Jasimuddin (2021), Chen and Zhang (2021), Chen and Hu (2023), and Yao et al. (2024), etc., this study adopted the PEG model to calculate the cost of equity in the subsequent empirical part.

$$COE_t = \sqrt{\frac{(eps_{t+2} - eps_{t+1})}{p_t}}$$

(Formula 3.1)

In this formula, COE_t represents the cost of equity of the company in period t . eps_{t+2} denotes the forecasted value of earnings per share at the end of period $t+2$, while eps_{t+1} represents the forecasted value of earnings per share at the end of period $t+1$. P_t indicates the company's stock price at the end of period t . Since the model assumes $eps_{t+2} - eps_{t+1} > 0$, observations with $eps_{t+2} \leq eps_{t+1}$ were excluded to ensure consistency with the model's underlying premise.

In the PEG model, the forecasted value of earnings is a core variable, mainly derived from two sources: securities analysts and statistical models. On the one hand, earnings forecasts by analysts have significant advantages in terms of accuracy and responsiveness (Zou et al., 2019). However, due to the relatively late development of the analyst industry in China, many listed companies, especially small-scale and financially distressed ones, have not received much attention from analysts. Additionally, analysts rarely provide forecasts for more than two years (Mao et al., 2012), resulting in a significant amount of missing data in forecasted earnings for Chinese pharmaceutical listed companies. At the same time, there is also a phenomenon of excessive optimism in earnings forecasts by analysts for Chinese listed companies (Sun & Yang, 2018). On the other hand, initially, statistical models for forecasting earnings used time series regression models, but companies must have a relatively long survival period to achieve reasonably accurate forecasts. Therefore, the trend of using cross-sectional regression models to forecast earnings gradually emerged because of lower requirements for the company's survival period and larger statistical quantities of cross-sectional data, which can effectively overcome the shortcomings of time series regression models. Hou et al. (2012) pointed out that cross-sectional regression models not only address missing values and short windows in earnings forecast data but also have smaller biases and higher reliability than analyst forecast data.

Hou et al. (2012) integrated and expanded upon previous scholars' statistical forecasting models, further proposing the hybrid cross-sectional regression model: Hou-Van Dijk-Zhang (HVZ) model. The HVZ model not only addresses the issue of reduced sample size due to missing data in analyst forecasts, but also allows for longer-term (5-year) earnings data compared to analyst forecasts, which typically cover 1-2 years. In addition, Zou et al. (2019) indicated that the HVZ model outperformed alternatives in terms of coverage, forecast bias, and earnings responsiveness coefficient for Chinese listed companies. As a result, the HVZ model has enjoyed widespread application in research (Patatoukas, 2012; Jones & Tuzel, 2013; Li et al., 2018; Y. Li et al., 2023). Therefore, this paper adopted the HVZ model to calculate corporate earnings forecast data. The HVZ model is as follows:

$$FE_{i,t+n} = \alpha_0 + \alpha_1 A_{i,t} + \alpha_2 D_{i,t} + \alpha_3 DD_{i,t} + \alpha_4 E_{i,t} + \alpha_5 NegE_{i,t} + \alpha_6 AC_{i,t} + \varepsilon_{i,t+n}$$

(Formula 3.2)

In the formula, $FE_{i,t+n}$ represents the net profit before extraordinary items of company i in year $t+n$; n represents the future forecasting year(s). $A_{i,t}$ denotes the total assets of company i in year t . $D_{i,t}$ represents the dividends paid by company i in year t . $DD_{i,t}$ represents the dividend dummy variable, taking the value of 1 if company i pays dividends in year t , otherwise 0. $E_{i,t}$ denotes the net profit before extraordinary items of company i in year t . $NegE_{i,t}$ represents the earnings dummy variable, taking the value of 1 if company i has negative earnings in year t , otherwise 0. $AC_{i,t}$ represents the accrued earnings of company i in year t . Following the approach of Hou et al. (2012), accrued earnings are calculated using the cash flow method, that is, accrued earnings = net profit -

cash flow from operating activities.

This study followed the approach of Hou et al. (2012) by using a forward rolling window of 10 years of data to predict the earnings of the next 2 years for companies. For instance, when predicting earnings for year $t+1$ in year t , the equation utilised data from year $t-9$ to year t on the left-hand side, and data from year $t-10$ to year $t-1$ on the right-hand side. This involved a one-year lag for the mixed regression to obtain the regression coefficients for year $t+1$. These coefficients are then multiplied by the accounting data for year t to obtain earnings forecast data for year $t+1$ ($FE_{i,t+1}$). Following the same procedure, when predicting earnings for year $t+2$ in year t , the equation used data from year $t-9$ to year t on the left-hand side, and data from year $t-11$ to year $t-2$ on the right-hand side. This involved a lag of 2 years for the mixed regression to obtain the regression coefficients for year $t+2$, which are then multiplied by the accounting data for year t to obtain the earnings forecast data for year $t+2$ ($FE_{i,t+2}$).

In this study, the sample period ranged from 2018 to 2022. Following the basic principle of the rolling time window described above, when sequentially predicting the earnings for the next 1 to 2 years from 2018, the data corresponding to the left-hand side of the equation covered the years 2009 to 2018, while the data corresponding to the right-hand side covered the years 2008 to 2017 (for predicting year 1, $FE_{1i,2019}$), and the years 2007 to 2016 (for predicting year 2, $FE_{2i,2020}$). Similarly, when predicting the earnings for the next

1 to 2 years from 2022, the data corresponding to the left-hand side of the equation covered the years 2013 to 2022, while the data corresponding to the right-hand side covered the years 2012 to 2021 (for predicting year 1, $FE1_{i,2020}$), and the years 2011 to 2020 (for predicting year 2, $FE2_{i,2021}$).

Finally, drawing from the study by Y. Li et al. (2023), the earnings forecast data ($FE_{i,t+1}$ and $FE_{i,t+2}$) for each sample company in year t were divided by the total number of shares outstanding at the end of year t (assuming that the total number of shares remains stable over the next 5 years), to obtain the forecasted value of earnings per share.

3.5.8 Cost of Debt

The cost of debt is defined as the financial cost borne by a firm for obtaining funds from creditors (Modigliani & Miller, 1958). As for the measurement of the cost of debt, scholars from different countries have not reached consistent measurement standards.

Therefore, when it comes to measuring the cost of debt, on the one hand, due to the relatively late start of credit rating agencies in China, there are still many problems in terms of the completeness and scientific construction of rating indicators (Tian et al., 2023). In this context, it is relatively difficult to obtain accurate and comprehensive credit ratings. Therefore, this study did not utilise credit ratings from major rating agencies as a measure of the cost of debt. On the

other hand, the development of corporate bonds in China has been relatively slow, and their share is relatively small (Wei, 2021). Not all listed companies have issued corporate bonds, so it is difficult to obtain the yield of corporate bonds and calculate the difference between the yield of corporate bonds and the yield of government bonds to measure the debt financing cost. Ultimately, this study relied on the approach of Zhang et al. (2021), who used accounting data to measure the cost of debt.

Furthermore, considering the availability of data and the comprehensiveness of cost of debt coverage, this study drew on the research of Rao and Luo (2016), Wu et al. (2020), and Peng and Sun (2024), representing cost of debt as the financial expense ratio: "financial expenses divided by total liabilities".

$$COD_t = \frac{Financial\ Expenses_t}{Total\ Liabilities_t}$$

(Formula 3.3)

In this formula, COD_t represents the cost of debt for the company in period t . $Financial\ Expenses_t$ denotes the total financial expenses incurred during period t . $Total\ Liabilities_t$ refers to the total liabilities at the end of period t .

3.5.9 Control Variables for the Impact on Financing Costs

In examining the impact of corporate environmental disclosure on

financing costs, this study selected control variables based on data availability and the specific characteristics of the Chinese market. For the analysis of the cost of equity, the control variables include firm profitability, financial leverage, asset turnover ratio, cash flow ratio, book-to-market ratio, beta coefficient, and quick ratio. In addition, for the analysis of the cost of debt, the selected control variables include firm profitability, financial leverage, asset turnover ratio, cash flow ratio, revenue growth rate, liquidity ratio, and tangible asset ratio.

3.5.9.1 Firm Profitability

Firm profitability refers to a company's ability to generate profits, which is typically reflected by the amount of a company's earnings over a certain period. Firstly, enhanced firm profitability implies lower operational risk for the company, which means investors face reduced predictive risk regarding future earnings, thereby lowering the required rate of return and subsequently reducing the cost of equity (Luo, Cai, et al., 2020). Secondly, enhanced firm profitability indicates more optimistic prospects for the company's growth. This increases the likelihood of timely principal and interest repayments, correspondingly reducing the company's debt default risk. Consequently, the company gains more trust from creditors, which lowers the cost of capital utilization, thereby lowering the cost of debt (L. Y. Zhang, 2021). This study used ROE as an indicator for firm profitability, which was calculated as "net profit divided by average equity".

3.5.9.2 Financial Leverage

Financial leverage refers to the use of debt financing to influence the return on equity provided to shareholders. Higher financial leverage means a higher proportion of debt in the capital structure, which indicates a higher risk of bankruptcy. Consequently, as the level of uncertainty in risk assessment increases, investors and creditors demand higher returns to compensate for the elevated risk. This results in a growth in both cost of equity and debt (Zhao & He, 2021; Guo & Wang, 2023). This study used the debt-to-asset ratio as a measure of a company's financial leverage, which was expressed as "total liabilities divided by total assets".

3.5.9.3 Asset Turnover Ratio

The asset turnover ratio is a crucial financial indicator that reflects a firm's efficiency in utilising its assets to generate revenue. A higher asset turnover ratio indicates better revenue performance and more efficient asset utilisation, which improves expected operational performance and reduces investors' perceived risk, thereby lowering the required rate of return. Therefore, asset turnover is included as a control variable when examining the impact of corporate environmental disclosure on the cost of equity (Chen & Yin, 2022). Similarly, higher asset turnover implies stronger cash-generating capacity and sufficient internal funds, which reduce default risk and encourage creditors to lower the cost of debt financing. Consequently, asset turnover is also controlled

for when analysing the impact of corporate environmental disclosure on the cost of debt (Zhang et al., 2021). In this study, asset turnover is measured as "operating revenue divided by average total assets".

3.5.9.4 Cash Flow Ratio

The cash flow ratio reflects a company's operational performance and sustainable development capability. A higher cash flow ratio indicates that the company has more sufficient working capital, demonstrating better profitability and stable cash flow. This boosts investor confidence regarding the company's financial health and future growth prospects, leading them to perceive lower risk. Consequently, investors are more willing to accept a lower equity return. Similarly, a higher cash flow ratio also indicates that the company has sufficient funds to repay debt, lowering the likelihood of default. This reduces the risk premium demanded by creditors, consequently lowering their debt return. Therefore, the ratio may influence both the cost of equity and the cost of debt (Guo & Wang, 2023). In this study, cash flow ratio was calculated as "net cash flow from operating activities divided by total assets".

3.5.9.5 Book-to-Market Ratio

The book-to-market ratio measures a company's growth potential. Companies with high growth prospects have lower risk expectations and inspire investor confidence in their future development, which can lower the current expected return rate. Similarly, companies with higher price-to-book ratios are

more likely to be undervalued, offering investors the potential for higher future returns. Consequently, investors demand a lower rate of return from such companies. The price-to-book ratio is calculated as "book value / total market value". Therefore, the book-to-market ratio may influence the cost of equity (Chen & Yin, 2022). In this study, the book-to-market ratio was represented as "book value divided by total market value".

3.5.9.6 Beta Coefficient

The beta variable is used as a proxy for firm-level risk exposure and reflects the volatility of a company's stock returns. Firms with higher stock return volatility are generally exposed to greater uncertainty, which increases investors' perceived risk and, consequently, the required rate of return. Accordingly, higher risk exposure is generally expected to be associated with a higher cost of equity. Following Hu and Song (2022), firm-level risk was measured using the annualized volatility of daily stock returns for Chinese listed companies. Specifically, the standard deviation of daily stock returns was multiplied by 250 to obtain an annualized measure, and the natural logarithm of this value was used as the beta variable in the empirical analysis.

3.5.9.7 Quick Ratio

The quick ratio is a key financial ratio that measures a company's short-term solvency, reflecting whether the company has sufficient liquid assets to cover short-term liabilities. When the quick ratio of a company increases,

investors perceive increased liquidity, a more robust financial position of the company, and a reduction in short-term risk. Therefore, the quick ratio may influence the cost of equity (Chen & Yin, 2022). In this study, the quick ratio was represented as "(current assets - inventories) divided by current liabilities".

3.5.9.8 Revenue Growth Rate

The revenue growth rate is an indicator that measures how much a company's revenue has increased or decreased over a specific period. A higher revenue growth rate typically indicates strong business expansion, robust market demand, and effective management operations. Consequently, companies with higher revenue growth rates often have lower default risk and better credit ratings, allowing them to secure debt financing at lower costs. Therefore, the revenue growth rate can influence the cost of debt (Fonseka et al., 2020; Mei & Zhang, 2023). In this study, the revenue growth rate was calculated as "(current year revenue divided by previous year revenue) - 1".

3.5.9.9 Liquid Ratio

The liquid ratio is a measure of a company's liquidity, representing the ratio of its current assets to its current liabilities. It signifies a company's ability to meet short-term liabilities with its current assets. A higher ratio indicates that the company has sufficient current assets to promptly repay its short-term debts. This assurance of creditor interests reduces the risk associated with investments, thereby lowering the cost of debt. Therefore, it can influence the cost of debt

(Mei & Zhang, 2023). In this study, the liquid ratio was calculated as "current assets divided by current liabilities".

3.5.9.10 Tangible Asset Ratio

The tangible asset ratio refers to the proportion of a company's tangible assets to its total assets. Tangible assets reflect a company's actual repayment ability and a higher ratio indicates stronger repayment capability and a lower likelihood of default. This reduced risk of default translates to lower costs of debt (Lei, 2023). Therefore, the influence of the tangible asset ratio on the cost of debt should be considered, and it was included as a control variable in this study (Fonseka et al., 2020; J. L. Li et al., 2023). In this study, the tangible asset ratio was calculated as "(total assets - net intangible assets - net goodwill) divided by total assets".

3.5.10 Summary of Variables Operationalisation

Table 3.6 The Summary of Operationalization of the Variables

Variables	Acronym	Definition	Measurement	Source
Corporate Environmental Disclosure	ED	Corporate environmental disclosure index	Standardised Corporate Environmental Disclosure Score (Details can be found in Table 3.1)	CSMAR Database
Regulatory Pressure	GOV	Local governments' supervision and control of the environment	Frequency of Environmental-related Vocabulary in the Government Work Reports of Various Provinces in China	Government Work Reports from Various Provinces
Media Exposure	MEDIA	The numbers of news reports about the company published in the media	The natural logarithm of (1 + number of media reports)	CNRDS Database
Firm Profitability	ROE	A company's ability to generate profits	Net profit divided by average equity	CSMAR Database
Corporate Governance	CG	Corporate Governance Index	Included nine variables and constructed by the PCA	
Cost of Equity	COE	The minimum required rate of return from shareholders	Calculated using the PEG model (Formula 3.1)	
Cost of Debt	COD	The cost to a firm of using funds from creditors	Financial expenses divided by total liabilities	
Financial Leverage	LEV	Asset-liability ratio	Total liabilities divided by total assets	
Price-to-Book Ratio	PB	The ratio of the market price per share of common stock to net assets per share	Market price per share divided by net asset value per share	
Accounts Receivable Ratio	REC	Reflects the collection capacity and financial position of the enterprise	Net accounts receivable divided by total assets at the end of the period	
Book-to-Market Ratio	BM	The ratio of book value to its total market value	Book value divided by the total market value	
Holding Bank Shares	BANK	Whether the company holds shares in a listed or unlisted bank	If the company holds shares of listed or unlisted banks, the value is 1; otherwise, it is 0	
Audited by Big Four	BIG4	Whether the company was audited by a Big four during the year	If a company is audited by a Big four in a given year, the value is 1; otherwise, it is 0	

Asset Turnover Ratio	ATO	Total Asset turnover	Operating revenue divided by average total assets
Cash Flow Ratio	CF	A company's production and operating status and its sustainability	Net cash flow from operating activities divided by total assets at the end of the period
Beta Coefficient	BETA	Firm-level risk exposure (volatility-based proxy)	ln (250* annual standard deviation of daily individual stock returns of listed companies)
Quick Ratio	QUICK	Ratio of quick assets to current liabilities	(current assets minus inventories) divided by current liabilities
Revenue Growth Rate	GROWTH	Measure the growth of a company's revenue over a period of time	(current year revenue divided by previous year revenue) - 1
Liquid Ratio	LIQUID	Ratio of current assets to current liabilities	current assets divided by current liabilities
Tangible Asset Ratio	TANGIBLE	Ratio of tangible assets to total assets of the enterprise	(total assets minus net intangible assets minus net goodwill) divided by total assets

3.6 Research Models

As part of the quantitative research, regression models are used to model and examine the relationship between explanatory and dependent variables. This section proposes eleven models based on the research framework in Chapter 2. Models 4.1 to Model 4.7 are employed to analyse the influence of certain factors on the corporate environmental disclosure, and the moderating effect of corporate governance in these relationships. Models 5.1 to Model 5.4 are used to examine its impact on financing costs, and also the moderating effect of corporate governance in these relationships.

3.6.1 Models of Factors Influencing Corporate Environmental Disclosure

To test the hypotheses *H1*, *H2*, *H3*, and *H4* proposed in Chapter 2, Model 4.1 to Model 4.4 are constructed to examine the influence of regulatory pressure, media exposure, firm profitability, and corporate governance on corporate environmental disclosure among listed pharmaceutical enterprises in China.

(1) The influence of Regulatory Pressure on Corporate Environmental Disclosure

$$ED = \alpha_0 + \alpha_1 GOV + \sum \alpha_2 \text{Control} + \varepsilon$$

(Model 4.1)

ED represents corporate environmental disclosure. GOV represents regulatory pressure, and ε represents the random error term. Control

denotes a set of control variables including financial leverage (LEV), price-to-book ratio (PB), accounts receivable ratio (REC), book-to-market ratio (BM), whether or not own bank shares (BANK), and whether or not audited by Big Four (BIG4).

In Model 4.1, if α_1 is significantly positive, it indicates that regulatory pressure promotes corporate environmental disclosure. Therefore, the **H1** hypothesis is supported; otherwise, the **H1** hypothesis is not supported.

(2) The influence of Media Exposure on Corporate Environmental

Disclosure

$$ED = \alpha_0 + \alpha_1 MEDIA + \sum \alpha_2 \text{Control} + \varepsilon$$

(Model 4.2)

ED represents corporate environmental disclosure. MEDIA represents media exposure, and ε represents the random error term. Control denotes a set of control variables including financial leverage (LEV), price-to-book ratio (PB), accounts receivable ratio (REC), book-to-market ratio (BM), whether or not own bank shares (BANK), and whether or not audited by Big Four (BIG4).

In Model 4.2, if α_1 is significantly positive, it indicates that media exposure promotes corporate environmental disclosure. Therefore, the **H2** hypothesis is supported; otherwise, the **H2** hypothesis is not supported.

(3) The influence of Firm Profitability on Corporate Environmental

Disclosure

$$ED = \alpha_0 + \alpha_1 ROE + \sum \alpha_2 \text{Control} + \varepsilon$$

(Model 4.3)

ED represents corporate environmental disclosure. ROE represents firm profitability, and ε represents the random error term. Control denotes a set of control variables including financial leverage (LEV), price-to-book ratio (PB), accounts receivable ratio (REC), book-to-market ratio (BM), whether or not own bank shares (BANK), and whether or not audited by Big Four (BIG4).

If α_1 is significantly positive, it indicates that firm profitability positively influences corporate environmental disclosure. Therefore, the **H3** hypothesis is supported; otherwise, the **H3** hypothesis is not supported.

(4) The influence of Corporate Governance on Corporate Environmental Disclosure

$$ED = \alpha_0 + \alpha_1 CG + \sum \alpha_2 \text{Control} + \varepsilon$$

(Model 4.4)

ED represents corporate environmental disclosure. CG represents corporate governance, and ε represents the random error term. Control denotes a set of control variables including financial leverage (LEV), price-to-book ratio (PB), accounts receivable ratio (REC), book-to-market ratio (BM), whether or not own bank shares (BANK), and whether or not audited by Big Four (BIG4).

If α_1 is significantly positive, it reflects that corporate governance plays a facilitating role in enhancing corporate environmental disclosure. Hence, the

H4 hypothesis is supported; otherwise, the *H4* hypothesis is not supported.

**(5) Moderating Role of Corporate Governance on the Influence of
Regulatory Pressure on Corporate Environmental Disclosure**

To further test the hypotheses *H5a*, *H5b* and *H5c* proposed in Chapter 2, Model 4.5 to Model 4.7 are constructed to examine the moderating effect of corporate governance on the influence of regulatory pressure, media exposure and firm profitability on the corporate environmental disclosure among listed pharmaceutical companies in China:

$$ED = \alpha_0 + \alpha_1 GOV + \alpha_2 GOV * CG + \alpha_3 CG + \sum \alpha_4 Control + \varepsilon$$

(Model 4.5)

ED represents corporate environmental disclosure, GOV represents regulatory pressure, GOV*CG represents the standardised interaction terms between corporate governance (CG) and regulatory pressure (GOV), CG represents the comprehensive corporate governance index, and ε represents the random error term. Control denotes a set of control variables including financial leverage (LEV), price-to-book ratio (PB), accounts receivable ratio (REC), book-to-market ratio (BM), whether or not own bank shares (BANK), and whether or not audited by Big Four (BIG4).

In Model 4.5, if α_2 is significantly positive, it shows that corporate governance can significantly enhance the promoting effect of regulatory pressure on corporate environmental disclosure. Therefore, the *H5a* hypothesis is supported; otherwise, the *H5a* hypothesis is not supported.

(6) Moderating Role of Corporate Governance on the Influence of Media

Exposure on Corporate Environmental Disclosure

$$ED = \alpha_0 + \alpha_1 MEDIA + \alpha_2 MEDIA * CG + \alpha_3 CG + \sum \alpha_4 Control + \varepsilon$$

(Model 4.6)

ED represents corporate environmental disclosure, MEDIA represents media exposure, MEDIA*CG represents the standardised interaction terms between corporate governance (CG) and media exposure (MEDIA), CG represents the comprehensive corporate governance index, and ε represents the random error term. Control denotes a set of control variables including financial leverage (LEV), price-to-book ratio (PB), accounts receivable ratio (REC), book-to-market ratio (BM), whether or not own bank shares (BANK), and whether or not audited by Big Four (BIG4).

If α_2 is significantly positive, it suggests that corporate governance can significantly strengthen the promoting effect of media exposure on corporate environmental disclosure. Thus, the **H5b** hypothesis is supported; otherwise, the **H5b** hypothesis is not supported.

(7) Moderating Role of Corporate Governance on the Influence of Firm

Profitability on Corporate Environmental Disclosure

$$ED = \alpha_0 + \alpha_1 ROE + \alpha_2 ROE * CG + \alpha_3 CG + \sum \alpha_4 Control + \varepsilon$$

(Model 4.7)

ED represents corporate environmental disclosure, ROE represents firm profitability, ROE*CG represents the standardised interaction terms

between corporate governance (CG) and firm profitability (ROE), CG represents the comprehensive corporate governance index, and ε represents the random error term. Control denotes a set of control variables including financial leverage (LEV), price-to-book ratio (PB), accounts receivable ratio (REC), book-to-market ratio (BM), whether or not own bank shares (BANK), and whether or not audited by Big Four (BIG4).

If α_2 is significantly positive, it suggests that corporate governance can significantly enhance the promoting effect of firm profitability on corporate environmental disclosure. Therefore, the *H5c* hypothesis is supported; otherwise, the *H5c* hypothesis is not supported.

3.6.2 Models of the Impact of Corporate Environmental Disclosure on Financing Costs

To test the hypothesis *H6* proposed in Chapter 2, Model 5.1 is constructed to examine the impact of corporate environmental disclosure on the cost of equity in listed pharmaceutical companies in China.

$$\text{COE} = \alpha_0 + \alpha_1 \text{ED} + \sum \alpha_2 \text{Control} + \varepsilon$$

(Model 5.1)

COE represents cost of equity, ED represents corporate environmental disclosure, and ε represents the random error term. Control denotes a set of control variables, including firm profitability (ROE), financial leverage (LEV), book-to-market ratio (BM), beta coefficient (BETA), asset turnover ratio (ATO), cash flow ratio (CF), and quick ratio (QUICK).

If α_1 is significantly negative, it indicates that corporate environmental disclosure significantly reduces the cost of equity. Therefore, the **H6** hypothesis is supported. Conversely, if α_1 is not negative, the **H6** hypothesis is not supported.

To test the hypothesis **H7** proposed in Chapter 2, Model 5.2 is constructed to examine the impact of corporate environmental disclosure on the cost of debt of listed pharmaceutical companies in China.

$$\text{COD} = \alpha_0 + \alpha_1 \text{ED} + \sum \alpha_2 \text{Control} + \varepsilon$$

(Model 5.2)

COD represents cost of debt, ED represents corporate environmental disclosure, and ε represents the random error term. Control denotes a set of control variables, including firm profitability (ROE), financial leverage (LEV), revenue growth rate (GROWTH), asset turnover ratio (ATO), and cash flow ratio (CF), liquid ratio (LIQUID), and tangible asset ratio (TANGIBLE).

If α_1 is significantly negative, it indicates that corporate environmental disclosure significantly reduces the cost of debt. Therefore, the **H7** hypothesis is supported. Conversely, if α_1 is not negative, the **H7** hypothesis is not supported.

To test the hypothesis **H8a** proposed in Chapter 2, Model 5.3 is constructed to examine the moderating effect of corporate governance on the

impact of corporate environmental disclosure on cost of equity in Chinese listed pharmaceutical companies.

$$COE = \alpha_0 + \alpha_1 ED + \alpha_2 ED * CG + \alpha_3 CG + \sum \alpha_4 \text{Control} + \varepsilon$$

(Model 5.3)

COE represents cost of equity, ED represents corporate environmental disclosure, ED*CG represents the standardised interaction terms between ED and CG, CG represents the comprehensive corporate governance index, and ε represents the random error term. Control denotes a set of control variables, including firm profitability (ROE), financial leverage (LEV), book-to-market ratio (BM), beta coefficient (BETA), asset turnover ratio (ATO), cash flow ratio (CF), and quick ratio (QUICK).

If α_2 is significantly negative, it suggests that corporate governance can significantly enhance the negative impact of corporate environmental disclosure on cost of equity. Therefore, the **H8a** hypothesis is supported; otherwise, the **H8a** hypothesis is not supported.

To test the hypothesis **H8b** proposed in Chapter 2, Model 5.4 is constructed to examine the moderating effect of corporate governance on the impact of corporate environmental disclosure on cost of debt of listed pharmaceutical companies in China.

$$COD = \alpha_0 + \alpha_1 ED + \alpha_2 ED * CG + \alpha_3 CG + \sum \alpha_4 \text{Control} + \varepsilon$$

(Model 5.4)

COD represents cost of debt, ED represents corporate environmental disclosure, ED*CG represents the standardised interaction terms between ED and CG, CG represents the comprehensive corporate governance index, and ε represents the random error term. Control denotes a set of control variables, including firm profitability (ROE), financial leverage (LEV), revenue growth rate (GROWTH), asset turnover ratio (ATO), and cash flow ratio (CF), liquid ratio (LIQUID), and tangible asset ratio (TANGIBLE).

If α_2 is significantly negative, it suggests that corporate governance can significantly enhance the negative impact of corporate environmental disclosure on cost of debt. Therefore, the **H8b** hypothesis is supported; otherwise, the **H8b** hypothesis is not supported.

3.7 Statistical Analysis

This study utilised STATA software (version 17) to analyse panel data from Chinese listed pharmaceutical companies during the 2018-2022 period. First, considering the characteristics of panel data and to mitigate the impact of extreme values on estimation results, this study applied the "winsor2" command in STATA to perform winsorization on all variables (Nie & Wang, 2023). Subsequently, the study conducted the VIF test to detect multicollinearity issues, implemented with the "vif" command in STATA (Adriana & Dewi, 2019; Baalouch et al., 2019).

To determine the appropriate panel regression approach, this study

employed F-tests, Breusch-Pagan tests, and Hausman tests during the preliminary analysis phase, to determine whether the Ordinary Least Squares (OLS) model, Fixed Effects (FE) model, or Random Effects (RE) model was more appropriate to analyse the relationship between the explanatory and dependent variables. Based on the results presented in Chapters 4 and 5, this study adopted for the FE model for regression analysis, implemented using the "xtreg" command in STATA. Meanwhile, given the relatively short study period (five years) and the comprehensive coverage of firms within the Chinese pharmaceutical sector, the time effect may be relatively weak. Additionally, firms within the same pharmaceutical industry tend to exhibit similar time trends, suggesting that controlling for time-fixed effects has a limited impact on the core conclusions of this study. Therefore, following the approach of Shima and Fung (2019), Sun & Ye (2020), and Cao and Sun (2021), this study did not control for year effects.

Building upon the selected FE model, the study applied the Modified Wald test to examine heteroskedasticity issues in the group-specific error terms of the FE model (Salawu et al., 2021), utilizing the "xttest3" command in STATA. If the results in Chapters 4 and 5 indicate the presence of heteroskedasticity, the study employed robust standard errors to address this issue (Katmon et al., 2019) through the "vce(robust) " command in STATA.

Finally, to mitigate potential endogeneity concerns, the study used

system GMM estimation for robustness testing (El Ghoul et al., 2018; Gerged, 2021; Huang et al., 2023). This is because the system GMM estimation incorporates lagged terms of the dependent variable and applies internal transformations by subtracting past values of variables from their current values, thereby controlling for endogeneity (Roodman, 2009).

3.7.1 Static Panel Data Estimation

In the analysis of static data, commonly employed regression estimation models include the OLS model, FE model and RE model.

(1) OLS Model

The OLS model assumes that there are no individual effects and that all individuals have the same regression. That is, the intercept and slope terms defining the individual cross-sectional estimating equations are the same. And the panel data can be directly combined and estimated using OLS for parameter estimation. The mixed model is defined as follows:

$$y_{it} = \alpha + x_{it}\beta + \varepsilon_{it} \quad (i = 1, 2, \dots, n; t = 1, 2, \dots, T)$$

Where y_{it} represents the dependent variable being regressed (a scalar), α is the intercept term, x_{it} is a $k \times 1$ vector of regressor variables (comprising k variables), β is a $k \times 1$ vector of regression coefficients, and ε_{it} stands for the error term (a scalar).

This assumption implies that the intercept term α and the regression coefficients β are statistically identical across different individuals or cross-sectional entities. This assumption of consistency enables the consolidation of data from diverse cross-sections, permitting the utilization of OLS estimation to yield statistically meaningful and consistent estimates.

(2) FE Model

The FE model assumes that individual effects exist and that there is a correlation between individual effects and the explanatory variables. Thus, differences between individuals are fixed and invariant, and considering only the impact of within-individual changes on the dependent variable, this approach is generally appropriate when there is potential correlation between individual effects and regressors in panel data. The FE model uses OLS estimation to remove individual fixed effects. What remains after accounting for individual fixed effects is the time variable effect, which can be used to analyse the impact of time effect. The FE model employed in this study is formulated as:

$$y_{it} = \alpha_i + x_{it}\beta + \varepsilon_{it} \quad (i = 1, 2, \dots, n; t = 1, 2, \dots, T)$$

Where y_{it} represents the dependent variable being regressed (a scalar), α_i is a random variable indicating that for i individuals there are i different intercept terms and their variation is related to x_{it} , x_{it} is a $k \times 1$ vector of regressor variables (comprising k variables), β is a $k \times 1$ vector of regression coefficients and the coefficients are the same for different individuals, and ε_{it} stands for the error term (a scalar).

(3) RE Model

The RE model assumes that individual effects exist, but that there is no correlation between individual effects and the explanatory variables. Thus, differences between individuals fluctuate randomly, and the RE model considers both the impact of within-individual changes on the dependent variable and the influence of between-individual differences. This model is generally suitable for panel data where individual-specific effects are uncorrelated with regressors. The RE model is estimated using Generalized Least Squares and takes into account both individual-specific random effects and the effects of time-varying variables, making it suitable for studying the impact of individual characteristics on the dependent variable. The RE model is defined as:

$$y_{it} = \alpha_i + x_{it}\beta + \varepsilon_{it} \quad (i = 1, 2, \dots, n; t = 1, 2, \dots, T)$$

Where y_{it} represents the dependent variable being regressed (a scalar), α_i is a random variable and the variation is independent of x_{it} , x_{it} is a $k \times 1$ vector of regressor variables (comprising k variables), β is a $k \times 1$ vector of regression coefficients and the coefficients are the same for different individuals, and ε_{it} stands for the error term (a scalar).

(4) Selecting the Model

In the process of selecting the model, the F-test can be used to decide whether to choose the OLS model or the FE model, the Breusch-Pagan test to decide whether to choose the OLS model or the RE model, and the Hausman test to decide whether to choose the FE model or the RE model. The specific tests

are shown in Table 3.7 below:

Table 3.7 Static Panel Data Model Selection

Type of Test	Test Purpose	Test Value	Test Result
F-test	FE model and OLS model	p-value < 0.05	FE model
Breusch-Pagan test	RE model and OLS model	p-value < 0.05	RE model
Hausman test	RE model and FE model	p-value < 0.05	FE model

Source: Osemene and Fagbemi (2020)

3.7.2 Dynamic Panel Data Estimation

Since this study focuses on dependent variables such as corporate environmental disclosure and financing costs, both of which may exhibit dynamic persistence over time (Huang & He, 2020; Huang et al., 2023; Y. Zhao et al., 2024), it also takes into account potential endogeneity issues in the original model. To address these concerns, this study includes the lagged term of the dependent variable among the explanatory variables in the original models, constructing dynamic panel models for robustness testing. The GMM estimation can eliminate fixed effects through first differencing the model and, under certain conditions, introduce instrumental variables to derive the difference GMM estimation. This approach effectively resolves the endogeneity of explanatory variables and heteroskedasticity of residuals, yielding unbiased and consistent estimates (Chen, 2014). GMM estimation includes Difference GMM, Level GMM, and System GMM. Notably, System GMM combines both Difference GMM and Level GMM, treating the differenced and level equations as a system

of equations for GMM estimation (Blundell & Bond, 1998).

The following dynamic panel model is assumed:

$$y_{it} = \alpha + \mu y_{i,t-1} + x_{it}\beta + \delta_{it} + \theta_{it} \quad (\text{Model 3.1})$$

The departure form of model (3.1) is obtained by variation:

$$y_{it} - \bar{y}_i = \mu(y_{i,t-1} - \bar{y}_i) + \beta(x_{it} - \bar{x}_i) + (\theta_{it} - \bar{\theta}_i) \quad (\text{Model 3.2})$$

As $\bar{y}_i = \frac{1}{T-1} \sum_{t=2}^T y_{i,t-1}$ of Model 3.2, so information on the explanatory variables is included in $\bar{y}_i$. Since the explanatory variables are correlated with $(\theta_{it} - \bar{\theta}_i)$, $\bar{y}_i$ and $(\theta_{it} - \bar{\theta}_i)$ must be correlated. This factor, which causes inconsistency in the estimates within the group, is called "dynamic panel bias".

Considering the above, the prevailing Model 3.3 is first-order differenced to obtain model (3.4):

$$y_{it} = \alpha + \mu y_{i,t-1} + x'_{it}\beta + \vartheta'\varphi + \delta_i + \theta_{it} \quad (\text{Model 3.3})$$

$$\Delta y_{it} = \mu \Delta y_{i,t-1} + \Delta x'_{it}\beta + \Delta \theta_{it} \quad (\text{Model 3.4})$$

The explanatory variables $\Delta y_{i,t-1}$ and $\Delta \theta_{it}$ in Model 3.4 are still

correlated, and Anderson and Hsiao (1981) argued that $\Delta y_{i,t-2}$ can be used as an instrumental variable for $\Delta y_{i,t-1}$ in the above first-order difference equation because $\Delta y_{i,t-2}$ is correlated with $\Delta y_{i,t-1}$ but not with $\Delta \theta_{it}$, so that the above model can be estimated by two-stage least squares (2SLS). On this basis, it is argued that the instrumental variables should include all possible lagged terms of the explanatory variables, which is the Difference GMM.

When estimating using Difference GMM, variable ϑ' is eliminated by differencing because it does not vary over time, which leads to the instrumental variable problem, i.e., $y_{i,t-2}$ is not strongly correlated with $\Delta y_{i,t-1}$. Arellano and Bover (1995) building on Model 3.3, propose using lagged first differences of the dependent variable, such as $\{\Delta y_{i,t-1}, \Delta y_{i,t-2} \dots \dots\}$, as an instrumental variable for the lagged level term $\Delta y_{i,t-1}$. Two of the premise assumptions of this methodology are (1) that there is no autocorrelation in the perturbation terms, and (2) that $\{\Delta y_{i,t-1}, \Delta y_{i,t-2} \dots \dots\}$ and θ_{it} are not correlated. This is the Level GMM.

Blundell and Bond (1998) synthesise the advantages and disadvantages of Difference GMM and Level GMM, and propose the classical System GMM estimation by imposing smoothness assumptions on the initial values. System GMM is able to correct for unobserved individual heterogeneity problems, omitted variable bias, measurement error, and potential endogeneity problems that often affect model estimation when using OLS and FE methods. The System

GMM estimation also reduces the potential bias and imprecision associated with the use of Difference GMM estimation methods.

Therefore, this study tested the robustness of the regression related to corporate environmental disclosure and financing costs through a System GMM estimation using the lagged dependent variables as its instrumental variables to better address the endogeneity issue without adding exogenous instrumental variables.

3.8 Chapter Conclusion

This chapter firstly describes the positivist approach, deductive approach, and quantitative research methods used in the study. Next, the sample of 326 Chinese listed pharmaceutical companies used in this study is organised, and the sources of the corresponding data collection are identified. Then, this study defines and measures corporate environmental disclosure, regulatory pressure, media exposure, firm profitability, corporate governance, cost of equity, and cost of debt, as well as control variables. In addition, seven empirical models are developed to examine the hypotheses regarding the factors that influence corporate environmental disclosure, as well as four empirical models to test the hypotheses related to the impact of corporate environmental disclosure on financing costs. Finally, the OLS, FE, and RE models, which may be used in the data analysis depending on the results of model specification tests, are

introduced for regression analysis, together with the System GMM estimation employed for robustness testing.

Chapter Four

FINDINGS AND DISCUSSION OF FACTORS INFLUENCING CORPORATE ENVIRONMENTAL DISCLOSURE

4.1 Overview of the Chapter

This chapter addresses RQ1 to RQ5, which focus on the influencing factors of corporate environmental disclosure. It begins with Section 4.2, which provides a descriptive analysis of all variables, followed by Section 4.3, which examines the correlation coefficients among them. To ensure the validity of the regression analysis, Section 4.4 conducts a series of pre-estimation tests, including VIF analysis, panel model selection, and heteroskedasticity analysis. Building on these foundations, Section 4.5 employs a FE regression model to empirically test the influence of regulatory pressure, media exposure, corporate governance, and firm profitability on corporate environmental disclosure, while also assessing the moderating role of corporate governance. To verify the robustness of these findings, Section 4.6 applies the system GMM estimation for further validation. Finally, Section 4.7 summarizes the key insights from this chapter.

4.2 Descriptive Analysis

To reduce potential distortions caused by extreme values and outliers, this study enhances the robustness and credibility of the results by applying a winsorization procedure, trimming all continuous variables at the 1st and 99th

percentile levels (Benjamin et al., 2023). Winsorization was applied uniformly across all continuous variables used in both the descriptive statistics and regression analyses, excluding dummy variables. After excluding firm-year observations with missing values, the final sample consists of 1083 observations for listed pharmaceutical companies in China. These observations are distributed across the years 2018 to 2022 as follows: 184 in 2018, 190 in 2019, 208 in 2020, 241 in 2021, and 260 in 2022. The corresponding descriptive statistics include the mean, minimum, maximum, standard deviation, and median of the relevant variables, as shown in Table 4.1¹⁸. An analysis of these statistics indicates that the variables' minimum and maximum values did not exhibit significant abnormalities, suggesting no extreme deviations in the data distribution.

From the perspective of corporate environmental disclosure, the sample mean is 0.305, with a minimum value of 0.026 and a maximum value of 0.737. The standard deviation (SD) is 0.168, indicating significant disparities in corporate environmental disclosure among different samples. This variance in corporate environmental disclosure can be attributed to internal factors such as firm profitability and internal corporate governance, as well as external factors such as regulatory intensity and media oversight across different regions. Furthermore, the majority of Chinese pharmaceutical listed companies have not

¹⁸ The descriptive statistics reported in this chapter are based on the effective samples used for the corresponding regression analyses. Variations in model specifications may lead to differences in the number of firm-year observations due to missing data in an unbalanced panel setting.

met the average value of 0.305, compared with the median value of 0.289. This suggests that both regulatory agencies and the companies themselves need to make additional efforts to improve corporate environmental disclosure. Compared with Guo and Hong (2023), who examined 16 heavily polluting industries from 2016 to 2020 and reported a mean corporate environmental disclosure score of 0.267, the pharmaceutical sector in this study shows a slightly higher average. One important factor contributing to this difference is the sample period. This study covers 2018-2022, with all firm-years falling after the introduction of mandatory corporate environmental disclosure policy in 2018. As a result, firms in this study are likely to have been more strongly influenced by the tightened regulatory environment, leading to improvements in disclosure practices. Although both studies focus on heavy-polluting sectors, the inclusion of more recent years in this study enhances its relevance in evaluating the policy's impact and the current state of corporate environmental transparency. However, this improvement should be interpreted with caution. Existing studies have consistently shown that pharmaceutical companies in China underperform in corporate environmental disclosure even within the heavily polluting category. Thus, despite the observed increase in average disclosure, significant gaps remain in meeting expectations. This further justifies focusing on this industry to explore the persistent challenges and potential drivers of enhanced disclosure practices.

In terms of regulatory pressure, the mean value is 0.006, with observed values ranging from 0.004 to 0.009. The SD is 0.001, indicating relatively consistent levels of regulatory pressure across different samples. This consistency can be attributed to the improvement of relevant environmental laws and regulations and the collective attention and advocacy from various sectors of society, leading to relatively uniform regulatory efforts by local governments. However, in the face of increasingly severe environmental issues and the contradiction of asymmetric corporate environmental disclosure, there is still room for improvement in government regulatory efforts. Zheng and Xue (2024) conducted a study using Chinese listed companies excluding the financial industry as samples from 2008 to 2021, finding an average regulatory pressure score of 0.003, ranging from 0 to 0.012. By comparing the mean values, it can be observed that the average regulatory pressure has intensified when focusing on the 2018-2022 period. This indicates that the Chinese government is placing an increasing emphasis on corporate environmental disclosure.

The average level of media exposure is 5.141, with a minimum value of 3.332 and a maximum value of 8.006. The SD is 0.904, and the median is 5.043. The standard deviation, which is the highest among these variables, indicates that media exposure levels vary considerably across firms in the sample. Combining this with the median, it is evident that the majority of companies in the sample do not receive media exposure at the average level. Therefore, the

media should enhance their role in external supervision, especially by increasing attention to industries like pharmaceuticals, which are categorized as heavy polluters, to better supervise corporate environmental management behaviours. Li and Zeng (2020) conducted a study on Chinese pharmaceutical listed companies from 2013 to 2018, with 167 observations. Their research found that the mean value of media exposure was 2.777, with a minimum value of 0 and a maximum value of 4.489, and a standard deviation of 0.842. This comparison suggests that media exposure toward pharmaceutical companies has increased over time. This shift may reflect growing concerns over health-related environmental risks and the expanding role of media in regulatory accountability.

The sample firms exhibit an average firm profitability of 0.075, ranging from -0.418 to 0.563. The SD is 0.108, indicating that there is a relatively significant disparity in firm profitability among the sample companies. Some individual companies exhibit poor performance, with some even in a loss-making state. Additionally, the median firm profitability of sample companies is only 0.075, indicating that the majority of companies have relatively weak firm profitability. Li and Zeng (2020) examined Chinese pharmaceutical listed companies, using ROE as a measure, found that the mean firm profitability was 0.133, ranging from 0.008 to 0.429, with a SD of 0.067. There are some differences between the past study and the current one, which could stem from variations in research periods and sample selection. There are certain differences

compared to this study, as the mean firm profitability during the study period is relatively lower. This discrepancy may stem from differences in the research period and the selection of samples. This decline in firm profitability may also limit firms' willingness or ability to invest in voluntary corporate environmental disclosure.

The mean value of corporate governance is -0.014, with a minimum value of -1.244 and a maximum value of 1.483. The standard deviation is 0.574, indicating a relatively large level of variance in corporate governance among Chinese pharmaceutical listed companies. Furthermore, the SD of corporate governance is among the highest within the existing variables, suggesting significant disparities in corporate governance practices. Furthermore, with a median of 0.026, it suggests that the corporate governance capability of heavy polluting enterprises in China needs improvement, with substantial room for enhancement. It is also worth noting that negative CG values reflect below-average governance performance relative to the sample, as explained in Chapter 3, and do not imply invalidity. This highlights the necessity for national laws and regulations to focus on key polluting entities and strengthen supervision and restrictions on such companies. Wang and Yuan (2022), using a sample of listed companies in heavily polluting industries from 2016 to 2020, found that corporate governance exhibited a mean of -0.1039, with observed values ranging from -7.7363 to 8.4802 and a variance of 4.685. These results differ significantly

from the data in this study, which may be attributed to differences in the selection of indicators used for PCA. The variability observed in this study highlights the uneven corporate governance practices within the pharmaceutical industry and supports the rationale for exploring its moderating role in corporate environmental behaviour.

With respect to the control variables, firstly, financial leverage has a mean value of 0.294, with a minimum value of 0.04 and a maximum value of 0.747. The SD is 0.159, reflecting considerable variation in debt levels across the sample firms. With a median of 0.272, this suggests that most companies maintain a debt-to-assets ratio below 30%, reflecting a generally conservative capital structure adopted to mitigate financial risks. This observation is in line with Zheng et al. (2019), who examined listed pharmaceutical companies in China and reported a mean financial leverage of 0.322, spanning a range between 0.046 and 0.845. Such consistency indicates that the financial leverage distribution in this study is aligned with prior industry-specific evidence.

Secondly, the sample firms exhibit a mean price-to-book ratio of 3.674, with substantial variation ($SD = 3.162$) and a range between 0.73 and 19.55. This reflects a relatively high valuation among sample companies, indicating significant investor interest in Chinese pharmaceutical listed firms, albeit with considerable variation. This result is broadly in line with Su et al. (2023), who reported a mean price-to-book ratio of 3.247 (ranging from 0.591 to 16.434) for

Chinese listed firms, supporting the reasonableness of the observed distribution.

Thirdly, an average accounts receivable ratio of 0.108 was observed, with values distributed between 0.001 and 0.397. The standard deviation is 0.075, and the median stands at 0.088. This indicates that the majority of Chinese pharmaceutical listed companies have accounts receivable accounting for around 10% of total assets, with relatively minor overall differences. These findings are broadly consistent with Pei (2024), who reported a mean of 0.128 and a maximum of 0.427 in an extensive empirical investigation involving publicly listed firms in China, validating the typicality of the current sample.

Fourthly, the mean book-to-market ratio is 0.558, indicating that there are many companies in the sample with significant growth potential and fewer value-oriented companies. With a minimum of 0.091, a maximum of 1.131, and a SD of 0.223, the data indicate notable differences in investment value across the sample companies. This is consistent with Wei and He (2022), who reported book-to-market ratios ranging from 0.580 to 0.638 in their analysis of Chinese listed firms. This further confirms that the current sample's distribution falls within the expected range for domestic capital markets.

Fifthly, the mean of holding bank shares is 0.003, with a standard deviation of 0.053, and a median of 0, indicating a relatively low level of holding bank shares among Chinese pharmaceutical listed companies, with few

companies exhibiting this behaviour. Although the ratio appears low, it remains within a plausible range. Prior research on listed firms in China has also identified a limited but observable presence of such ownership patterns (Z. X. Li et al., 2023). This supports the view that the distribution in this study reflects broader characteristics of holding bank shares, particularly within industry-specific settings like pharmaceuticals.

Finally, the mean of Big Four is 0.066, with a SD of 0.249 and a median of 0, suggesting that few Chinese pharmaceutical listed companies opt for Big Four audit, with more companies choosing Chinese accounting firms or non-Big Four international accounting firms for audits. This observation closely matches the results of Wei (2024), who examined a large sample of all listed firms from 2013 to 2022 and reported a mean Big Four of 0.0639. This strong alignment further confirms the plausibility of the observed audit distribution.

Table 4.1 Descriptive Analysis (Influencing Factors)

Variable	Mean	Min	Max	SD	p50
ED	0.305	0.026	0.737	0.168	0.289
GOV	0.006	0.004	0.009	0.001	0.006
MEDIA	5.141	3.332	8.006	0.904	5.043
ROE	0.075	-0.418	0.563	0.108	0.075
CG	-0.014	-1.244	1.483	0.574	0.026
LEV	0.294	0.04	0.747	0.159	0.272
PB	3.674	0.73	19.55	3.162	2.693
REC	0.108	0.001	0.397	0.075	0.088
BM	0.558	0.091	1.131	0.223	0.572
BANK	0.003	0	1	0.053	0
BIG4	0.066	0	1	0.249	0

Whereby: ED= Corporate Environmental Disclosure; GOV= Regulatory Pressure; MEDIA= Media Exposure; ROE= Firm Profitability; LEV=

Financial Leverage; PB= Price-to-Book Ratio; REC= Accounts Receivable Ratio; BM= Book-to-Market Ratio; BANK= Holding Bank Shares; BIG4 =Audit by Big Four

4.3 Correlation Analysis

The correlation matrix in Table 4.2 demonstrates significant relationships between corporate environmental disclosure and various explanatory variables (regulatory pressure, media exposure, firm profitability and corporate governance). Specifically, a positive and statistically significant relationship is observed between the corporate environmental disclosure index and regulatory pressure at the 5% level, suggesting that regulatory pressure enhances corporate environmental disclosure. Similarly, the environmental disclosure index shows significant positive correlations with media exposure, firm profitability and corporate governance at the 1% level, suggesting that media exposure, firm profitability and corporate governance can enhance corporate environmental disclosure, too. This provides preliminary support for H1 through H4 proposed in this study.

Regarding the control variables, both financial leverage and Big Four are significantly and positively correlated with the disclosure. Nevertheless, a significant inverse correlation is observed between the accounts receivable ratio and the disclosure. With respect to the relationship between the price-to-book ratio, the book-to-market ratio and whether the company holds bank shares and corporate environmental disclosure, the results are not significant.

Table 4.2 Pairwise Correlation (Influencing Factors)

	ED	GOV	MEDIA	ROE	CG	LEV	PB	BM	BAN K	BIG4	
ED	1										
GOV	0.049**	1									
MEDIA	0.337***	-0.090***	1								
ROE	0.229***	0.071**	0.166***	1							
CG	0.224***	-0.048	0.347***	0.027	1						
LEV	0.093***	0.015	0.119***	-0.181***	-0.046	1					
PB	-0.037	-0.009	0.234***	0.193***	0.023	0.019	1				
REC	-0.085***	0.163***	0.110***	0.139***	-0.008	0.229***	0.095***	1			
BM	-0.002	-0.013	-0.104***	-0.297***	-0.039	0.129***	-0.682***	-0.062**	1		
BANK	0.047	-0.015	0.013	-0.065**	0.048	0.053*	-0.027	-0.045	0.039	1	
BIG4	0.220***	-0.089***	0.226***	-0.04	0.305***	-0.080***	0.032	-0.110***	0.021	-0.014	1

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively.

4.4 Preliminary Analysis

4.4.1 Variance Inflation Factor Analysis

To assess the validity of the model, a test for multicollinearity was performed using the VIF and tolerance (1/VIF), and the results were presented in Table 4.3.

The multicollinearity check based on VIF revealed a minimum value of 1.01 and a maximum of 2.05, indicating acceptable collinearity levels. Additionally, the inverse VIF values ranged between 0.487 and 0.987, further confirming the absence of multicollinearity issues.

In general, VIF values less than 10 and 1/VIF values greater than 0.1 are considered to indicate freedom from multicollinearity (Adriana & Dewi, 2019). Therefore, it was concluded that the model investigating the factors influencing corporate environmental disclosure in this study did not suffer from severe multicollinearity, and the selection of variables was appropriate for further empirical testing.

Table 4.3 Variance Inflation Factor (Influencing Factors)

Variable	VIF	1/VIF
BM	2.05	0.487
PB	2.02	0.496
MEDIA	1.33	0.754
CG	1.23	0.812
ROE	1.2	0.833
LEV	1.17	0.852
BIG4	1.16	0.861

REC	1.14	0.876
GOV	1.05	0.955
BANK	1.01	0.987
Mean VIF	1.34	

4.4.2 Analysis of Panel Model Estimation Methods

For the selection of the most suitable model for processing and analysing the panel data used in this chapter, the F-test, Breusch-Pagan test, and Hausman test were conducted.

In Table 4.4, the F-test result indicates a highly significant outcome ($p = 0.0000$), thereby rejecting the null hypothesis at the 5% level. This indicates that the FE model provides a significantly better fit than the OLS model. Similarly, the Breusch-Pagan test yields a p-value of 0.0000 (less than 0.05), suggesting that the RE model is preferable to the OLS model in accounting for unobserved heterogeneity. Furthermore, a p-value of 0.0000 was obtained from the Hausman test, also below the 0.05 threshold, indicating that the FE model is statistically more appropriate than the RE model for this dataset. Collectively, these test results confirm the suitability of the FE model for the subsequent regression analysis. Therefore, the regression analysis in this chapter is conducted using the FE model.

Table 4.4 Panel Model Estimation Method (Influencing Factors)

Type of Test	Test Value		Options
F Test	F = 6.73	Prob > F = 0.0000	FE Model
Breusch-Pagan	chibar2(01) = 478.23	Prob > chibar2 =	RE Model

Test		0.0000	
Hausman Test	chi2(10) = 70.82	Prob > chi2 = 0.0000	FE Model

4.4.3 Heteroskedasticity Analysis

Given the FE model and the characteristics of the unbalanced panel data, this study employs the modified Wald test to detect heteroskedasticity (Baum, 2024). The results indicate that, regarding the influencing factors of corporate environmental disclosure, for Model 4.1 to Model 4.4, $\chi^2(299) = 242910.39$, with $\text{Prob} > \chi^2 = 0.0000$. Concerning the moderating effect of corporate governance, for Model 4.5, $\chi^2(299) = 1209348.36$, with $\text{Prob} > \chi^2 = 0.0000$; for Model 4.6, $\chi^2(299) = 17591113.31$, with $\text{Prob} > \chi^2 = 0.0000$; for Model 4.7, $\chi^2(299) = 99544.03$, with $\text{Prob} > \chi^2 = 0.0000$. All these results reject the null hypothesis, indicating the presence of heteroskedasticity.

Therefore, to address the heteroskedasticity issue, heteroskedasticity-robust standard errors are employed in this chapter (Katmon et al., 2019) to obtain more reliable regression results.

4.5 Regression Analysis

4.5.1 Factors Influencing Corporate Environmental Disclosure

Table 4.5 reports the regression results of Models 4.1 to 4.4, examining the determinants of corporate environmental disclosure. Specifically, regulatory pressure, media exposure, firm profitability, and corporate governance are

introduced sequentially as the key explanatory variables, with corporate environmental disclosure as the dependent variable. The corresponding regression results are presented in Panels I to IV, which allow the influence of each factor to be examined separately while controlling for firm-specific characteristics. Panel V then incorporates all four factors simultaneously to examine their combined influence on corporate environmental disclosure.

(1) Regulatory pressure positively influences corporate environmental disclosure.

The regression results from Panel I and Panel V indicate that the regulatory pressure coefficient estimates are 12.14 and 10.76, respectively. These coefficients are significantly and positively correlated with corporate environmental disclosure at the 1% level, suggesting that corporate environmental disclosure significantly enhances with the intensification of regulatory pressure. Therefore, H1 is validated.

This finding is consistent with the studies of Zhao (2019), Nguyen et al. (2020), Luo, Xiao, et al. (2020), Su and Zhang (2020), He and Ren (2020), and Lei and Huang (2024). The reason for this conclusion may be that as the government gradually strengthens environmental regulation on enterprises, firms tend to improve their environmental disclosures to avoid the adverse effects of environmental penalties and reputational damage while establishing a more favourable public image (Su & Zhang, 2020; Lei & Huang, 2024). This

effect is particularly pronounced in the pharmaceutical industry, where strict government regulations increase the potential risk of environmental penalties. Between 2018 and 2022, multiple publicly listed pharmaceutical companies in China were fined or even forced to cease operations due to environmental violations, including Northeast Pharmaceutical and Xinhua Pharmaceutical (VOCs Frontier, 2021), Hongyuan Pharmaceutical (JRJ.com, 2022), and Senxuan Pharmaceutical (Hubei Changjiang Business News, 2024), among others. Consequently, increased regulatory pressure compels pharmaceutical firms to pay greater attention to environmental issues and disclose more environmental information to gain recognition from key stakeholders, such as the government, ultimately helping them avoid penalties and enhance their corporate reputation. Therefore, for publicly listed pharmaceutical companies in China, intensified regulatory pressure from the government significantly contributes to enhancing corporate environmental disclosure.

(2) Media exposure does not have a positive influence on corporate environmental disclosure

In Panel II, the coefficient estimate for media exposure is -0.0137, indicating a significant and negative correlation with corporate environmental disclosure at the 10% level. However, in Panel V, the coefficient estimate for media exposure is -0.00996, showing that it has no significant correlation with corporate environmental disclosure. These results suggest that media exposure

has an inconsistent influence on corporate environmental disclosure. Moreover, the influence is negative, contrary to the hypothesized positive relationship. Therefore, H2 is not accepted.

This conclusion aligns with the prior empirical findings reported by Zhang et al. (2016). There are two possible reasons why the research conclusion deviates from the initial hypothesis.

First, this study does not distinguish between the nature of media exposure (i.e., positive, negative or neutral reports) or the media channels (i.e., print or online media). However, compared with positive reports, negative media exposure tends to exert a stronger influence on enhancing corporate environmental disclosure (Ji et al., 2019; Zeng, 2021). Since negative media exposure typically involves criticism of listed companies for certain issues or misconduct, such reports most accurately reflect the subjective stance of the media. Once disseminated, the reports are most likely to trigger public reactions. Moreover, a large volume of critical reports from the media exerts invisible pressure on the management of listed companies, making them feel under public and media scrutiny. To prevent further damage to their corporate image, they may consciously reduce behaviours that harm investor interests. In contrast, positive media exposure often praises corporate actions or provides neutral descriptions with little significance. These reports fail to attract the attention of the public and regulatory authorities, and therefore, have a limited influence on

listed companies. Additionally, print media, due to its authoritative and accurate nature, has a more significant influence on corporate environmental disclosure (Zeng, 2021), whereas online media, lacking credibility, may fail to fulfil its supervisory function due to public distrust (Chen, Fang, et al., 2023).

Second, under high media exposure, corporate actions are more likely to attract further public scrutiny. As a result, firms may adopt a more conservative and cautious approach when disclosing environmental information to avoid severe repercussions from inappropriate disclosure (Li & Zhai, 2018). The pharmaceutical industry, classified as a heavily polluting industry, faces heightened environmental scrutiny. Any severe environmental incident reported in the media could directly harm a company's financial performance (Pan, 2021). Given this context, since environmental disclosure incurs costs, pharmaceutical firms suffering economic losses due to negative media exposure may lack the resources to intensify corporate environmental disclosure. Taken together, these factors may explain why media exposure exhibits an unstable and insignificantly negative influence on corporate environmental disclosure.

(3) Firm profitability positively influences corporate environmental disclosure.

In Panel III, the coefficient estimate for firm profitability is 0.112, with the influence remaining positive and statistically significant at the 5% level. Similarly, in Panel V, the coefficient estimate for firm profitability is 0.0999 and

the relationship with corporate environmental disclosure is positive and statistically significant at the 10% level. These findings suggest that the corporate environmental disclosure significantly enhances with enhanced firm profitability. Therefore, H3 is validated.

The result is in agreement with Deng et al. (2020), Zeng et al. (2021), Liu and Gao (2022), and Lei and Huang (2024). The rationale behind this result lies in two main considerations. First, financially strong companies are more capable of efficiently utilizing and allocating resources to generate higher profits (Lei & Huang, 2024). They are also more likely to disclose environmental information to help stakeholders and investors better understand their competitive advantages and to enhance their corporate image (Deng et al., 2020). However, Xu (2021) suggests that the relationship between firm profitability and this type of disclosure, in the pharmaceutical industry, may be negative. Firms with lower profitability might have stronger incentives to signal their commitment to environmental protection in an attempt to gain investor recognition.

Nevertheless, enhanced corporate environmental disclosure requires substantial financial investment (Blankespoor et al., 2020). Furthermore, the pharmaceutical industry itself demands significant capital investment for its development (Shan & Qiu, 2021). Consequently, financially weak pharmaceutical firms that overemphasise corporate environmental disclosure

may risk misallocating their limited resources, potentially disrupting their funding. In contrast, firms with stronger financial capabilities are better positioned to engage in enhanced corporate environmental disclosure, which allows them to showcase their strengths and achieve long-term sustainable growth. Therefore, among Chinese listed pharmaceutical firms, enhanced firm profitability is associated with enhanced corporate environmental disclosure.

(4) Corporate Governance positively influences corporate environmental disclosure.

The regression results in Panel IV and Panel V show that the coefficient estimates of corporate governance are 0.0374 and 0.0362 respectively, and that these coefficients are significantly and positively correlated with corporate environmental disclosure at the 1% level, suggesting that corporate environmental disclosure significantly enhances with more effective corporate governance. Therefore, H4 is validated.

Similar conclusions have been drawn in the studies by studies of Ezhilarasi (2019), Moalla et al. (2021), Wang and Yuan (2022) and Wang and Sun (2023). This may be attributed to several factors.

First, equity balance, institutional shareholding, executive shareholding, and the nature of ownership all contribute to firms making long-term and compliance-oriented decisions while constraining selective disclosure

behaviours by executives, thereby enhancing corporate environmental disclosure (Li & Zhang, 2019; Feng & Hong, 2024).

Second, corporate governance mechanisms (including independent board composition, board scale, and the supervisory board) can strengthen corporate oversight, driving improvements in both the quality and comprehensiveness of environmental disclosure (Xu, 2021b; Wang & Xiong, 2021; H. Y. Zhang et al., 2019).

Moreover, CEO-chair duality separation helps mitigate firm-level risks associated with earnings management for personal gain (Ma, 2020). Meanwhile, executive compensation incentives, as a natural mechanism to alleviate agency problems, effectively prevent short-sighted managerial behaviour, such as reducing environmental disclosure levels to minimise short-term costs (Wang & Xiong, 2021).

Thus, to sum up, despite the varying methodologies adopted by scholars to construct a corporate governance index, they consistently conclude that effective corporate governance leads to enhanced corporate environmental disclosure. Given that pollution in the pharmaceutical industry is a prominent issue, the sustainable, green, and healthy development of this sector is not only critical to public health but also to regional economic growth (Li, 2024). As a result, pharmaceutical companies are highly influenced by national

macroeconomic regulations, making corporate governance a crucial factor in corporate decision-making (Hong & Xu, 2021). Against this backdrop, the more effective the corporate governance, the more intensive the disclosure becomes for listed pharmaceutical companies in China.

(5) The relationship between corporate environmental disclosure and control variables

Among the control variables, both financial leverage and Big Four are significantly positively correlated with corporate environmental disclosure. Firstly, financial leverage demonstrates a statistically significant positive association with corporate environmental disclosure across Panels I to V, at the 1% and 5% significance levels in corresponding order. Accordingly, firms with higher leverage are more likely to disclose environmental information. Secondly, Big Four is significantly positively correlated with corporate environmental disclosure in Panel I to Panel V at the 1% level, suggesting that audits conducted by the Big Four significantly enhance the quality of corporate environmental disclosure.

However, the price-to-book ratio, accounts receivable ratio, and book-to-market ratio are all significantly and negatively correlated with corporate environmental disclosure. Firstly, the price-to-book ratio is significantly negatively correlated with corporate environmental disclosure in Panel I to Panel V at the 1% level, implying that a decrease in the price-to-book ratio leads to an

improvement in corporate environmental disclosure. Secondly, the accounts receivable ratio in Panel I to Panel V shows a significant and negative correlation with corporate environmental disclosure at both the 5% and 10% levels. As the accounts receivable ratio increases, the corporate environmental disclosure decreases. Thirdly, a statistically significant inverse association is found between the book-to-market ratio and such disclosure in Panel I to Panel V at the 5% and 10% levels, respectively, suggesting that higher book-to-market ratios are associated with lower quality of corporate environmental disclosure.

Lastly, holding bank shares is significantly and negatively correlated with corporate environmental disclosure in Panel I, Panel II, and Panel IV at 5% and 10% levels. However, in Panel III and Panel V, the regression results for this variable reveal a negative relationship as well, but they are not statistically significant. This indicates that the influence of holding bank shares on corporate environmental disclosure is not robust.

Table 4.5 Fixed Effect Regression Results (Influencing Factors)

	Panel I	Panel II	Panel III	Panel IV	Panel V
GOV	12.14*** (3.17)				10.76*** (2.78)
MEDIA		-0.0137* (-1.93)			-0.00996 (-1.39)
ROE			0.112** (2.05)		0.0999* (1.85)
CG				0.0374** (2.14)	0.0362** (2.07)
LEV	0.0983** (2.09)	0.102** (2.21)	0.126*** (2.75)	0.109** (2.33)	0.119*** (2.65)

PB	0.0121*** (-3.74)	0.0122*** (-3.74)	0.0122*** (-3.59)	0.0125*** (-3.90)	0.0107*** (-3.15)
REC	-0.268** (-2.12)	-0.231* (-1.85)	-0.274** (-2.19)	-0.214* (-1.77)	-0.302** (-2.46)
BM	-0.0919** (-2.48)	-0.0836** (-2.20)	-0.0709* (-1.84)	-0.0808** (-2.14)	-0.0723* (-1.88)
BANK	-0.0737** (-2.25)	-0.0731* (-1.75)	-0.06 (-1.11)	-0.0688* (-1.94)	-0.058 (-1.20)
BIG4	0.179*** (4.31)	0.177*** (3.99)	0.178*** (4.15)	0.161*** (3.77)	0.169*** (3.81)
_cons	0.313*** (7.50)	0.450*** (9.78)	0.362*** (9.65)	0.377*** (10.74)	0.348*** (6.14)
<i>N</i>	1083	1083	1083	1083	1083
<i>R</i> ²	0.094	0.087	0.09	0.089	0.109
adj. <i>R</i> ²	0.088	0.081	0.084	0.083	0.101
<i>F</i>	9.311	7.284	8.049	7.482	7.355

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are t-values.

4.5.2 Moderating Effect of Corporate Governance

Based on the regression results of Models 4.1 to Model 4.3 presented in Table 4.5, it is observed that regulatory pressure and firm profitability have a positive influence on corporate environmental disclosure, whereas media exposure has a negative but statistically unstable and insignificant influence. In the next stage, this study examined whether corporate governance plays a moderating role in the relationship between regulatory pressure and firm profitability, and corporate environmental disclosure. Additionally, to strengthen the conceptual framework of the study, corporate governance is further examined as a moderator in the relationship between media exposure and the disclosure.

Therefore, Table 4.6 reports the estimation outcomes for Models 4.5 to

Model 4.7, with regulatory pressure, media exposure, and firm profitability as explanatory variables, corporate governance as the moderating variable, and corporate environmental disclosure as the dependent variable. The regression results correspond to Panel I to Panel III. To eliminate the influence of collinearity and dimensional differences, this study mean-centred the variables before constructing the interaction terms between the explanatory variables and the moderating variable.

(1) Corporate governance positively moderates the relationship between regulatory pressure and corporate environmental disclosure

From the regression results of Panel I, it is observed that the coefficient estimate for regulatory pressure is 12.70, which is significantly and positively correlated with corporate environmental disclosure at the 1% level. Additionally, the coefficient estimate for the interaction term between regulatory pressure and corporate governance is 13.51, which exhibits a positive association with corporate environmental disclosure that is statistically significant at the 5% level. This finding indicates that corporate governance positively moderates the relationship between regulatory pressure and this type of disclosure. Therefore, H5a is validated. It is also consistent with the conclusion of Tao (2022). This is because, first, corporate governance ensures that managers and employees fulfil their responsibilities in compliance with laws, regulations, and institutional rules (Cui, 2022). Therefore, effective corporate governance enables managers to

respond to government regulations more proactively and efficiently, preventing firms from engaging in unfavourable corporate environmental disclosures that merely meet minimum regulatory requirements. Second, effective corporate governance enhances internal oversight (Liu & Liu, 2001). Under external regulatory pressure, well-governed firms can establish transparent and efficient disclosure mechanisms from within, thereby improving corporate environmental disclosure. Finally, given the increasing severity of environmental issues, the pharmaceutical industry, as a heavily polluting sector, faces heightened scrutiny from government stakeholders who prioritize environmental concerns. Effective corporate governance encourages managers to adopt a long-term perspective, actively fulfil corporate environmental and social responsibilities, and pursue sustainable, green, and healthy development, thereby gaining government trust (Tao, 2022). Corporate governance acts as an amplifier of policy effects, significantly strengthening the regulatory pressure's positive influence on corporate environmental disclosure.

(2) Corporate governance does not moderate the relationship between media exposure and corporate environmental disclosure

Although Table 4.5 in Section 4.5.1 indicates that media exposure does not exhibit a robust and significant influence on corporate environmental disclosure, this study further tests the moderating role of corporate governance. Panel II of Table 4.6 reports a coefficient of -0.0109 for media exposure and

0.0176 for the interaction between media exposure and corporate governance; neither estimate reaches statistical significance. This suggests that corporate governance does not significantly moderate the relationship. Therefore, Hypothesis H5b is not accepted. In other words, for listed pharmaceutical companies in China, the influence of media exposure on this type of disclosure remains unclear, and corporate governance does not significantly amplify or weaken this relationship.

(3) Corporate governance positively moderates the relationship between firm profitability and corporate environmental disclosure

From the regression results of Panel III, it is evident that the coefficient estimate for firm profitability is 0.124, and demonstrates a statistically significant positive relationship with corporate environmental disclosure ($p < 0.05$). Additionally, the coefficient estimate for the interaction term between firm profitability and corporate governance is 0.157, and shows a positive and significant association with this type of disclosure at the 10% significance level. This finding highlights the positive moderating effect of corporate governance on the link between firm profitability and such disclosure. Therefore, the hypothesis H5c is validated. This conclusion extends the findings of Ardi and Yulianto (2020), who discovered that board independence in corporate governance serves as a significant moderator, strengthening the influence of firm profitability on the disclosure. The rationale behind this conclusion lies in the

strategic choices available to such firms: they can either prioritize short-term profit maximization (by minimizing corporate environmental disclosure costs) or pursue long-term value creation (through intensified corporate environmental disclosure to enhance reputation and legitimacy). Effective corporate governance helps balance the interests of stakeholders, including shareholders, the board of directors, and management (Dang & Lu, 2012), thereby reducing the likelihood of management withholding or manipulating environmental information. As a result, profitable firms with strong governance structures are more inclined to engage in environmental disclosure, leveraging their financial capacity to enhance their long-term competitiveness. Additionally, effective corporate governance improves a company's decision-making efficiency (Liu, 2003). Firms with higher decision-making efficiency can better respond to regulatory, market, and stakeholder demands. Given that pharmaceutical companies, as heavily polluting enterprises, face heightened scrutiny from stakeholders, decision-process efficiency becomes particularly critical. Under conditions of enhanced firm profitability, increased decision-process efficiency enables management to reduce approval and communication costs when making environmental decisions, thereby facilitating intensified corporate environmental disclosure.

In addition, as a moderating variable, corporate governance shows a positive and statistically significant relationship with environmental disclosure

at the 5%, in both Panel I and Panel III. Similarly, in Panel II, a statistically significant and positive relationship with the disclosure is observed at the 10% level. This indicates that in all three regression analyses, more effective corporate governance is associated with enhanced corporate environmental disclosure.

In the control variables, both financial leverage and Big Four are significantly and positively correlated with corporate environmental disclosure. Financial leverage is significantly and positively correlated with corporate environmental disclosure in Panel I to Panel III with significance observed at the 1% and 5% levels, suggesting that higher financial leverage is associated with better corporate environmental disclosure. Similarly, Big Four audit is also significantly and positively correlated with corporate environmental disclosure in Panel I to Panel III at the 1% level, suggesting that audits conducted by the Big Four significantly enhance corporate environmental disclosure.

Nevertheless, the price-to-book ratio, accounts receivable ratio and book-to-market ratio are all significantly and negatively correlated with corporate environmental disclosure. Firstly, the price-to-book ratio is negatively correlated with the disclosure across all Panels at the 1% level, suggesting that an increase in the price-to-book ratio leads to a unfavourable corporate environmental disclosure. Secondly, the accounts receivable ratio in Panel I to III shows a significant and negative correlation with corporate environmental disclosure at

both the 5% and 10% significance levels. This suggests that a lower accounts receivable ratio leads to enhanced corporate environmental disclosure. Thirdly, the book-to-market ratio in Panel I to III also shows a significant and negative correlation with corporate environmental disclosure at both the 5% and 10% significance levels, indicating that a higher book-to-market ratio results in unfavourable corporate environmental disclosure.

Finally, holding bank shares is significantly and negatively correlated with corporate environmental disclosure in Panel I and Panel II at the 1% and 5% levels, respectively. However, in Panel III, the regression results for this variable are not statistically significant, indicating that the effect of the holding bank shares on this type of disclosure is not robust.

Table 4.6 Fixed Effect Regression Results
(Moderating Effect of Corporate Governance)

	Panel I	Panel II	Panel III
GOV	12.70*** (3.32)		
GOV*CG	13.51** (2.12)		
MEDIA		-0.0109 (-1.49)	
MEDIA*CG		0.0176 (1.35)	
ROE			0.124** (2.41)
ROE*CG			0.157* (1.83)
CG	0.0392** (2.23)	0.0329* (1.88)	0.0382** (2.22)

LEV	0.102** (2.19)	0.104** (2.23)	0.127*** (2.82)
PB	-0.0116*** (-3.63)	-0.0120*** (-3.64)	-0.0119*** (-3.54)
REC	-0.275** (-2.23)	-0.227* (-1.88)	-0.287** (-2.34)
BM	-0.0868** (-2.35)	-0.0819** (-2.13)	-0.0660* (-1.70)
BANK	-0.0750*** (-2.70)	-0.0706** (-2.03)	-0.0308 (-0.41)
BIG4	0.164*** (3.92)	0.162*** (3.80)	0.163*** (3.80)
_cons	0.306*** (7.31)	0.432*** (9.50)	0.360*** (9.66)
<i>N</i>	1083	1083	1083
<i>R</i> ²	0.106	0.096	0.103
adj. <i>R</i> ²	0.098	0.088	0.096
F	7.79	6.254	6.888

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are t-values.

4.6 Robustness Test: GMM Estimation

4.6.1 Factors Influencing Corporate Environmental Disclosure

Due to its persistence, corporate environmental disclosure tends to be correlated across periods, linking current practices with those of the past (Peng, 2020). Potential endogeneity may stem from unobserved factors that are not accounted for in the model, meaning that prior corporate environmental disclosure may affect disclosure in the subsequent period (Huang & He, 2020). Therefore, following the studies of Peng (2020), Huang and He (2020), and Gerged (2021), this study includes the lagged dependent variable as an explanatory variable of the original model to form a dynamic panel and thus control for endogeneity.

This study intends to use the two-step system GMM estimation for dynamic panel analysis to obtain robustness test results (Alipour et al., 2019; Gerged, 2021). In the two-step system GMM estimation, if the AR(1) test yields a p-value below the 0.05 threshold, it indicates rejection of the null hypothesis, suggesting the presence of first-order autocorrelation. If the AR(2) test produces a p-value exceeding the 0.05 threshold, it suggests the inability to reject the null hypothesis, indicating the absence of second-order autocorrelation.

According to Table 4.7, under the two-step system GMM estimation, the regression results from Panel I to Panel V show that the AR(1) test yields p-values reported as 0.000, all less than 0.05. However, the p-values for the AR(2) test are reported as 0.102, 0.358, 0.120, 0.115, and 0.126, respectively, all greater than 0.05. Therefore, the AR(1) test rejects the null hypothesis, indicating first-order autocorrelation, while the AR(2) test fails to reject the null hypothesis, indicating the absence of second-order autocorrelation. Additionally, the regression results from Panel I to Panel V also show that the p-values of the Hansen test are 0.200, 0.383, 0.257, 0.139, and 0.415, respectively, all greater than 0.1. Hence, the null hypothesis cannot be rejected, indicating that all instrumental variables are exogenous and there is no overidentification problem. Therefore, using the two-step system GMM estimation in this study to address endogeneity issues in the regression setup is appropriate.

In Table 4.7, Panel I to Panel V respectively present the regression results

obtained from regressing regulatory pressure, media exposure, firm profitability, and corporate governance as explanatory variables against corporate environmental disclosure as the dependent variable. Meanwhile, Panel V presents the regression results including all influencing factors simultaneously, including regulatory pressure, media exposure, firm profitability, and corporate governance.

From the regression results of Panel I and Panel IV, it can be observed that the coefficient estimates for regulatory pressure are 61.22 and 44.67, respectively. Both estimates exhibit a positive association with this type of disclosure that is statistically significant at the 1% level. This suggests that corporate environmental disclosure improves significantly as regulatory pressure intensifies.

The regression results from Panel II and Panel V show that the coefficient estimates for media exposure are -0.0554 (at the 10% level) and -0.00931 (statistically insignificant), respectively. This indicates that media exposure has a negative but not robust influence on the disclosure.

From the regression results of Panel III and Panel IV, it is evident that firm profitability coefficient estimates are 0.514 and 0.318, respectively. They are significantly and positively correlated with corporate environmental disclosure at the 5% level and 10% level, separately. Thus, enhanced firm

profitability is associated with enhanced corporate environmental disclosure.

In Panel IV and Panel V, the coefficient estimates for corporate governance are reported as 0.191 and 0.0392, both of which are significantly and positively correlated with corporate environmental disclosure at the 5% level. This suggests that corporate environmental disclosure enhances with more effective corporate governance.

Therefore, according to the results shown in Table 4.7, the signs and significance of the coefficients of each explanatory variable remain consistent, indicating that the regression results regarding the influencing factors of corporate environmental disclosure in this study are robust.

Table 4.7 Results of Two-Step System GMM Estimations (Influencing Factors)

	Panel I	Panel II	Panel III	Panel IV	Panel V
L.ED	0.240** (0.034)	0.486* (0.057)	0.256** (0.040)	0.223** (0.043)	0.236** (0.050)
GOV	61.22*** (0.000)				44.67*** (0.000)
MEDIA		-0.0554* (0.086)			-0.00931 (0.549)
ROE			0.514** (0.016)		0.318* (0.093)
CG				0.191** (0.043)	0.0392** (0.023)
LEV	0.440** (0.018)	1.023*** (0.000)	0.379*** (0.002)	0.441*** (0.004)	0.249* (0.064)
PB	-0.000656 (0.901)	-0.0431*** (0.007)	-0.0140** (0.048)	-0.00696 (0.177)	-0.00464 (0.366)
REC	-0.574*** (0.007)	0.861* (0.061)	-0.186 (0.575)	0.274 (0.400)	0.254 (0.427)

BM	0.00482 (0.970)	-1.222*** (0.000)	-0.18 (0.113)	-0.0726 (0.413)	-0.0351 (0.573)
BANK	-7.452 (0.484)	86.31 (0.419)	-1.171 (0.652)	0.0941 (0.984)	3.341** (0.029)
BIG4	0.161*** (0.000)	0.381*** (0.000)	0.178*** (0.000)	0.0791 (0.297)	0.149 (0.129)
_cons	-0.201** (0.042)	0.721*** (0.000)	0.243** (0.026)	0.148*** (0.005)	-0.0836 (0.458)
<i>AR(1)</i>	-3.64 (0.000)	-3.61 (0.000)	-4.09 (0.000)	-3.6 (0.000)	-3.85 (0.000)
<i>AR(2)</i>	1.63 (0.102)	0.92 (0.358)	1.56 (0.120)	1.58 (0.115)	1.53 (0.126)
<i>Hansen</i>	9.8 (0.200)	7.46 (0.383)	46.49 (0.257)	36.14 (0.139)	25.85 (0.415)

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are p-values.

4.6.2 Moderating Effect of Corporate Governance

This study examined the positive moderating effect of corporate governance on the relationship between regulatory pressure, firm profitability, and corporate environmental disclosure in Section 4.5.2. However, the results also indicate that corporate governance does not exhibit a significant moderating effect on the relationship between media exposure and this disclosure. In addition, to address endogeneity issues, this study employed the two-step system GMM estimation for dynamic panel analysis to obtain robust test results.

According to Table 4.8, under the two-step system GMM estimation, the regression results from Panel I to Panel V indicate that the p-values for the AR(1) test are all 0.000, which are less than 0.05. However, the p-values for the AR(2) test are 0.126, 0.241, and 0.113, respectively, all exceeding 0.05. Therefore,

rejection of the null hypothesis in the AR(1) test suggests the presence of first-order autocorrelation, while failure to reject the null hypothesis in the AR(2) test indicates the absence of second-order autocorrelation. Additionally, the regression results from Panel I to Panel III also reveal that the p-values for the Hansen test are 0.384, 0.181, and 0.154, respectively, all greater than 0.1. Consequently, failure to reject the null hypothesis in the Hansen test suggests that all instrumental variables are exogenous, and that there is no overidentification problems. Therefore, the application of the two-step system GMM estimation to address endogeneity issues in the regression setup of this study is deemed appropriate.

Table 4.8 presents the estimation results corresponding to Panel I to Panel III, where regulatory pressure, media exposure, and firm profitability are respectively used as explanatory variables, while corporate governance is the moderating variable, and corporate environmental disclosure serves as the dependent variable. To mitigate the effects of collinearity and scale differences, mean-centring was conducted before constructing the interaction terms between the explanatory and moderating variables.

From the results in Panel I, it can be observed that the estimated coefficient of regulatory pressure is 46.28, with the estimate exhibiting a positive association with such disclosure that is statistically significant at the 1% level. Simultaneously, the interaction term between regulatory pressure and corporate

governance yields a coefficient of 39.80, which is positively and significantly related to this type of disclosure at the 5% significance level. This indicates that corporate governance acts as a positive moderating variable in the relationship between regulatory pressure and corporate environmental disclosure.

From the results in Panel II, it is evident that the coefficient estimate for media exposure is -0.0113, which is insignificantly and negatively correlated with corporate environmental disclosure. Meanwhile, the coefficient estimate for the interaction term between media exposure and corporate governance is 0.0182, but it is not significantly related to the disclosure. These results suggest that corporate governance does not effectively moderate the influence of media exposure.

In Panel III, the coefficient estimate for firm profitability is reported as 0.295, which is significantly and positively correlated with corporate environmental disclosure at the 5% level. Furthermore, the coefficient estimate of the interaction term between firm profitability and corporate governance is 0.213 and it is significantly and positively associated with corporate environmental disclosure at the 10% level. This finding highlights the positive moderating effect of corporate governance on the linkage between firm profitability and the disclosure.

Therefore, as indicated by the results in Table 4.8, the signs and

significance of the coefficients of each variable have not fundamentally changed.

This suggests that the regression results regarding the moderating effect of corporate governance in this study are robust.

Table 4.8 Results of Two-Step System GMM Estimations
(Moderating Effect of Corporate Governance)

	Panel I	Panel II	Panel III
L.ED	0.204** (0.032)	0.200** (0.047)	0.270** (0.031)
GOV	46.28*** (0.005)		
GOV*CG	39.80** (0.011)		
MEDIA		-0.0113 (0.412)	
MEDIA*CG		0.0182 (0.486)	
ROE			0.295** (0.021)
ROE*CG			0.213* (0.086)
CG	0.139** (0.015)	0.239*** (0.000)	0.150*** (0.003)
Lev	0.131** (0.046)	0.149** (0.041)	0.257** (0.033)
PB	-0.00126 (0.747)	-0.0103 (0.107)	-0.00933 (0.107)
REC	-0.324*** (0.009)	0.317 (0.284)	-0.0749 (0.824)
BM	-0.00306 (0.955)	-0.0644 (0.516)	-0.0308 (0.683)
Bank	1.259 (0.720)	-4.293* (0.089)	-1.905 (0.364)
Big4	0.0868* (0.052)	0.0112 (0.836)	0.0855 (0.108)
_cons	-0.031 (0.773)	0.311*** (0.002)	0.195** (0.012)
<i>AR(I)</i>	-4.53	-4.12	-3.78

	(0.000)	(0.000)	(0.000)
<i>AR(2)</i>	1.53	1.17	1.59
	(0.126)	(0.241)	(0.113)
<i>Hansen test</i>	1.91	37.98	76.6
	(0.384)	(0.181)	(0.154)

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are p-values.

4.7 Chapter Conclusion

This chapter empirically examines the influence of regulatory pressure, media exposure, firm profitability, and corporate governance on corporate environmental disclosure, and the moderating effect of corporate governance on the relationship between these factors and corporate environmental disclosure for Chinese listed pharmaceutical companies from 2018 to 2022. Tables 4.5 and 4.6 present the empirical results of the main regression tests. Tables 4.7 and 4.8 present the robustness tests that account for endogeneity, leading to the following conclusions:

Firstly, for Chinese pharmaceutical listed companies, intensified regulatory pressure, enhanced firm profitability, and more effective corporate governance all lead to enhanced corporate environmental disclosure. However, media exposure has a negative but not robust influence on corporate environmental disclosure. Secondly, corporate governance positively moderates the relationship between regulatory pressure and corporate environmental disclosure, as well as between firm profitability and such disclosure. In other words, more effective corporate governance enhances the positive influence of

regulatory pressure and firm profitability on corporate environmental disclosure.

Nevertheless, the moderating effect of corporate governance on the relationship between media exposure and corporate environmental disclosure is not significant.

Chapter Five

FINDINGS AND DISCUSSION OF THE IMPACT OF CORPORATE ENVIRONMENTAL DISCLOSURE ON FINANCING COST

5.1 Overview of the Chapter

This chapter addresses RQ6 to RQ8, which examine the impact of corporate environmental disclosure on the cost of equity and the cost of debt, with the moderating effect of corporate governance. Section 5.2 outlines the empirical findings and interpretation regarding how corporate environmental disclosure impacts the cost of equity, while Section 5.3 reports and analyses how corporate environmental disclosure impacts the cost of debt. Section 5.4 provides a summary of this chapter.

Specifically, Sections 5.2 and 5.3 follow the same structure. Firstly, all variables are analysed descriptively. Second, the correlation coefficients between the variables are analysed. Thirdly, a series of pre-estimation analyses, including VIF analysis, panel model estimation methods analysis and heteroskedasticity analysis, are examined. Fourth, the impact of corporate environmental disclosure on the cost of equity and debt and the moderating role of corporate governance are tested through the regression analysis of the FE model. Finally, robustness verification is conducted through System GMM estimation.

5.2 Findings and Discussion on the Cost of Equity

5.2.1 Descriptive Analysis

Consistent with the approach adopted in Chapter 4, this chapter applies winsorization at the 1st and 99th percentiles to all continuous variables in order to limit the effect of outliers (Benjamin et al., 2023). After excluding firm-year observations with missing values, the study on the impact of corporate environmental disclosure on the cost of equity by listed pharmaceutical companies in China ultimately utilised 1,042 observations in Section 5.2. These observations are distributed across the years 2018 to 2022 as follows: 164 in 2018, 181 in 2019, 199 in 2020, 241 in 2021, and 257 in 2022. The corresponding descriptive statistics include the mean, minimum, maximum, standard deviation, and median of the relevant variables and do not exhibit significant anomalies (as shown in Table 5.1).

The average cost of equity is 0.063, slightly above the median (0.061). The variable ranges from 0.009 to 0.204, with a SD of 0.031, indicating moderate variation. Such results reveal the average cost of equity in China's pharmaceutical industry is around 6%. Wu (2023), using all listed firms in China from 2006 to 2020 and applying the HVZ and PEG models, reported a similar mean value of 0.06, though with a slightly narrower range (0.007-0.155). The slight differences in extreme values may stem from differences in industry type and sampling period. Pharmaceutical firms are both capital- and technology-

intensive, often requiring long Research and Development (R&D) cycles and substantial upfront investment (Shan & Qiu, 2021). Such characteristics increase financing needs and risk exposure. If these firms are unable to access equity capital at costs comparable to or below the market average, their overall financing burden rises, potentially constraining innovation and long-term development. This underscores the importance of exploring whether corporate environmental disclosure can help reduce the cost of equity in this context.

Corporate environmental disclosure has a mean of 0.306 and a SD of 0.161, with values ranging from 0.026 to 0.737. These figures are broadly consistent with those reported in the previous chapter (Section 4.2), with slight variation due to sample adjustment. Therefore, a detailed analysis is omitted here to avoid redundancy. The corporate environmental disclosure data in this section primarily serve as contextual support for the subsequent regression analysis on cost of equity.

For the corporate governance index, the mean is 0.027, taking values between -1.237 and 1.536, the SD is 0.57, and the median is 0.053. The presence of negative values reflects below-average governance performance relative to the sample. This is consistent with the PCA-based construction approach described in Chapter 3. The distribution of values suggests substantial heterogeneity in corporate governance practices across listed pharmaceutical firms in China.

The cost of equity model incorporates several firm-specific controls, including firm profitability, financial leverage, and the book-to-market ratio, all of which have been examined in Chapter 4. Although slight differences in descriptive statistics are observed due to sample variation, their distributions remain consistent with earlier results and fall within reasonable ranges. These variables continue to reflect key aspects of firm performance and capital structure, and serve as standard controls in estimating the cost of equity.

The remaining control variables are described in detail as follows. The average Beta is 5.294, with a minimum of 0 and a maximum of 6.223. This relatively high level of firm-level risk exposure, as captured by stock return volatility, reflects the characteristics of China's pharmaceutical sector, which is influenced by intensive R&D activities, long product development cycles, and stringent regulatory pressure. Prior studies using similar methods have reported lower averages across broader samples. For example, Yang et al. (2021) reported a mean of 1.047, Huang and Peng (2021) found a mean of 1.149, and Z. G. Li et al. (2022) observed a mean of 1.142 and a maximum of 9.518. These comparisons support the plausibility of the distribution observed in this study.

In addition, the average asset turnover ratio is 0.499, with a minimum of 0 and a maximum of 1.199, and a standard deviation of 0.255. This suggests that operational efficiency varies across firms, but overall turnover remains moderate. The result is consistent with Chen and Hu (2023), who reported a mean of 0.747

and a maximum of 3.218 in a broader sample of A-share listed companies, further supporting the plausibility of the observed values.

With a mean of 0.073 and a standard deviation of 0.077, the cash flow ratio shows considerable variation, ranging from -0.189 to 0.373. The negative minimum value indicates that some firms experienced periods where total cash outflows exceeded inflows, signalling potential short-term liquidity risks. These values are consistent with Guo and Wang (2023), who reported a mean of 0.074 and a maximum of 0.227 in a large sample of heavily polluting listed firms in China, supporting the plausibility of the variable's distribution.

Finally, the mean and median of the quick ratio are 3.102 and 2.105, respectively, with observed values spanning from 0.304 to 17.64 and a SD of 3.061. This indicates that pharmaceutical firms generally maintain strong short-term solvency. However, the large standard deviation and the gap between the mean and median suggest that a few firms with exceptionally high liquidity skew the average. This pattern aligns with Pan and Shen (2020), who reported a mean quick ratio of 2.35 and a maximum of 27.13 for listed pharmaceutical manufacturers.

Table 5.1 Descriptive Analysis (Cost of Equity)

Variable	Mean	Min	Max	SD	p50
COE	0.063	0.009	0.204	0.031	0.061
ED	0.306	0.026	0.737	0.161	0.289
CG	0.027	-1.237	1.536	0.57	0.053

ROE	0.085	-0.551	0.594	0.138	0.087
LEV	0.292	0.040	0.801	0.164	0.268
BM	0.546	0.047	1.099	0.223	0.552
BETA	5.294	0.000	6.223	0.818	5.482
ATO	0.499	0.000	1.199	0.255	0.485
CF	0.073	-0.189	0.373	0.077	0.069
QUICK	3.102	0.304	17.64	3.061	2.105

Whereby: COE= Cost of Equity; ED= Corporate Environmental Disclosure; CG= Corporate Governance; ROE= Firm Profitability; LEV= Financial Leverage; BM= Book-to-Market Ratio; BETA= Beta Coefficient; ATO= Asset Turnover Ratio; CF= Cash Flow Ratio; QUICK= Quick Ratio.

5.2.2 Correlation Analysis

According to the correlation matrix in Table 5.2, it is evident that there is a significant negative correlation between the dependent variable, cost of equity, and the explanatory variable, corporate environmental disclosure, at the 1% significance level. This suggests that corporate environmental disclosure can reduce the cost of equity, which also confirms hypothesis H6 of this study provisionally.

With respect to the control variables, corporate governance, firm profitability, and the Beta coefficient exhibit significant negative associations with the cost of equity at the 1% significance level. Conversely, the book-to-market ratio and the cash flow ratio are positively correlated with the cost of equity at the 1% significance level, while the quick ratio is positively correlated with the cost of equity at the 10% significance level. Finally, the results of the correlation coefficients for the relationship between financial leverage and asset turnover ratio with the cost of equity are not statistically significant.

Table 5.2 Pairwise Correlation (Cost of Equity)

	COE	ED	CG	ROE	Lev	BM	BETA	ATO	CF	Quick
COE	1									
ED	-0.323***	1								
CG	-0.159***	0.208***	1							
ROE	-0.089***	0.079**	0.015	1						
LEV	0.028	0.084***	-0.038	-0.210***	1					
BM	0.313***	0.023	-0.017	-0.215***	0.114***	1				
BETA	-0.083***	-0.014	-0.02	-0.015	0.025	-0.014	1			
ATO	0.006	0.103***	0.036	0.423***	0.215***	-0.091***	0.158***	1		
CF	0.111***	0.073**	0.034	0.680***	-0.178***	-0.203***	0.014	0.429***	1	
QUICK	0.052*	-0.095***	0.053*	0.057*	-0.648***	-0.031	-0.047	-0.340***	0.051	1

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively.

5.2.3 Preliminary Analysis

5.2.3.1 Variance Inflation Factor Analysis

To verify the reasonableness of the model, a test for multicollinearity was conducted on the variables using the VIF and tolerance, as depicted in Table 5.3.

Consistent with the threshold used in Chapter 4, this study considers VIF values below 10 and $1/\text{VIF}$ values above 0.1 as indicative of low multicollinearity. As shown in Table 5.3, all VIF values ranged between 1.04 and 2.06, and the corresponding inverse VIF values fell within the range of 0.486 to 0.963.

These results suggest that the explanatory variables were sufficiently independent, thereby validating the model specification for analysing the relationship between corporate environmental disclosure and the cost of equity. This provides a solid foundation for the subsequent regression analysis.

Table 5.3 Variance Inflation Factor (Cost of Equity)

Variable	VIF	1/VIF
ROE	2.06	0.486
CF	2.00	0.500
QUICK	1.87	0.533
LEV	1.87	0.535
ATO	1.63	0.615
ED	1.07	0.933
BM	1.06	0.940
CG	1.06	0.948
BETA	1.04	0.963
Mean VIF	1.52	

5.2.3.2 Analysis of Panel Model Estimation Methods

To determine the most appropriate model for processing and analysing the panel data used in this section (Section 5.2), the F-test, Breusch-Pagan test, and Hausman test must be conducted. Table 5.4 presents the results of the tests.

Consistent with the diagnostic results reported in Chapter 4, the F-test, Breusch-Pagan test, and Hausman test all yield p-values of 0.0000, supporting the use of the FE model. Accordingly, the regression analysis related to the cost of equity is conducted using the FE model.

Table 5.4 Panel Model Estimation Method (Cost of Equity)

Type of Test	Test Value		Options
F Test	F = 2.36	Prob > F = 0.0000	FE Model
Breusch-Pagan Test	chibar2(01) = 45.2	Prob > chibar2 = 0.0000	RE Model
Hausman Test	chi2(10) = 74.29	Prob > chi2 = 0.0000	FE Model

5.2.3.3 Heteroskedasticity Analysis

Based on the results of panel model estimation methods analysis, FE model is used in this study. In addition, because of the characteristics of unbalanced panel data, this study employs the modified Wald test to detect heteroskedasticity (Baum, 2024). The results indicate that for Model 5.1, $\chi^2(308) = 107847.94$, with $\text{Prob} > \chi^2 = 0.0000$, while for Model 5.3, and $\chi^2(308) = 99544.03$, with $\text{Prob} > \chi^2 = 0.0000$. Both results reject the null hypothesis, indicating the presence of heteroskedasticity.

Therefore, to address the heteroskedasticity issue, heteroskedasticity-robust standard errors are employed in this section (Katmon et al., 2019) to obtain more reliable regression results.

5.2.4 Regression Analysis

Table 5.5 presents the regression results of Model 5.1 and Model 5.3. Specifically, Panel I examines the impact of corporate environmental disclosure on the cost of equity, while Panel II further examines this relationship by incorporating corporate governance as a moderating variable. To mitigate the effects of multicollinearity and dimensional differences, this study mean-centred the variables when constructing interaction terms between explanatory and moderating variables. In addition, to account for individual differences between companies, all regressions control for individual fixed effects.

(1) Corporate environmental disclosure negatively impacts the cost of equity

From the regression results in Panel I, the coefficient estimate for corporate environmental disclosure is -0.0289. It is significantly negatively correlated with the dependent variable, the cost of equity, at the 1% level. The regression results indicate that corporate environmental disclosure is negatively associated with the cost of equity, as the coefficient is statistically significant and negative. Therefore, hypothesis H6 is supported. This finding is consistent with the results reported by Atasel et al. (2020), Su and Zhang (2020), Ould Daoud

Ellili (2020), Luo, Cai, et al. (2020), Garzón-Jiménez and Zorio-Grima (2021), and Wu and Qin (2022).

In contrast, this conclusion differs from the findings of some scholars who argue that corporate environmental disclosure does not significantly impact the cost of equity (Ren & Hong, 2017; Yan et al., 2023). This discrepancy may stem from several factors. First, China's capital market lacks a well-developed institutional framework, and the emphasis on corporate environmental disclosure remains relatively limited. Second, the absence of authoritative third-party data often leads the market to interpret corporate environmental disclosures with scepticism.

However, this study focuses on data from 2018 to 2022, following the issuance of the *2017 Guidelines* (CSRC, 2017). With the continuous introduction of policies, both enterprises and the capital market have placed increasing importance on corporate environmental disclosure. Meanwhile, this study adopts a content analysis approach, incorporating predefined indicators from existing databases (CSMAR database). This method ensures the credibility of classification criteria while avoiding potential biases associated with directly relying on third-party data.

Therefore, this study demonstrates that enhanced corporate environmental disclosure leads to a reduction in the cost of equity because, as

firms operate in a heavily polluting industry, pharmaceutical companies may face significant environmental issues and risks while also being subject to heightened scrutiny from the public and government. Against this backdrop, as firms enhance corporate environmental disclosure, investors can timely access information regarding the time, expenses, and achievements associated with corporate environmental efforts, enabling them to accurately assess the firm's future growth potential and fulfilment of social responsibility (Wu & Qin, 2022). Consequently, investors may demand a lower return rate when providing funding to these companies. In contrast, the lack of enhanced corporate environmental disclosure may lead to firms concealing or misrepresenting environmental information, misleading or even deceiving investors (Su & Zhang, 2020). Such practices could ultimately result in severe consequences, including substantial environmental fines or business shutdowns, harming investor interests. Under these circumstances, investors would require higher returns to compensate for the risks associated with unfavourable corporate environmental disclosure, leading to an increase in the cost of equity. Therefore, enhanced corporate environmental disclosure can effectively reduce the cost of equity.

(2) Corporate governance positively moderates the relationship between corporate environmental disclosure and the cost of equity

Moreover, as shown in Panel II, the coefficient of corporate environmental disclosure is -0.0238, with the impact remaining statistically

significant at the 1% level and pointing to a negative impact on the cost of equity. A statistically significant coefficient of -0.0306 at the 5% level was found for the interaction between the disclosure and corporate governance, reflecting a negative correlation with the cost of equity. This indicates that corporate governance positively moderates the relationship between corporate environmental disclosure and the cost of equity, thus validating hypothesis H8a.

This conclusion further extends the studies by Li (2019) and Zhu (2021). These authors each examined one aspect of corporate governance, board experience and institutional ownership, as moderating variables, both finding that these factors positively moderate the relationship between corporate environmental disclosure and the cost of equity. This study also reached a similar conclusion, identifying corporate governance as a positive moderating variable in this relationship. First, due to the absence of a widely recognised and authoritative corporate environmental disclosure rating database in China (Lu et al., 2020), investors may have concerns about whether such ratings accurately reflect the actual quality of corporate environmental disclosure. Effective corporate governance implies stronger internal oversight (Liu & Liu, 2001), ensuring that corporate environmental disclosures are more truthful, reliable, and verifiable. This, in turn, increases investor confidence in firms' environmental commitments, while reducing information asymmetry, ultimately lowering the cost of equity. Second, effective corporate governance helps balance stakeholder

interests (Dang & Lu, 2012), preventing management from focusing excessively on short-term profits at the expense of long-term sustainable development. By integrating environmental responsibility into long-term corporate strategy, companies can enhance their attractiveness to sustainable investors on capital markets, further reducing the cost of equity.

Firm profitability and Beta, as control variables, are both found to be inversely and significantly related to the cost of equity. Specifically, the results in Panel I and Panel II consistently show that firm profitability is inversely associated with the cost of equity, with the relationship being statistically significant at 1% level, indicating enhanced firm profitability leads to a reduction in the cost of equity. Similarly, the Beta coefficient exhibits a significant negative association with the cost of equity at the 5% and 10% significance levels in Panel I and Panel II, respectively, suggesting that firms with higher return volatility tend to exhibit lower estimated costs of equity in the sample period. The findings from Panel I and Panel II consistently reveal statistically significant positive relationships between the cost of equity and four control variables: financial leverage, book-to-market ratio, asset turnover, and cash flow ratio ($p < 0.01$). This implies that higher financial leverage, larger book-to-market ratio, higher asset turnover ratio, and increased cash flow ratio are associated with the increase in the cost of equity. Finally, the quick ratio is negatively correlated with the cost of equity across Panel I and Panel II, but the regression results are not

statistically significant.

Table 5.5 Fixed Effect Regression Results (Cost of Equity)

	Panel I	Panel II
ED	-0.0289*** (-3.67)	-0.0238*** (-3.09)
ED*CG		-0.0306** (-2.40)
CG		0.00315 (0.78)
ROE	-0.0739*** (-3.66)	-0.0734*** (-3.61)
LEV	0.0422*** (3.26)	0.0417*** (3.21)
BM	0.0420*** (5.30)	0.0415*** (5.26)
BETA	-0.00264** (-2.01)	-0.00253* (-1.91)
ATO	0.0247*** (3.55)	0.0237*** (3.39)
CF	0.108*** (4.81)	0.111*** (4.97)
QUICK	-0.000914 (-1.32)	-0.000949 (-1.39)
_cons	0.0393*** (3.39)	0.0385*** (3.34)
<i>N</i>	1042	1042
<i>R</i> ²	0.144	0.151
adj. <i>R</i> ²	0.137	0.143
F	11.35	10.14

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are t-values.

5.2.5 Robustness Test: GMM Estimation

Since the cost of equity exhibits a certain degree of inertia and persistence, the empirical regression model is subject to lag effects (Dai & Deng, 2023). As discussed earlier, potential endogeneity may result from omitted

variables, meaning that a firm's previous cost of equity may affect its subsequent cost of equity. Therefore, following the studies of Yao and Liang (2019) and Garzón-Jiménez and Zorio-Grima (2021), this study incorporates to incorporate the lagged dependent variable into the set of explanatory variables in the original model, forming a dynamic panel to control for endogeneity.

This study employed the two-step system GMM estimation for dynamic panel analysis to obtain robust estimation results (El Ghouli et al., 2018; Y. Zhao et al., 2024). According to the results in Table 5.6, using the two-step system GMM estimation, the P-values of the AR(1) test for both Panel I and Panel II regressions are 0.000. The P-values of the AR(2) test are 0.171 and 0.201, respectively, which are both greater than 0.05. Therefore, the AR(1) test rejects the null hypothesis, indicating first-order autocorrelation, while the AR(2) test fails to reject the null hypothesis, indicating no second-order autocorrelation. Additionally, the P-values of the Hansen test for both Panel I and Panel II regressions are 0.220 and 0.228, respectively, both of which are greater than 0.1. Thus, as the null hypothesis remains unchallenged, this implies that all instrumental variables are jointly valid, with no evidence of instrument over-identification. Therefore, using the dynamic panel system GMM estimation to overcome endogeneity issues in the regression setup is appropriate for this study.

In Table 5.6, Panel I presents the regression estimates where corporate environmental disclosure serves as the explanatory variable and the cost of

equity is the dependent variable. Panel II, on the other hand, presents the regression results with corporate environmental disclosure as the explanatory variable, the cost of equity as the dependent variable, and corporate governance as the moderating variable. Additionally, to mitigate potential multicollinearity and scale differences when constructing the interaction term, all variables involved were mean-centred prior to estimation.

From the regression results in Panel I, the estimated coefficient of corporate environmental disclosure is -0.0358, demonstrating a statistically significant negative relationship with the cost of equity ($p < 0.01$). This indicates that enhanced corporate environmental disclosure leads to a reduction in the cost of equity.

Similarly, the regression output in Panel II shows that corporate environmental disclosure has a coefficient of -0.0310, which is statistically significant at the 1% level and indicates a negative effect on the cost of equity. Moreover, the interaction term between corporate environmental disclosure and corporate governance is estimated at -0.0452 and reaches significance at the 5% level, also implying a negative impact. These findings imply that corporate governance strengthens the inverse relationship between disclosure and the cost of equity, highlighting its positive moderating role.

Therefore, in light of the findings presented in Table 5.6, the signs and

significance of the coefficients of the explanatory and moderating variables remain consistent with the baseline FE regression results, indicating considerable robustness in the conclusions drawn regarding the impact of this type of disclosure on the cost of equity and the moderating effect of corporate governance on this relationship.

Table 5.6 Results of Two-Step System GMM Estimations (Cost of Equity)

	Panel I	Panel II
L.COE	0.213*** (0.007)	0.209*** (0.005)
ED	-0.0358*** (0.003)	-0.0310*** (0.009)
EDCG		-0.0452** (0.044)
CG		-0.000495 (0.922)
ROE	-0.0800*** (0.005)	-0.0651** (0.031)
Lev	0.0374 (0.250)	0.0244 (0.355)
BM	0.0315*** (0.000)	0.0309*** (0.000)
BETA	-0.00714* (0.080)	-0.00847** (0.025)
ATO	0.0400** (0.027)	0.0300** (0.044)
CF	0.0958*** (0.004)	0.0941*** (0.006)
Quick	0.00230* (0.058)	0.00162 (0.106)
_cons	0.0427 (0.108)	0.0599*** (0.007)
<i>AR(1)</i>	-4.80 (0.000)	-4.80 (0.000)
<i>AR(2)</i>	1.37 (0.171)	1.28 (0.201)
<i>Hansen</i>	31.21	48.47

(0.220)	(0.228)
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***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are p-values.

5.3 Findings and Discussion on the Cost of Debt

5.3.1 Descriptive Analysis

All continuous variables in this section are treated using the same winsorization approach described earlier. After excluding firm-year observations with missing values, the analysis on the impact of corporate environmental disclosure on the cost of debt for listed pharmaceutical companies in China ultimately utilised 1,141 observations in Section 5.3. These observations are distributed across the years 2018 to 2022 as follows: 182 in 2018, 191 in 2019, 216 in 2020, 268 in 2021, and 284 in 2022. Furthermore, the corresponding descriptive statistics include the mean, minimum, maximum, standard deviation, and median of the relevant variables (as depicted in Table 5.7). An analysis of the descriptive statistics indicates that the distribution of maximum and minimum values across variables does not exhibit significant anomalies.

From the perspective of the cost of debt, the mean value is 0.015, while the median is 0.012, indicating that although most firms have relatively low cost of debt, a small number of firms face significantly higher costs. With values ranging from 0 to 0.055 and a SD of 0.013, the distribution of cost of debt appears relatively concentrated, except for a few firms with substantially higher levels. In comparison, Wu et al. (2020) analysed a broader dataset encompassing

all Chinese listed firms from 2011 to 2018, reporting a mean cost of debt of 0.021, with the lowest and highest values being 0.0001 and 0.0658, respectively. Although slight differences exist, the results are generally comparable. These differences may stem from variations in industry coverage (this study focuses on the pharmaceutical sector, while the comparative study covers all industries) and sample periods.

From the perspective of corporate environmental disclosure, the sample mean is 0.293, with a minimum of 0.026, a maximum of 0.711, and a standard deviation of 0.165, indicating substantial variation across firms.

Regarding the moderating variable corporate governance, the average value is 0.012, while the observed range spans from -1.223 to 1.596, with a SD of 0.57. The occurrence of negative values is consistent with the PCA-based index construction and indicates below-average governance relative to the sample mean. The distribution reflects considerable variation in governance effectiveness among listed pharmaceutical companies.

As both variables (corporate environmental disclosure and corporate governance) have already been examined in detail in Chapter 4, and their descriptive patterns remain broadly consistent despite minor sample differences, further discussion is omitted here to avoid redundancy.

Several control variables, including firm profitability, financial leverage, revenue growth rate, asset turnover ratio, and the cash flow ratio, have been discussed in detail in the influencing factors model and the cost of equity model. While slight differences in descriptive statistics arise due to sample variation, their distributions remain broadly consistent with earlier results and fall within plausible ranges. These variables continue to reflect key aspects of firm performance and capital structure, and serve as standard controls in estimating the cost of debt.

The remaining control variables are described in detail as follows. First, the average revenue growth rate is 0.175, with a median of 0.087, indicating that most sample companies have revenue below the mean, suggesting considerable room for growth. However, the SD is 0.552, reflecting a distribution ranging from -0.508 to 4.294, signifying the presence of loss-making situations among some companies, with significant variations in revenue changes across firms. This distribution closely aligns with Mei and Zhang (2023), who reported a mean of 0.171 and a SD of 0.466, supporting the use of growth as a relevant control variable in estimating cost of debt.

Similarly, the liquid ratio has an average value of 3.669, with observed values spanning from 0.645 to 18.52. The SD is 3.326, indicating notable differences in liquidity across companies. This suggests that pharmaceutical firms maintain relatively high levels of liquid assets and short-term solvency, but

the large variation reflects significant heterogeneity. This is consistent with Li and Zhang (2023), who found a similar mean (3.42) and standard deviation (2.94) in Chinese pharmaceutical firms, reaffirming its role as a control variable in cost of debt estimation.

Finally, the average tangible assets ratio is 0.523, with a minimum of 0 and a maximum of 0.986. The standard deviation is 0.446, indicating significant differences in asset composition across firms, with some having very limited tangible assets. As pharmaceutical companies typically incur high research and development costs, intangible assets (such as patents) are particularly important. Nonetheless, the existence of firms with almost no tangible assets warrants attention. This is broadly consistent with Ye and Deng (2020), who reported a mean tangible asset ratio of 0.639 and a standard deviation of 0.645 in a global sample of large pharmaceutical firms, reaffirming its relevance as a control variable in cost of debt estimation.

Table 5.7 Descriptive Analysis (Cost of Debt)

Variable	Mean	Min	Max	SD	p50
COD	0.015	0	0.055	0.013	0.012
ED	0.293	0.026	0.711	0.165	0.289
CG	0.012	-1.223	1.596	0.57	0.046
ROE	0.081	-0.424	0.594	0.138	0.081
LEV	0.293	0.04	0.747	0.161	0.27
GROWTH	0.175	-0.508	4.294	0.552	0.087
ATO	0.497	0	1.206	0.258	0.483
CF	0.072	-0.166	0.373	0.077	0.068
LIQUID	3.669	0.645	18.52	3.326	2.569
TANGIBLE	0.523	0	0.986	0.446	0.802

Whereby: COD= Cost of Debt; ED= Corporate Environmental

Disclosure; CG= Corporate Governance; ROE= Firm Profitability; LEV= Financial Leverage; GROWTH= Revenue Growth Rate; ATO= Asset Turnover Ratio; CF= Cash Flow Ratio; LIQUID= Liquid Ratio; TANGIBLE= Tangible Asset Ratio.

5.3.2 Correlation Analysis

The results of the correlation analysis presented in Table 5.8 show that there is a significant and negative correlation between dependent variable, the cost of debt, and the explanatory variable, corporate environmental disclosure, at the 1% level. This finding reveals a significant negative relationship between such disclosure and the cost of debt, offering initial empirical support for Hypothesis H7.

In addition, for the moderating variable, corporate governance, shows a significant and negative correlation with the cost of debt at the 1% significance level.

Regarding the control variables, firm profitability, revenue growth rate, total asset turnover ratio, cash flow ratio and liquid ratio all show significant and negative correlations with the cost of debt at the 1% significance level. Conversely, financial leverage and the tangible assets ratio have significant and positive correlations with the cost of debt at the 1% significance level.

Table 5.8 Pairwise Correlation (Cost of Debt)

	COD	ED	CG	ROE	LEV	GROWTH	ATO	CF	LIQUID	TANGI BLE
COD	1									
ED	-0.089***	1								
CG	-0.085***	0.202***	1							
ROE	-0.341***	0.047	0.015	1						
LEV	0.600***	0.086***	-0.051*	-0.225***	1					
GROWTH	-0.139***	-0.037	0.061**	0.271***	-0.017	1				
ATO	-0.117***	0.090***	0.035	0.443***	0.205***	0.221***	1			
CF	-0.240***	0.033	0.022	0.687***	-0.180***	0.188***	0.438***	1		
LIQUID	-0.376***	-0.074**	0.031	0.073**	-0.668***	0.024	-0.321***	0.056*	1	
TANGIBLE	0.242***	0.073**	0.096***	-0.075**	0.198***	-0.128***	0.092***	0.007	-0.213***	1

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively.

5.3.3 Preliminary Analysis

5.3.3.1 Variance Inflation Factor Analysis

To validate the integrity of the model, a multicollinearity test was performed using the VIF and tolerance (1/VIF) for the variables.

The assessment of multicollinearity in this section also follows the thresholds established earlier. As shown in Table 5.9, all calculated VIF values ranged from 1.07 to 2.18, well below the critical threshold of 10. Similarly, the corresponding inverse VIF values fell within the range of 0.459 to 0.938, indicating acceptable levels of variable independence.

These diagnostic results confirm the validity of the model assessing the relationship between corporate environmental disclosure and the cost of debt. The selected variables exhibit sound statistical properties, providing a reliable basis for the subsequent regression analysis.

Table 5.9 Variance Inflation Factor (Cost of Debt)

Variable	VIF	1/VIF
ROE	2.18	0.459
CF	2.02	0.495
LEV	1.99	0.504
LIQUID	1.96	0.509
ATO	1.62	0.618
GROWTH	1.13	0.885
TANGIBLE	1.1	0.911
CG	1.07	0.937
ED	1.07	0.938
Mean VIF	1.57	

5.3.3.2 Analysis of Panel Model Estimation Methods

To determine the most appropriate model for processing and analysing the panel data used in this section (Section 5.3), the F-test, Breusch-Pagan test, and Hausman test must be conducted. Table 5.10 provides an overview of the results obtained from the conducted tests.

In line with the earlier model selection diagnostics, the F-test, Breusch-Pagan test, and Hausman test all report p-values of 0.0000, confirming the appropriateness of the FE model. Therefore, the regression analysis related to the cost of debt is also conducted using this model specification.

Table 5.10 Panel Model Estimation Method (Cost of Debt)

Type of Test	Test Value		Options
F Test	F = 5.39	Prob > F = 0.0000	FE Model
Breusch-Pagan Test	chibar2(01) = 496.69	Prob > chibar2 = 0.0000	RE Model
Hausman Test	chi2(10) = 38.85	Prob > chi2 = 0.0000	FE Model

5.3.3.3 Heteroskedasticity Analysis

Based on the results of panel model estimation methods analysis, the FE model is used in this study. In addition, because of the characteristics of unbalanced panel data, this study employs the modified Wald test to detect heteroskedasticity (Baum, 2024). The results indicate that for Model 5.2, $\chi^2(313) = 9977.64$, with $\text{Prob} > \chi^2 = 0.0000$, while for Model 5.4, $\chi^2(313) = 11922.34$, with $\text{Prob} > \chi^2 = 0.0000$. Both results reject the null hypothesis,

indicating the presence of heteroskedasticity.

Therefore, to address the heteroskedasticity issue, heteroskedasticity-robust standard errors are employed in this section (Katmon et al., 2019) to obtain more reliable regression results.

5.3.4 Regression Analysis

Therefore, in Table 5.11, the regression results for Model 5.2 and Model 5.4 are presented. Specifically, Panel I examines the impact of corporate environmental disclosure on the cost of debt, while Panel II further examines this relationship by incorporating corporate governance as a moderating variable. To mitigate the effects of multicollinearity and scale differences, this study mean-centred the variables when constructing interaction terms between explanatory and moderating variables. In addition, to account for individual differences between companies, all regressions controlled for individual fixed effects.

(1) Corporate environmental disclosure negatively impacts the cost of debt

From the regression results in Panel I, the estimated coefficient of the explanatory variable, corporate environmental disclosure, is -0.00863, which is significantly and negatively correlated with the cost of debt at the 1% significance level. The regression results indicate that corporate environmental disclosure is negatively associated with the cost of debt, as the coefficient is

statistically significant and negative. Therefore, hypothesis H7 is supported. This finding is consistent with prior studies such as Guan and Xiao (2019), Liu and Bian (2020), Fonseka et al. (2020), Zhao and He (2021), Q. Li et al. (2022), Wang and Zhao (2022), Febrinalda and Hasnawati (2022), Morrone et al. (2022), and Tarulli et al. (2023).

Although the present study identifies a statistically significant negative relationship, previous literature has reported mixed results. For instance, Yao and Pan (2018) argued that corporate environmental disclosure might increase the cost of debt by signalling potential environmental risks to creditors. Other studies (e.g., Gao et al., 2018; Du et al., 2022; W. C. Li et al., 2022) found no significant association between disclosure and debt costs. These inconsistencies may stem from differences in industry contexts, time periods, and methods for measuring disclosure.

This study focuses on the period from 2018 to 2022 and specifically examines pharmaceutical firms listed in China. As previously discussed, with the implementation of mandatory disclosure requirements, corporate environmental disclosure is unlikely to increase creditors' risk perceptions. In parallel, recent regulatory initiatives have elevated the role of environmental factors in financial decision-making. Recent policy developments have further reinforced the role of environmental considerations in financial decision-making, signalling a broader trend towards green finance in China (Securities Times,

2025). Consequently, environmental factors are becoming integral to debt risk assessments. Furthermore, this study adopts a content analysis approach and integrates authoritative database indicators to evaluate corporate environmental disclosure. Unlike studies that primarily assess disclosure volume, this research emphasises disclosure quality, adding granularity to existing knowledge on the association between corporate environmental disclosure and the cost of debt. This approach enhances the ability to capture the substantive economic effects of environmental disclosure.

Therefore, this study provides empirical evidence that enhanced corporate environmental disclosure contributes to a reduction in the cost of debt because, first, as firms operating in a heavily polluting industry, pharmaceutical listed companies in China are subject to stringent environmental compliance regulations. Environmental compliance affects production costs, social acceptance and government policy support. Consequently, banks and creditors perceive enhanced corporate environmental disclosure as an indicator of a firm's long-term sustainable operational capability. In this context, companies that proactively disclose more environmental-related information can signal positive prospects to the market and creditors, thereby shaping a favourable corporate image (Xu & Liang, 2024), and ultimately securing lower cost of debt. Second, enhanced corporate environmental disclosure reflects a firm's compliance and transparency in environmental management, reducing risks associated with

environmental violations, such as fines, litigation, or operational disruptions. Creditors can more accurately assess a firm's environmental compliance and operational stability, leading to a lower credit risk premium and default risk premium, thereby decreasing debt financing costs. Finally, with the support of the Chinese government, financial institutions are required to improve green financial management systems by incorporating environmental requirements into comprehensive risk management frameworks and providing policy incentives (e.g., low-interest loans) to green compliant firms (Securities Times, 2025). Therefore, Chinese pharmaceutical listed companies with comprehensive corporate environmental disclosure are more likely to meet green finance requirements and benefit from the lower cost of debt.

(2) Corporate governance positively moderates the relationship between corporate environmental disclosure and the cost of debt

Turning to the regression results in Panel II, the estimated coefficient of corporate environmental disclosure is -0.00717, which is significantly and negatively correlated with the cost of debt at the 1% significance level. In addition, a coefficient of -0.00724 is observed for the interaction between this disclosure and corporate governance, indicating a moderating effect of corporate governance on the relationship between environmental disclosure and the cost of debt at the 1% significance level. This suggests that the association between corporate environmental disclosure and the cost of debt is strengthened in the

presence of effective corporate governance. Therefore, hypothesis H8b is supported. This finding is also consistent with Shan (2018).

This is because corporate governance can effectively mitigate and control principal-agent conflicts and information asymmetry. Effective corporate governance helps balance stakeholders' interests (Dang & Lu, 2012), preventing certain internal stakeholders from manipulating the timeliness and accuracy of disclosed information for short-term gains. As a result, effective corporate governance enhances creditors' recognition of the authenticity and transparency of corporate environmental disclosures, thereby reducing the risk premium and ultimately lowering financing costs. Additionally, effective corporate governance strengthens the internal supervisory role of the dual board system (Liu & Liu, 2001), discouraging managerial short-termism and encouraging the implementation of long-term environmental strategies. This long-term operational perspective further signals corporate stability to creditors, making them more willing to offer a reduction in the cost of debt.

Among the control variables, both financial leverage and tangible asset ratio are significantly positively correlated with the cost of debt. Specifically, in Panel I and Panel II, financial leverage exhibits a statistically significant positive effect on the cost of debt at the 1% level, indicating that higher financial leverage leads to increased cost of debt. Similarly, the tangible asset ratio is significantly and positively correlated with the cost of debt in Panel I and Panel II at the 5%

significance level. Higher levels of tangible assets are found to correspond with an increase in the cost of debt. Conversely, firm profitability and total asset turnover are significantly and negatively correlated with the cost of debt. Firm profitability is negatively correlated with the cost of debt in Panel I and Panel II at the 10% significance level. Similarly, total asset turnover is negatively correlated with the cost of debt in Panel I and II at the 5% significance level. Then, the revenue growth rate is negatively correlated with the cost of debt at the 10% significance level in Panel II. However, in Panel I, this relationship is not significant. This suggests that the impact of the revenue growth rate on the cost of debt is not robust. Finally, cash flow ratio and liquid ratio are both positively correlated with the cost of debt, although these correlations are not statistically significant in the regression results.

Table 5.11 Fixed Effect Regression Results (Cost of Debt)

	Panel I	Panel II
ED	-0.00863*** (-3.52)	-0.00717*** (-2.96)
ED*CG		-0.00724*** (-2.61)
CG		-0.00158 (-1.25)
ROE	-0.00753* (-1.84)	-0.00740* (-1.84)
LEV	0.0284*** (5.10)	0.0281*** (5.19)
GROWTH	-0.000912 (-1.64)	-0.000946* (-1.72)
ATO	-0.00436** (-2.18)	-0.00447** (-2.25)
CF	0.00539 (0.91)	0.00612 (1.04)

LIQUID	0.000176 (1.25)	0.000164 (1.17)
TANGIBLE	0.00266** (2.16)	0.00280** (2.35)
_cons	0.00940*** (4.44)	0.00919*** (4.37)
<i>N</i>	1141	1141
<i>R</i> ²	0.136	0.144
adj. <i>R</i> ²	0.130	0.136
F	8.513	7.654

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are t-values.

5.3.5 Robustness Test: GMM Estimation

Considering that debt financing may exhibit dynamic persistence, the cost of debt in the current period is, to some extent, impacted by the cost of debt in the previous period (Yin, 2022). As discussed earlier, endogeneity issues may arise from omitted variable bias, wherein the prior period's cost of debt impacts the subsequent period's cost. Therefore, following the studies of Wang (2019) and Yin (2022), this study incorporates the lagged dependent variable into the original model's explanatory variables to construct a dynamic panel, thereby addressing endogeneity concerns.

This study employed the two-step system GMM estimation for dynamic panel analysis to obtain robust estimation results (Huang et al., 2023). According to the results in Table 5.12, under the two-step system GMM estimation, as shown in Panel I and Panel II, the p-values for AR(1) are 0.003 and 0.000, respectively, indicating significant first-order serial correlation. In contrast, the

AR(2) p-values of 0.228 and 0.202 exceed 0.05, confirming the absence of second-order autocorrelation. Therefore, the AR(1) test rejects the null hypothesis, indicating first-order autocorrelation, while the AR(2) test fails to reject the null hypothesis, suggesting no second-order autocorrelation. Additionally, the regression results for Panel I and Panel II show that the P-values of the Hansen test are 0.120 and 0.350, respectively, both greater than 0.1. Consequently, there is insufficient evidence to reject the null hypothesis, indicating that instrumental variables are jointly valid, and that there is no evidence of instrument over-identification. Therefore, using the dynamic panel system GMM estimation to overcome endogeneity issues in regression settings is appropriate for this study.

In Table 5.12, Panel I displays the regression results with corporate environmental disclosure and the cost of debt. In addition, Panel II presents the regression results with corporate environmental disclosure as the explanatory variable, the cost of debt as the dependent variable, and corporate governance as the moderating variable. To control for multicollinearity and dimensional differences, the variables were mean-centred when constructing interaction terms between the explanatory and moderating variables.

From the regression results in Panel I, it can be observed that the estimated coefficient of corporate environmental disclosure is -0.0395, significantly and negatively correlated with the cost of debt at the 1%

significance level. This implies that an enhanced corporate environmental disclosure leads to a reduction in the cost of debt.

From the regression results in Panel II, the coefficient for corporate environmental disclosure is -0.0386, showing a negative association with the cost of debt at the 1% level. Furthermore, the interaction term between the disclosure and corporate governance yields a coefficient of -0.0354, which is also statistically significant and negatively linked to the cost of debt at the 1% threshold. This shows corporate governance acts as a positive moderating variable in the relationship between corporate environmental disclosure and the cost of debt.

Therefore, according to the results in Table 5.12, there are no substantial changes in the coefficients' signs or significance levels of the explanatory and moderating variables. This suggests that the research findings regarding the impact of corporate environmental disclosure on the cost of debt, as well as the moderating role of corporate governance in this relationship, are robust.

Table 5.12 Results of Two-Step System GMM Estimations (Cost of Debt)

	Panel I	Panel II
L.COD	-0.351*** (0.001)	-0.327*** (0.000)
ED	-0.0395*** (0.000)	-0.0386*** (0.000)
ED*CG		-0.0354*** (0.009)
CG		0.00222

		(0.103)
ROE	0.00846	0.019
	(0.4640)	(0.180)
LEV	0.0664***	0.0729***
	(0.001)	(0.000)
GROWTH	-0.00208**	0.00115
	(0.036)	(0.349)
ATO	-0.00649	-0.0229**
	(0.506)	(0.011)
CF	-0.0115	-0.00214
	(0.414)	(0.870)
LIQUID	-0.0000351	-0.000163
	(0.963)	(0.729)
TANGIBLE	-0.000288	-0.000933
	(0.946)	(0.769)
_cons	0.0151	0.0206***
	(0.199)	(0.008)
<i>AR(1)</i>	-2.96	-3.56
	(0.003)	(0.000)
<i>AR(2)</i>	-1.21	-1.28
	(0.228)	(0.202)
<i>Hansen</i>	34.64	39.71
	(0.120)	(0.350)

***, **, and * represent null rejection at 1%, 5%, and 10% levels of significance, respectively. Figures in brackets are p-values.

5.4 Chapter Conclusion

This chapter examines the empirical impact of corporate environmental disclosure on the costs of equity and debt of Chinese pharmaceutical listed companies from 2018 to 2022. It also examines the moderating effect of corporate governance on the relationship between corporate environmental disclosure and financing costs, including both equity and debt.

On the one hand, Table 5.5 presents the empirical results of the main

regression tests on the impact of corporate environmental disclosure on the cost of equity and the moderating effect of corporate governance. At the same time, Table 5.6 outlines the empirical outcomes of robustness tests considering endogeneity. Ultimately, the following conclusions are jointly drawn: enhanced corporate environmental disclosure leads to a reduction in the cost of equity for Chinese pharmaceutical listed companies, and corporate governance strengthens this relationship as a positive moderating factor.

On the other hand, Table 5.11 provides the empirical results of the main regression tests on the impact of corporate environmental disclosure on the cost of debt and the moderating effect of corporate governance. Simultaneously, Table 5.12 outlines the empirical results of robustness tests considering endogeneity. Ultimately, the following conclusions are jointly reached: An enhanced corporate environmental disclosure leads to a reduction in the cost of debt for Chinese pharmaceutical listed companies, and corporate governance similarly strengthens this relationship as a positive moderating factor.

Chapter Six

CONCLUSION

6.1 Overview of the Chapter

This chapter constitutes the final chapter of this study. Section 6.2 summarizes the conclusions of all empirical analyses presented in Chapters 4 and 5. Section 6.3 presents the implications of the findings from three perspectives: theoretical, policy, and managerial. Section 6.4 outlines the limitations of this study, while Section 6.5 provides directions for future research based on these limitations. Finally, Section 6.6 offers concluding reflections on the overall contributions of the study.

6.2 Summary of Key Findings

This study selected Chinese listed pharmaceutical companies from 2018 to 2022 as the research sample, focusing on two key aspects: the influencing factors of corporate environmental disclosure and the impact on financing costs.

First, based on FE models, this study examined the influence of regulatory pressure, media exposure, firm profitability, and corporate governance on corporate environmental disclosure. Additionally, it empirically tested corporate governance's moderating role in these relationships. These analyses directly address RQ1 to RQ5c and fulfil RO1 to RO5c. Table 6.1 summarizes the findings of this part, with specific conclusions as follows:

(1) Regulatory pressure

Regulatory pressure refers to governments' supervision and control of environmental issues, which is captured by counts of relevant keywords identified in provincial government work reports. The regression results indicate that pharmaceutical companies in provinces with intensified regulatory pressure exhibit enhanced corporate environmental disclosure. This finding addresses **RQ1**, confirming that regulatory pressure has a significant positive influence on corporate environmental disclosure, consistent with **RO1**.

(2) Media exposure

Media exposure represents the extent to which the media focuses on a specific firm. This study quantified media exposure using the logarithm of one plus the number of financial news reports from newspapers and online sources. The results reveal that higher media exposure is associated with unfavourable corporate environmental disclosure among Chinese listed pharmaceutical companies. However, this finding is not statistically significant. Although the result does not support the hypothesised positive relationship, it contributes to addressing **RQ2** and **RO2** by providing empirical evidence on how media exposure relates to corporate environmental disclosure practices.

(3) Firm profitability

Firm profitability reflects a firm's ability to generate profits. This study employed ROE as a proxy for firm profitability. The results show that enhanced

firm profitability significantly enhances corporate environmental disclosure for Chinese listed pharmaceutical companies. This finding addresses **RQ3**, confirming that firm profitability has a positive and significant influence on corporate environmental disclosure, consistent with **RO3**.

(4) Corporate governance

Corporate governance encompasses the mechanisms through which owners supervise and control a firm's management and performance. Using PCA, this study constructs a composite corporate governance index based on nine governance-related indicators. The empirical results demonstrate that effective corporate governance significantly enhances corporate environmental disclosure for Chinese listed pharmaceutical companies. This finding addresses **RQ4** and confirms that corporate governance plays a positive role in enhancing corporate environmental disclosure, consistent with **RO4**.

(5) The moderating role of corporate governance

The moderating role of corporate governance is evident in the positive moderation of the relationships between regulatory pressure, firm profitability, and corporate environmental disclosure. Specifically, more effective corporate governance amplifies the positive effect of regulatory pressure and firm profitability on corporate environmental disclosure. However, corporate governance does not significantly moderate the relationship between media exposure and corporate environmental disclosure, suggesting that governance

mechanisms do not intensify the adverse influence of media exposure on such disclosure for Chinese listed pharmaceutical companies. These results address **RQ5a**, **RQ5b**, and **RQ5c**. The findings confirm **RO5a** and **RO5c** by showing that corporate governance positively moderates the influences of regulatory pressure and firm profitability. However, **RO5b** is not supported, as the moderating effect of corporate governance on media exposure is not statistically significant.

Taken together, these findings help address the concern highlighted in the problem statement that corporate environmental disclosure among Chinese listed pharmaceutical companies remains uneven and subject to substantial managerial discretion, by providing empirical evidence on how regulatory pressure, firm profitability, and corporate governance are associated with variations in disclosure practices under the post-2018 regime.

Table 6.1 Summary of Regression Result for the Factors Influencing Corporate

Environmental Disclosure			
Hypotheses	Description	p-value	Remark
H1	Regulatory pressure has a positive influence on corporate environmental disclosure.	$P < 0.01$	Supported
H2	Media exposure has a positive influence on corporate environmental disclosure.	$P > 0.1$	Not supported
H3	Firm Profitability has a positive influence on corporate environmental disclosure.	$P < 0.1$	Supported
H4	Corporate governance has a positive influence on corporate environmental	$P < 0.05$	Supported

disclosure.

H5a	Corporate governance has a positive moderating effect on the influence of regulatory pressure on the corporate environmental disclosure.	$P < 0.05$	Supported
H5b	Corporate governance has a positive moderating effect on the influence of media exposure on the corporate environmental disclosure.	$P > 0.1$	Not supported
H5c	Corporate governance has a positive moderating effect on the influence of firm profitability on the corporate environmental disclosure.	$P < 0.1$	Supported

Furthermore, based on FE models, this study examines the impact of corporate environmental disclosure on financing costs from two perspectives: cost of equity and cost of debt. Additionally, it examines corporate governance's moderating role in this relationship. These analyses directly address RQ6 to RQ8b and fulfil RO6 to RO8b. Table 6.2 summarizes the findings of this part, with specific conclusions as follows:

(6) The cost of equity

The cost of equity is defined as the rate of return investors expect in exchange for assuming ownership risk, after considering operational uncertainty and earnings potential. This study employed the PEG model to estimate the cost of equity. The results indicate that corporate environmental disclosure is negatively associated with the cost of equity for Chinese listed pharmaceutical companies. This finding addresses **RQ6**, confirming that corporate

environmental disclosure is negatively associated with the cost of equity, consistent with **RO6**.

(7) The cost of debt

The cost of debt refers to the expenses a firm incurs to utilise creditors' funds. This study measured the cost of debt using the financial expense ratio. The findings suggest that corporate environmental disclosure is also negatively associated with the cost of debt for Chinese listed pharmaceutical companies. This finding addresses **RQ7**, confirming that corporate environmental disclosure is negatively associated with the cost of debt, consistent with **RO7**.

(8) The moderating role of corporate governance

The moderating role of corporate governance is evident in the relationship between corporate environmental disclosure and financing costs. Specifically, corporate governance strengthens the negative impact of corporate environmental disclosure on both the cost of equity and debt, indicating that firms with effective corporate governance experience a more pronounced reduction in financing costs due to enhanced corporate environmental disclosure for Chinese listed pharmaceutical companies. These findings address **RQ8a** and **RQ8b**, confirming that corporate governance positively moderates the relationship between corporate environmental disclosure and financing cost, consistent with **RO8a** and **RO8b**.

In this respect, the findings respond to the concern regarding the credibility of corporate environmental disclosure and its implications for financing outcomes, by showing that higher levels of disclosure are associated with lower financing costs, particularly when supported by more effective corporate governance.

Table 6.2 Summary of Regression Result for the Impact of Corporate Environmental Disclosure on Financing Costs

Hypotheses	Description	p-value	Remark
H6	Corporate environmental disclosure is negatively associated with the cost of equity.	$P < 0.01$	Supported
H7	Corporate environmental disclosure is negatively associated with the cost of debt.	$P < 0.01$	Supported
H8a	Corporate governance has a positive moderating effect on the impact of corporate environmental disclosure on cost of equity.	$P < 0.05$	Supported
H8b	Corporate governance has a positive moderating effect on the impact of corporate environmental disclosure on cost of debt.	$P < 0.01$	Supported

Finally, to ensure the robustness of the findings and account for potential endogeneity bias, this study applies a two-step system GMM estimator for dynamic panel analysis in both parts of the model. The GMM results are consistent with the primary conclusions obtained from the FE models, thereby reinforcing the reliability and robustness of the key findings.

6.3 Implications

Although this study is conducted in the context of Chinese listed pharmaceutical companies, the findings have implications that may extend beyond this specific setting. At a mechanism level, the study demonstrates that corporate environmental disclosure is jointly shaped by external institutional pressures, internal firm conditions, and corporate governance structures, and that the credibility of such disclosure plays an important role in impacting financing outcomes. These mechanisms are particularly relevant in industries characterised by heightened environmental scrutiny, evolving regulatory requirements, and significant financing needs, and may therefore also be relevant to other environmentally sensitive sectors.

6.3.1 Theoretical Implications

First, this study investigates the influencing factors of corporate environmental disclosure by integrating stakeholder theory, legitimacy theory, and agency theory, thereby offering a more integrative theoretical framework than studies relying on a single perspective. The findings suggest that these theories are complementary, yet their explanatory power varies across contexts. Specifically, the study confirms the significant role of regulatory pressure in enhancing corporate environmental disclosure, thereby reinforcing the assumptions of stakeholder theory and legitimacy theory that firms seek to meet external expectations and maintain social legitimacy. However, the negative and

insignificant influence of media exposure on corporate environmental disclosure challenges the general applicability of these theories. This suggests that stakeholder and legitimacy pressures may not be uniformly effective across all forms of media exposure. The study therefore highlights the need to account for the nature and channel of media reports, which remain underexplored in existing theory.

Moreover, this study also contributes to agency theory by empirically validating the enhancing influences of firm profitability and corporate governance on environmental disclosure practices. From a combined stakeholder-agency perspective, firms with higher profitability are more likely to allocate resources toward disclosure, as managers who have already met short-term performance targets face reduced incentive to withhold information and can more readily respond to stakeholder expectations. It further enhances agency theory by demonstrating that corporate governance not only has a direct effect on disclosure behaviour but also moderates the influence of both regulatory pressure and firm profitability. This introduces a dynamic interaction perspective into agency theory applications, emphasising that internal corporate governance structures shape how firms respond to external and financial pressures. The study thus refines agency theory by empirically modelling its conditional mechanisms within the corporate environmental disclosure context.

Second, this study combines stakeholder theory and signalling theory to

examine the financial consequences of corporate environmental disclosure, while also incorporating agency theory to analyse the moderating role of corporate governance. The finding that corporate environmental disclosure is negatively associated with financing costs supports the signalling view that firms use disclosure to mitigate information asymmetry and convey environmental responsibility to capital providers. At the same time, the alignment with stakeholder theory suggests that transparent environmental practices are increasingly valued by investors and creditors. Corporate governance is shown to strengthen this relationship, further validating its role as a mechanism for aligning managerial incentives with stakeholder interests.

In addition to these conceptual contributions, this study also enhances theoretical understanding through its methodological approach. By incorporating interaction terms into panel data regression models, this study examines how corporate governance moderates theoretical relationships in two distinct stages. It first moderates how firms respond to regulatory pressure and firm profitability in shaping disclosure behaviour. It then moderates the link between corporate environmental disclosure and financing outcomes, including both cost of equity and cost of debt. This empirical design enables a more nuanced understanding of how corporate governance functions not only as a direct influence but also as a conditional mechanism, which has been frequently proposed in theory but seldom tested in empirical research. Accordingly, this

study contributes methodologically to the application of agency theory, stakeholder theory, and signalling theory by modelling and validating their underlying mechanisms within a multi-variable framework.

6.3.2 Policy Implications

(1) Government

To enhance corporate environmental disclosure, governments at all levels in China should strengthen regulatory oversight. First, the central government should revise existing environmental disclosure-related laws and regulations to further clarify disclosure requirements for listed companies. The scope of mandatory disclosure should be expanded, and specific disclosure content should be clearly defined to enhance the comparability of environmental information across firms. Additionally, a credible corporate environmental disclosure evaluation system should be established. At the provincial level, governments should conduct thorough supervision of pharmaceutical companies' environmental practices within their jurisdictions, ensuring that firms fulfil their environmental responsibilities and proactively engage in favourable disclosures.

Second, the government can guide corporate behaviour through incentives and penalties. Pharmaceutical companies that actively disclose environmental information and maintain high disclosure quality should be recognised and provided with increased support and rewards, such as tax

incentives and preferential financing conditions, to create a virtuous cycle. Conversely, firms that engage in perfunctory disclosure or provide false environmental information should be subject to criticism and even financial penalties to regulate corporate behaviour effectively.

Finally, the government should leverage the media and other communication channels to widely publicize the economic benefits of environmental disclosure, such as reducing financing costs. Many companies fail to fully and accurately recognise the economic advantages of environmental disclosure and mistakenly perceive it as merely an additional cost burden. Consequently, they adopt a conservative approach, disclosing environmental information only to meet minimum regulatory requirements. Enhancing corporate awareness of the economic benefits associated with corporate environmental disclosure can stimulate motivation and confidence, leading firms to shift their attitudes and engage in enhanced disclosure proactively and voluntarily.

(2) Investors and Creditors

When evaluating a company's overall capabilities, particularly in the pharmaceutical industry, which is classified as heavily polluting and closely linked to public health (Liu et al., 2022), investors and creditors should incorporate corporate environmental disclosure into their investment and lending decisions.

First, investors should be encouraged to integrate corporate environmental disclosure into their decision-making models, fostering a mindset that extends beyond financial indicators to assess a firm's overall operational performance from both financial and non-financial perspectives. As more investors in the market focus on corporate environmental disclosure, firms will, in turn, be incentivized to improve their environmental reporting practices, thereby strengthening oversight over their environmental responsibility and corporate social responsibility efforts.

Second, in the context of debt financing for Chinese listed companies, creditors should adopt a long-term perspective and consider environmental responsibility as a core criterion in loan assessments. Financial institutions should incorporate corporate environmental disclosure into their risk evaluation frameworks, too. Since pharmaceutical firms belong to heavily polluting industries, corporate environmental risks influence creditors' lending risks. By analysing the disclosed environmental information of listed companies, creditors can assess firms' environmental commitments and potential environmental risks, thereby effectively managing lending risks. Ultimately, this approach reinforces creditors' supervisory role over firms, fostering a mutually beneficial dynamic where enhancements in corporate environmental disclosure lead to reductions in the cost of debt.

6.3.3 Managerial Implications

From a corporate managerial perspective, the first priority is to establish and enhance corporate governance. Effective corporate governance fosters corporate social responsibility awareness for environmentally friendly development and encourages firms to voluntarily disclose environmental information. For Chinese pharmaceutical companies, it is crucial to standardise governance structures, optimise internal environmental management, control pollution at its source, and ultimately enhance corporate environmental disclosure. Developing a comprehensive corporate governance framework and a well-structured management system is particularly critical for listed pharmaceutical companies.

(1) Companies should optimise their ownership structures, including the proportion of shares held by major shareholders, institutional investors, and management, to strike a balance that supports corporate development. (2) Expanding the size of boards of directors and supervisory boards can help firms obtain more regulatory insights, improve decision-making mechanisms, and enhance decision-making efficiency. Additionally, increasing the proportion of board members with pharmaceutical-related expertise can strengthen their ability to oversee and incentivize management. (3) Optimising executive compensation mechanisms, such as implementing incentive and penalty structures and maintaining reasonable internal pay differentials, can motivate

corporate executives to prioritize environmental responsibility and enhance corporate environmental disclosure. (4) Companies should establish dedicated environmental management departments and, where appropriate, set up a sustainability or environmental board committee to strengthen oversight of environmental strategies and disclosure practices. Given the significant pollution associated with the pharmaceutical industry (Wang, 2020), Chinese pharmaceutical companies should set up specialized departments to document and analyse environmental issues at each stage of production. This approach can improve production processes while systematically collecting environmental information. (5) Corporate environmental disclosure should undergo third-party audits. To enhance the reliability of disclosed environmental information, independent third-party audits should be conducted, similar to audit requirements for annual financial reports.

Furthermore, more pharmaceutical firms should integrate environmentally sustainable development principles into their corporate culture. This cultural shift can indirectly encourage corporate management to disclose timely and comprehensive information on energy conservation, emission reduction, green transitions, and workforce diversity. Enhanced corporate environmental disclosure helps companies convey positive signals to society, attract more investors and creditors, and gain broader public recognition. As a result, this enhances long-term corporate value and promotes sustainable

development.

6.4 Limitations of the Study

The study focuses on Chinese listed pharmaceutical companies, utilised data from 2018 to 2022 and adopted an empirical research approach to systematically examine the influencing factors of corporate environmental disclosure and its impact on financing costs. Although the study holds theoretical value and practical significance, several limitations remain:

(1) Limitations of Industry-Specific Sample Selection

As the study selects Chinese listed pharmaceutical companies as the research sample, the conclusions may not be generalisable beyond the pharmaceutical industry or to other industries. Additionally, the empirical analysis involves the deletion of observations due to missing data, further reducing the sample size and potentially affecting the reliability of the results.

(2) Limitations of Disclosure Channel Coverage

The diversity of corporate environmental disclosure channels might not have been fully captured in the database. This study employs content analysis to evaluate corporate environmental disclosure scores based on data from the CSMAR database, which sources information from corporate financial reports, government, and corporate announcements. However, with the rapid development of new media, an increasing number of companies may have

disclosed environmental information through such platforms, leading to potential data omissions.

(3) Limitations of Media Exposure Coverage and Classification

The data source for media exposure has certain limitations and does not further distinguish the nature of media exposure, which may have affected the robustness of the research conclusions. Although the media exposure data is obtained from the relatively authoritative CNRDS database, it does not include reports on Chinese enterprises from international media or social media platforms (e.g., TikTok and Xiaohongshu). Furthermore, the existing data cannot differentiate the nature of media exposure (e.g., positive, negative, or neutral) or conduct a detailed examination of how different types of media exposure influence corporate environmental disclosure.

(4) Limitations of Cost of Equity Estimation Methods

The methodology for estimating the cost of equity is constrained by data availability and model assumptions, which may affect the reliability of results. Although Chapter 3 discusses the advantages of the PEG model, its application still presents limitations. On the one hand, the PEG model relies on future earnings forecasts, but analyst forecast data for China's pharmaceutical sector are often incomplete, potentially leading to calculation biases. On the other hand, while the HVZ model (Hou, 2012) is employed to compensate for the lack of analyst forecast data, its assumptions and applicability may still have impacted

the accuracy of the cost of equity estimations.

6.5 Future Research Directions

Building on the limitations identified in this study, several directions for future research are proposed.

(1) Expanding Sample Scope and Industry Coverage

The sample size of Chinese listed pharmaceutical companies in this study was relatively small. Future research can adopt two approaches to expand the sample. First, analysing pharmaceutical companies from multiple countries to derive more generalisable conclusions applicable to the global pharmaceutical industry. Second, maintaining a focus on Chinese listed companies but expanding the scope to include companies from all heavily polluting industries or all industries to examine the generalisability of the findings. Additionally, while including unlisted pharmaceutical firms in China could have provided broader insights into the sector, future research may need to overcome current challenges related to the availability of financial and governance data before such an approach can be effectively implemented.

(2) Broadening Environmental Disclosure Data Sources

Future studies can integrate information from a broader range of new media platforms to construct a more comprehensive corporate environmental disclosure database. Additionally, comparing corporate environmental

disclosures across traditional and new media channels may help analyse differences in disclosure motivations and strategies.

(3) Enhancing Media Exposure Data Coverage and Classification

Future research should obtain more comprehensive media exposure data by incorporating a wider range of sources, including international media and social media platforms. Additionally, distinguishing the nature of media exposure is essential to examine the influence of different types of media reports on corporate environmental disclosure. Future research could explore whether positive, negative, and neutral media exposure exert different influences on corporate environmental disclosure and whether corporate governance plays a moderating role in these relationships.

(4) Improving Cost of Equity Estimation through Enhanced Forecasting Methods and Data Sources

To improve the estimation of the cost of equity, future research can leverage Artificial Intelligence models such as machine learning to optimise earnings forecasts, enhancing prediction accuracy and mitigating biases caused by missing analyst forecast data. Additionally, incorporating external data sources, such as industry reports and market surveys, can complement analyst forecasts and improve financing cost estimations, ultimately yielding more accurate insights into the cost of equity for Chinese listed pharmaceutical companies.

6.6 Final Remarks

This chapter synthesised the main findings of the study, outlined its theoretical and practical implications, acknowledged key limitations, and proposed directions for future research. Drawing on panel data from Chinese listed pharmaceutical companies between 2018 and 2022, the study successfully addressed all eight sets of research questions and achieved the corresponding research objectives. It revealed how regulatory pressure, firm profitability, and corporate governance significantly enhance corporate environmental disclosure, while corporate governance also strengthens the impact of disclosure on financing outcomes, including both the cost of equity and the cost of debt.

Importantly, while media exposure was hypothesised to influence disclosure through stakeholder and legitimacy pressures, the results showed no statistically significant effect. This finding highlights the contextual complexity of media exposure in relation to disclosure and indicates the need for further theoretical refinement and empirical exploration. Acknowledging such limitations not only reflects the contextual complexity of stakeholder responses but also offers opportunities to further develop the theoretical application of stakeholder and legitimacy perspectives in the study of corporate environmental disclosure.

Overall, the study contributes to a more integrated understanding of corporate environmental disclosure by modelling the dynamic interactions

between external institutional pressures, internal firm attributes, and governance mechanisms. It extends stakeholder theory, agency theory, legitimacy theory, and signalling theory by demonstrating how corporate governance conditions shape both disclosure behaviour and its financial implications. The research also offers policy-relevant insights for regulators, market participants, and corporate leaders in enhancing transparency, accountability, and capital market efficiency. Through this, the study meets its key theoretical and practical objectives and offers a valuable foundation for future research in this field.

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APPENDIX A:

Corporate Environmental Disclosure Regulations in China

Time	Issuing Authority	Document name	Requirements for ED
1997.07	CSRC	Content and Format of Prospectuses (Trial)	require listed companies to disclose environmental information related to their business
2003.09	State Environmental Protection Administration (SEPA)	Announcement on the Public Disclosure of Environmental Information by Enterprises	first normative document on the disclosure of environmental information by heavily polluting enterprises
2006.09	Shenzhen Stock Exchange (SZSE)	Trial Measures for Environmental Disclosure	clarify that every listed company should disclose environmental information in social reports and formulate environmental policies based on pollution status
2007.04	SEPA	Trial Measures for Environmental Disclosure	require major polluters to publish specific information on their key pollutants
2008.02	SEPA	Guiding Opinions on Strengthening Environmental Protection Supervision and Management of Listed Companies	explore establishing an environmental disclosure mechanism for listed companies, mainly divided into mandatory and voluntary disclosure.
2008.05	Shanghai Stock Exchange (SHSE)	Guiding Opinions on Strengthening Environmental Protection Supervision and Management of Listed Companies	heavily polluting listed companies should report on environmental events that have a significant impact on their share price or on the derivative products the trade
2010.09	SEPA	Guidelines for Environmental Disclosure of Listed Companies	identified 16 categories of heavily polluting industries
2014.04	Standing Committee of the National People's Congress	Environmental Protection Law of the People's Republic of China	explicitly require major polluting units to disclose detailed environmental information on pollutants to society
2015.09	CPC Central	General Plan for Ecological	clearly instruct the establishment of a

	Committee and the SC	Civilization Reform	sound system of environmental disclosure
2016.08	7 Ministries	Guiding Opinions on Building a Green Financial System	support the listing and refinancing of eligible green enterprises, and improve the mandatory environmental information disclosure system for listed companies and debt-issuing enterprises
2017.11	CSRC	Guidelines No. 2 for the Content and Format of Information Disclosure by Companies Offering Securities to the Public - Annual Reports	propose a hierarchical environmental disclosure system for listed companies and encouraged voluntary disclosure of information beneficial to ecological protection and pollution prevention
2018.09	CSRC	Guidelines for Corporate Governance of Listed Companies	establish the basic framework for ESG information disclosure for listed companies
2020.03	CPC Central Committee and the SC	Guiding Opinions on Building a Modern Environmental Governance System	clearly state the need to establish a mandatory environmental governance information disclosure system for listed companies and bond issuers, and linked corporate finance issues with environmental disclosure
2021.06	CSRC	Information Disclosure Guidelines No. 2 - Content and Format of Annual Reports for Publicly Issued Securities	add disclosure requirements for companies or their major subsidiaries
2022.01	Ministry of Ecology and Environment of China	Guidelines for the Format of Lawful Disclosure of Enterprise Environmental Information	required key emission to disclose eight types of information, including corporate environmental management information, information on pollutant generation, treatment and discharge, and carbon emissions information

APPENDIX B:

Classification of Pharmaceuticals Industry in China

According to the *Industrial Classification for National Economic Activities* (National Bureau of Statistics of China, 2017), the pharmaceutical manufacturing industry (C27) includes the following eight categories: Manufacture of chemical medicine raw materials (C271), Manufacture of chemical medicine preparations (C272), Processing of traditional Chinese medicine decoction pieces (C273), Manufacture of traditional Chinese patent medicine (C274), Manufacture of veterinary medicine (C275), Manufacture of biological products (C276), Manufacture of sanitary materials and medical supplies (C277), and Manufacture of pharmaceutical excipients and packaging materials (C278).

Category	Name	Description
C271	Manufacture of chemical raw materials	For further processing of chemical drug preparations, biological drug preparations required for the production of API activities
C272	Manufacture of chemical preparations	Directly for the prevention and treatment of human disease, the diagnosis of the manufacture of chemical pharmaceutical preparations
C273	Processing of traditional Chinese medicine decoction pieces	The collection of natural or artificial cultivation, farming of animals, plants and minerals of the herbal parts for processing, concoction, so that it is in line with the Chinese medicine prescription transfer or the production of proprietary Chinese medicine use activities
C274	Manufacture of traditional Chinese patent medicine	Processing and production activities of traditional medicine directly used for the prevention and treatment of human diseases
C275	Manufacture of veterinary medicine	For the manufacture of animal disease control medicine
C276	Manufacture of biological products	The use of biotechnology to produce biochemical drugs, genetically engineered

		drugs and vaccines for the production of preparations
C277	Manufacture of sanitary materials and medical supplies	Sanitary materials, surgical dressings and other medical products for internal and surgical manufacturing
C278	Manufacture of pharmaceutical excipients and packaging materials	Excipients and packaging materials for pharmaceuticals and other manufacturing

Source: Industrial Classification for National Economic Activities (National Bureau of Statistics of China, 2017)