THE IMPACT OF CORPORATE GOVERNANCE MECHANISMS ON ENVIRONMENTAL INFORMATION DISCLOSURE: EVIDENCE FROM CHINA

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Abstract

This thesis investigates the impact of corporate governance mechanisms—specifically board characteristics, ownership structure, and board diversity — on environmental information disclosure (EID) in Chinese firms, using a dataset of 300 firms listed on the SHSZ300 from 2009 to 2019. The findings reveal that larger boards and frequent meetings enhance EID, while independent directors play a crucial role in increasing EID; however, board gender diversity and CEO duality have no significant impact. The positive effects of board characteristics on EID are more pronounced in low-regulated industries, with the 2014 *Environmental Protection Law* strengthening these connections. Ownership structure significantly impacts EID: managerial ownership positively influences EID, while institutional and state ownership negatively affect EID due to potential short-termism and conflicts of interest. High ownership concentration leads to lower EID, as dominant shareholders may prioritize financial gains over environmental responsibilities. These effects vary by firm size and regulatory context, with the 2014 *Environmental Protection Law* enhancing the relationship between EID and ownership structures. Board diversity has complex impacts on EID: older board members and directors with international experience positively influence EID, while the impact of board tenure is mixed. Lower gender diversity is associated with higher EID, indicating cultural factors. The influence of board diversity varies by industry regulation levels, with tenure diversity having negative impacts in highly regulated industries but positive effects in less regulated ones. Academic background diversity also enhances EID. Integrating multiple theories, this thesis provides a nuanced understanding of the relationship between corporate governance and EID. The findings underscore the importance of tailored corporate governance practices to enhance environmental transparency and accountability in Chinese firms. Practical implications for policymakers, investors, and corporate leaders are discussed, emphasizing the need for regulatory frameworks and governance structures that promote sustainable business practices.

Keywords: Corporate governance, Board of directors, Ownership structure, Board diversity, Environmental information disclosure, China, SHSZ300, Fixed effect

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Table of Contents

List of Tables

List of Figures

List of Appendix

List of Abbreviations

Abbreviation	Full Term
2SLS	Two-Stage Least Squares
AFEP-MEDEF Code	Association Française des Entreprises Privées-Mouvement des Entreprises de France Code
AI	Artificial Intelligence
BoD	Board of Directors
CBRC	China Banking Regulatory Commission
CDP	Carbon Disclosure Project
CEO	Chief Executive Officer
COP	Conference of the Parties
CSMAR	China Stock Market & Accounting Research (Database)
CSR	Corporate Social Responsibility
CSRC	China Securities Regulatory Commission
CSRD	Corporate Sustainability Reporting Directive
EID	Environmental Information Disclosure
ESG	Environmental, Social, and Governance
EU ETS	EU Emissions Trading System
FE	Fixed Effects
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
IFRS	International Financial Reporting Standards
IIRC	International Integrated Reporting Council
IPCC	Intergovernmental Panel on Climate Change
IV	Instrumental Variable
ISSB	International Sustainability Standards Board
JSE	Johannesburg Stock Exchange
LM	Lagrangian Multiplier
MEP	Ministry of Environmental Protection
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
RBV	Resource-Based View
RE	Random Effects
SASAC	State-owned Assets Supervision and Administration Commission
SEBI	Securities and Exchange Board of India
SEC	Securities and Exchange Commission

SFDR	Sustainable Finance Disclosure Regulation
SHSZ300	Shanghai and Shenzhen 300 Index
SMEs	Small and Medium-sized Enterprises
SOE	State-Owned Enterprise
SOX	Sarbanes-Oxley Act
TCFD	Task Force on Climate-related Financial Disclosures
VIF	Variance Inflation Factor

Chapter 1

Introduction

1.1 Context and Background

1.1.1 Introduction

Corporate governance has emerged as a critical focus in both academic research and practical application, particularly concerning environmental information disclosure (EID) (Kolk, Levy and Pinkse, 2008; Zeng, et al., 2012). EID refers to the process by which firms disclose information regarding their environmental performance, impacts, and strategies to stakeholders, including investors, regulators, and the public (Clarkson et al., 2008; Hahn and Kühnen, 2013). Effective corporate governance mechanisms are essential in ensuring transparency, accountability, and sustainability in corporate practices (Healy and Palepu, 2001). As the global business environment becomes increasingly complex and interconnected, the role of corporate governance in promoting sustainable business practices cannot be overstated.

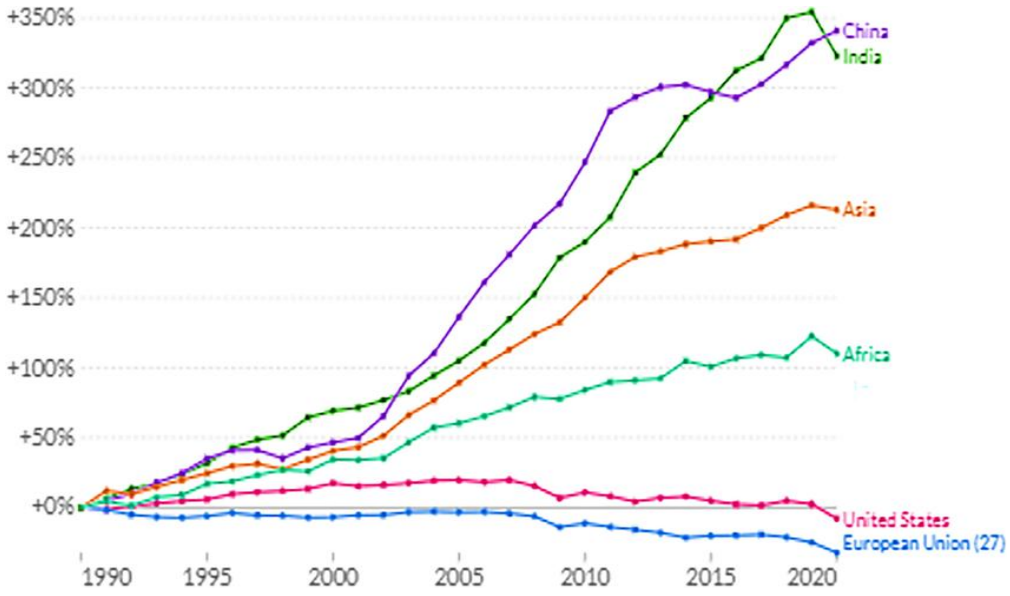
The motivation for focusing specifically on EID, rather than broader topics like environmental, social, and governance (ESG) or carbon emissions, stems from the distinct regulatory landscape and policy evolution in China. EID provides a more precise and actionable indicator of a firm's environmental performance, directly reflecting corporate responses to environmental laws and public pressures. This narrower focus allows for a more targeted investigation into how corporate governance mechanisms influence firms' disclosure practices, making it easier to assess the impact of board characteristics, ownership structures, and diversity on environmental accountability. Given the rapid regulatory developments in China — such as the 2014 *Environmental Protection Law* — EID becomes an ideal measure to evaluate the effectiveness of governance practices in enhancing environmental transparency and compliance.

The rapid industrialisation and urbanisation worldwide have led to significant environmental challenges, including air and water pollution, waste management issues, and biodiversity loss (Singh and Singh, 2017). For instance, the burning of fossil fuels has resulted in increased levels of greenhouse gases (GHG), contributing to climate change and global warming (Kumar, 2018). Figure 1 shows the trends of

global GHG emissions from 1990 to 2020. According to the Intergovernmental Panel on Climate Change (IPCC, 2018), human activities have caused approximately 1.0°C of global warming above pre-industrial levels, with severe consequences for natural and human systems. The Great Pacific Garbage Patch (see Figure 2), an immense accumulation of plastic waste, exemplifies the severe marine pollution problem, posing threats to marine life and ecosystems (Lebreton et al., 2018). Industrial discharges have polluted major rivers such as the Pearl River in China, causing detrimental effects on aquatic life and human health (Wang and Hao, 2020). The Pearl River, a critical water source in southern China, is heavily contaminated with industrial effluents, agricultural runoff, and untreated sewage. This pollution poses significant health risks to the millions of people dependent on the river for drinking water and irrigation. Efforts like the *Pearl River Water Pollution Prevention and Control Action Plan* aim to mitigate this pollution by investing in wastewater treatment and promoting sustainable practices along the river (Ma et al., 2023).

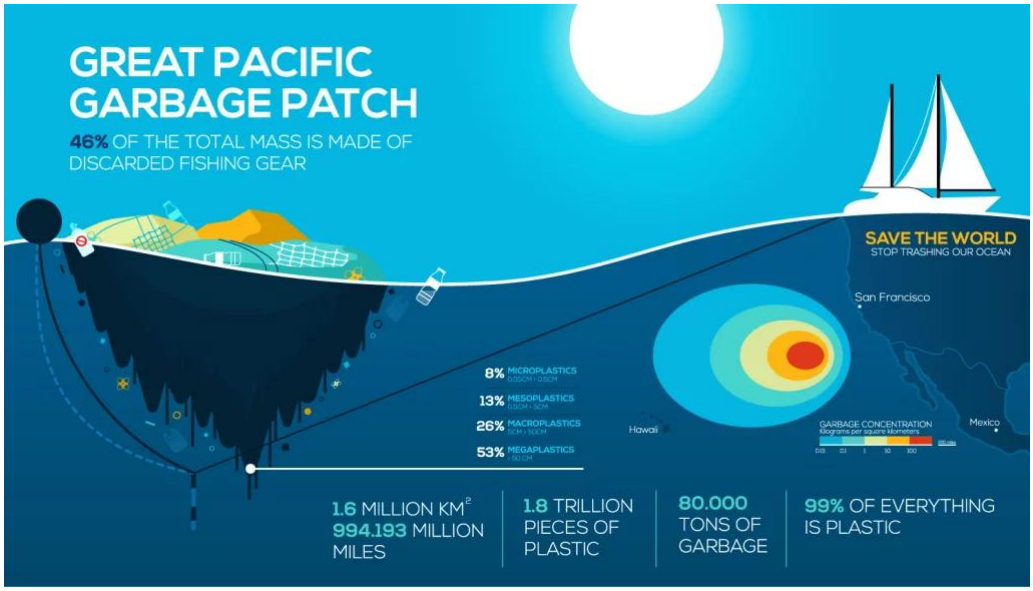
Table 1 summarizes the key environmental challenges worldwide.

Figure 1: Trends in Global Greenhouse Gas Emissions (1990-2020)



Source: Global Carbon Project

Figure 2: The Great Pacific Garbage Patch



Source: The Global Trash Solutions (2018)

Table 1: Summary of Key Environmental Challenges

Environmental Challenge	Example	Impact
Air Pollution	Industrial emissions, vehicle exhaust	Respiratory diseases, climate change
Water Pollution	Industrial discharges, agricultural runoff	Contaminated drinking water, aquatic ecosystem damage
Waste Management	Urban waste, plastic pollution	Soil contamination, marine life threats
Biodiversity Loss	Deforestation, habitat destruction	Species extinction, ecosystem imbalance

Under these circumstances, the importance of corporate governance in fostering sustainable business practices has been increasingly recognized over recent decades. Corporate governance is crucial in influencing sustainable strategy by ensuring accountability, transparency, strategic oversight, and risk management, all of which are vital for integrating sustainability into a firm's core operations and long-term goals (Eccles, Ioannou and Serafeim, 2014; Khan, Serafeim and Yoon, 2016). Effective governance structures enable firms to allocate resources responsibly, engage with stakeholders to align strategies with their expectations, and foster an ethical culture that prioritizes sustainability (Jo and Harjoto, 2012; Galbreath, 2013). Additionally, robust corporate governance frameworks help firms comply with regulations, measure

performance, and report on sustainability metrics, thereby enhancing their reputation and competitive advantage (Michelon and Parbonetti, 2012; Birindelli et al., 2015).

Environmental degradation, climate change, and resource depletion have brought environmental sustainability to the forefront of global concerns. Firms are now expected to go beyond financial performance and demonstrate their commitment to environmental stewardship (Freeman, 1984; Donaldson and Davis, 1991). This shift has been driven by regulatory pressures, stakeholder expectations, and the growing awareness of the long-term benefits of sustainable business practices (Clarkson et al., 2008). The integration of environmental considerations into corporate governance frameworks has become a strategic imperative for firms worldwide.

China's selection as the focus of this thesis is justified by its significant economic and industrial stature as the world's second-largest economy (World Bank, 2023). The country faces severe environmental challenges, including high levels of air and water pollution and substantial resource depletion, resulting from rapid industrialization (Zhang and Wen, 2008). This context emphasizes the urgent need for effective environmental management and transparency. The Chinese government has implemented an array of policies and regulations to address these environmental issues, creating a relevant backdrop for examining how corporate governance mechanisms influence EID in response to such regulatory pressures (Lo and Tang, 2006). Furthermore, the increasing pressure on Chinese firms from both domestic and international stakeholders to improve their environmental performance and transparency makes China an ideal setting for studying the dynamic interplay between governance structures and EID practices (Liu and Anbumozhi, 2009). Thus, China's economic significance, environmental challenges, regulatory landscape, and institutional context collectively make it a pertinent case for this research.

1.1.2 Global Regulatory Frameworks

In response to global environmental challenges, a range of international and national regulations has been established to enhance EID. The *Kyoto Protocol*, adopted in 1997 and enforced from 2005, is an international treaty that commits its parties to

reduce GHG emissions based on the scientific consensus that global warming is occurring and that human-made CO2 emissions are driving it (Tickell, 2009). This treaty established legally binding obligations for developed countries to reduce their GHG emissions (United Nations, 1997). The United Nations Global Compact, launched in 2000, encourages businesses worldwide to adopt sustainable and socially responsible policies and to report on their implementation. It includes principles on human rights, labor standards, the environment, and anti-corruption (United Nations Global Compact, 2000). The Carbon Disclosure Project (CDP), established in 2000, is an international non-profit organization that helps firms and cities disclose their environmental impact. It aims to make environmental reporting and risk management a business norm, driving disclosure, insight, and action towards a sustainable economy (CDP, 2000).

In 2001, the European Union introduced the EU Emissions Trading System (EU ETS), which became operational in 2005 (Parker, 2006). The EU ETS is a cornerstone of the EU's policy to combat climate change and is a key tool for reducing industrial GHG emissions cost-effectively. It operates on the 'cap and trade' principle, setting a cap on the total amount of certain GHGs that can be emitted by installations covered by the system (European Commission, 2001). The Global Reporting Initiative (GRI, 2016) offers comprehensive sustainability reporting standards that encourage organizations to disclose their environmental impacts. These standards cover a wide array of environmental indicators such as emissions, effluents, and waste management, fostering transparency and comparability in environmental performance. The Task Force on Climate-related Financial Disclosures (TCFD, 2017) provides guidelines aimed at improving the disclosure of climate-related financial risks, focusing on governance, strategy, risk management, and metrics related to climate change. The European Union's Sustainable Finance Disclosure Regulation (SFDR), effective from March 2021, requires financial market participants to disclose how they incorporate ESG factors into their investment decisions (European Commission, 2021). This regulation aims to enhance transparency and accountability in the financial sector regarding sustainability considerations.

Additionally, the *Corporate Sustainability Reporting Directive* (CSRD), which is set to come into effect in 2024, represents a significant expansion of the EU's *Non-Financial Reporting Directive*. The CSRD mandates that large and listed firms, as well as small and medium-sized enterprises (SMEs) in certain sectors, disclose detailed sustainability information, including their environmental impact, social issues, and governance practices (European Commission, 2022). The directive stipulates that firms must provide information on how their activities affect and are affected by various ESG factors, offering a clearer picture of their sustainability performance and risk exposure. It aims to improve the consistency, comparability, and reliability of sustainability reporting across the EU, ensuring that firms provide relevant and comparable ESG information to investors and other stakeholders.

In the United States, the Securities and Exchange Commission (SEC) proposed new rules in March 2022 to standardize and enhance climate-related disclosures (SEC, 2022). These proposed rules mandate that registrants disclose information about their governance of climate-related risks, the impacts of these risks on their strategy and business model, and their GHG emissions. Additionally, the International Sustainability Standards Board (ISSB), established by the International Financial Reporting Standards (IFRS) Foundation, represents a significant step forward in the realm of voluntary sustainability disclosure. The ISSB's mandate is to create a global baseline of sustainability disclosure standards that provide investors and other stakeholders with relevant, comparable, and reliable information on ESG issues (IFRS Foundation, 2021). This global baseline aims to enhance the consistency and comparability of sustainability reports across different jurisdictions, addressing the current fragmented landscape of sustainability reporting. The 28th United Nations Climate Change Conference of the Parties (COP28), held in Dubai in November-December 2023, highlighted the need for stronger climate action and enhanced corporate environmental transparency. The conference resulted in new guidelines for corporate reporting on climate-related risks and underscored the importance of comprehensive environmental disclosures to achieve global climate

objectives (United Nations Climate Change, 2023). Table 2 provides some key international environmental reporting frameworks.

Table 2: Key International Environmental Reporting Frameworks

Framework	Description	Key Focus Areas	Implementation Date
Kyoto Protocol	International treaty to reduce GHG emissions	GHG emissions reduction	1997 (enforced from 2005)
UN Global Compact	Encourages adoption of sustainable policies	Human rights, labor, environment, anti-corruption	2000
CDP	Helps firms disclose environmental impact	Environmental impact disclosure	2000
EU ETS	'Cap and trade' system for GHG emissions	GHG emissions cap and trade	2005
GRI	Sustainability reporting standards	Emissions, effluents, waste management	2016
TCFD	Climate-related financial risk disclosure	Governance, strategy, risk management	2017
SFDR	ESG disclosure in finance	Integration of ESG factors	2021
ISSB	Global baseline for sustainability disclosure standards	Climate-related and broader ESG issues	2022
CSRD	Mandatory sustainability reporting	Environmental impact, social issues, governance	2024 (effective date)

1.1.3 China's Environmental Regulations and EID

In China, the government has taken several significant steps to promote EID. The 2014 *Environmental Protection Law* mandates stricter penalties for polluters and requires more comprehensive environmental reporting (National People's Congress, 2014). This law represents a significant shift towards more rigorous environmental governance, emphasizing the importance of transparency and accountability. The introduction of the *Green Bond Endorsed Project Catalogue* by the People's Bank of China in 2015 has set clear criteria for green projects, ensuring that funds raised through green bonds are allocated to environmentally beneficial projects (People's Bank of China, 2015). This initiative has further reinforced the importance of EID in

the financial sector, encouraging greater transparency and accountability. The *Green Finance Guidelines*, introduced by the People's Bank of China in 2017, urge financial institutions to disclose the environmental impacts of their investments and loans (People's Bank of China, 2017). These guidelines aim to align financial flows with environmental sustainability goals, promoting the integration of environmental considerations into financial decision-making.

Additionally, the Ministry of Ecology and Environment's 2018 guidelines emphasize mandatory environmental disclosure for heavily polluting industries, reflecting the government's commitment to enhancing environmental transparency (Ministry of Ecology and Environment, 2018). In 2021, the Chinese government introduced the *Corporate Environmental Responsibility Reporting Guidelines*, which require listed firms and bond issuers to disclose environmental information. This move aims to enhance the quality and comparability of environmental disclosures across different sectors (Ministry of Ecology and Environment, 2021). In 2022, the State-owned Assets Supervision and Administration Commission (SASAC) of the State Council issued the *Guidelines for Environmental Information Disclosure by Central Enterprises*, mandating state-owned enterprises to publish detailed environmental reports annually (SASAC, 2022). These guidelines are designed to improve the environmental performance and transparency of some of the largest and most influential firms in China. Furthermore, the 2023 revision of the *Environmental Information Disclosure Law* mandates more stringent reporting requirements for a broader range of enterprises, with a particular focus on real-time disclosure of pollutant discharge data (National People's Congress, 2023). This law aims to ensure that both the government and the public have access to up-to-date and accurate environmental information, enhancing accountability and enforcement.

Table 3 provides the key environmental regulations in China.

Table 3: Key Environmental Regulations in China

Regulation	Description	Key Focus Areas	Implementation Date
Environmental Protection Law	Stricter penalties for polluters, comprehensive reporting	Transparency, accountability	2014
Green Bond Endorsed Project Catalogue	Criteria for green projects	Green bonds, financial sector transparency	2015
Green Finance Guidelines	Disclosure of environmental impacts by financial institutions	Investment, loans, sustainability	2017
Ministry of Ecology and Environment Guidelines	Mandatory disclosure for heavily polluting industries	Industry-specific transparency	2018
Corporate Environmental Responsibility Reporting Guidelines	Environmental information disclosure for listed firms	Quality and comparability of disclosures	2021
SASAC Guidelines for Central Enterprises	Detailed environmental reports by state-owned enterprises	Annual reporting, state-owned enterprises	2022
Environmental Information Disclosure Law (Revision)	Real-time disclosure of pollutant discharge data	Real-time data, broader enterprise coverage	2023

In the context of EID in China, it's essential to understand the dynamics between mandatory and voluntary reporting. While regulations such as the *Environmental Protection Law* mandate certain disclosures for listed firms, the landscape of EID in China also includes voluntary reporting mechanisms. Many Chinese firms voluntarily disclose environmental information as part of their corporate social responsibility (CSR) initiatives or in response to stakeholder pressures and expectations for transparency (Zeng et al., 2012). However, the level of voluntary disclosure varies across firms, with some leading firms embracing comprehensive reporting practices while others provide minimal information. This discrepancy underscores the need for more standardized and consistent reporting practices to ensure the comparability and reliability of EID among Chinese firms. Moreover, the government's emphasis on green finance and sustainable development is likely to drive further regulatory

reforms and encourage firms to enhance their environmental reporting practices to align with broader national objectives. Therefore, while EID in China encompasses both mandatory and voluntary aspects, there is growing momentum towards greater transparency and accountability in environmental disclosures, driven by regulatory requirements, stakeholder expectations, and broader sustainability imperatives.

1.1.4 Overview of corporate governance mechanisms

Corporate governance mechanisms play a crucial role in shaping a firm's EID practices. Effective corporate governance can lead to more transparent and accountable environmental reporting, thus enhancing the firm's reputation and stakeholder trust (Kolk, 2008). The Chinese corporate governance landscape is unique, characterized by the significant presence of state-owned enterprises (SOEs) and a regulatory framework that blends market mechanisms with government oversight. This hybrid system presents both opportunities and challenges for enhancing EID. On one hand, state ownership can facilitate the alignment of corporate strategies with national environmental goals. On the other hand, it can also lead to inefficiencies and conflicts of interest that undermine the effectiveness of corporate governance (Wang, Guthrie and Xiao, 2012). Understanding the dynamics of corporate governance in China requires a nuanced approach that considers these complexities. This study aims to explore the impact of corporate governance mechanisms on EID in Chinese firms. It focuses on three key aspects of corporate governance: board characteristics, ownership structure, and board diversity. Each of these aspects plays a critical role in shaping corporate strategies and practices related to environmental disclosure. By examining these factors, this study seeks to provide insights into how corporate governance can enhance transparency and accountability in environmental performance.

Board characteristics, including board size (Adams and Ferreira, 2009), independence (Bhagat and Bolton, 2008), diversity (Carter et al., 2003), meeting frequency (Vafeas, 1999), and chief executive officer (CEO) duality (Jensen, 1993), are fundamental to effective corporate governance. Boards of directors are responsible

for overseeing management and ensuring that the firm adheres to good governance practices. The composition and structure of the board can significantly influence its ability to provide effective oversight and promote transparency. Gender diversity, for instance, can be associated with better governance outcomes and more comprehensive EID (Bear, Rahman and Post, 2010). Larger boards may bring a wider range of expertise and perspectives, while independent directors can be better positioned to provide unbiased oversight (Adams and Ferreira, 2009). Frequent board meetings can enhance the board's ability to monitor management and address environmental issues proactively (Vafeas, 1999). CEO duality, where the CEO also serves as the board chair, may impair the board's independence and effectiveness in governance (Jensen, 1993). This study will examine how these board characteristics, including board size, independence, gender diversity, meeting frequency, and CEO duality, impact EID in the context of Chinese firms.

Ownership structure is another critical aspect of corporate governance that affects EID. In China, ownership structures vary widely, including SOEs, private firms, and foreign-invested firms, each presenting distinct governance challenges and opportunities. State ownership, for instance, can lead to greater alignment with government policies on environmental protection but may also result in less efficient governance practices (Musacchio and Lazzarini, 2014). Ownership concentration, which refers to the extent to which shares are held by large shareholders, can enhance monitoring and lead to better EID practices, but may also result in conflicts of interest (Claessens and Yurtoglu, 2013). Managerial ownership, where executives hold significant shares, can align management's interests with those of shareholders, potentially improving EID through better stewardship (Jensen and Meckling, 1976). Lastly, institutional ownership, involving shares held by financial institutions, can pressure firms to adopt higher standards of transparency and accountability (Bushee, 1998). This study will analyze how different ownership structures, including ownership concentration, managerial ownership, institutional ownership, and state ownership, influence EID practices in Chinese firms.

Board diversity, encompassing aspects such as age, tenure, gender diversity, and overseas background diversity, has gained increasing attention in corporate governance research. Diverse boards bring a range of perspectives and experiences that can enhance decision-making and oversight (Giang and Hien, 2024). Gender diversity, in particular, has been linked to better governance outcomes and more comprehensive EID (Galbreath, 2011). Additionally, board age and tenure contribute to a balance between fresh perspectives and experienced oversight, potentially impacting EID practices (Vafeas, 2003). Overseas background diversity introduces global standards and practices, further enriching the board's approach to environmental disclosure. In the context of China, where traditional gender roles and increased international exposure have historically influenced corporate practices (Liao, Luo and Tang, 2015; Liu, Wei and Xie, 2014; Gul, Srinidhi and Ng, 2011), understanding the impact of various elements of board diversity on EID is particularly relevant. This study will explore how board age, tenure, gender diversity, and overseas background diversity affect environmental disclosure practices in Chinese firms.

In summary, this study aims to provide a comprehensive analysis of the impact of corporate governance mechanisms on EID in Chinese firms. By examining board characteristics, ownership structure, and board diversity, it seeks to contribute to the understanding of how corporate governance can enhance transparency and accountability in environmental performance. The findings of this study will have significant implications for policymakers, practitioners, and scholars interested in promoting sustainable business practices in China and beyond.

1.2 Research Objectives and Questions

The primary objective of this thesis is to investigate the impact of corporate governance mechanisms on EID in Chinese firms, with particular emphasis on the role of environmental protection laws. Understanding this relationship is crucial for

improving corporate transparency and accountability, particularly in the context of China's significant environmental challenges. The study focuses on three key aspects of corporate governance: board characteristics, ownership structure, and board diversity. Additionally, it examines how environmental protection laws moderate the influence of these governance mechanisms on EID.

1.2.1 Research objectives

1) To examine how board characteristics influence EID in Chinese firms.

This objective aims to investigate specific board characteristics such as board size, board meetings, board independence, board gender diversity and CEO duality. These factors are considered crucial in determining the board's ability to oversee and ensure comprehensive EID practices.

2) To analyze the role of ownership structure in shaping EID practices in Chinese firms.

This objective focuses on the impact of different types of ownership, including ownership concentration, managerial ownership, institutional ownership, state ownership. The study seeks to understand how these ownership structures influence the extent of environmental disclosures.

3) To explore the impact of board diversity on EID in Chinese firms.

This objective examines the influence of various dimensions of board diversity (age, tenure, gender, and overseas background). The study aims to determine how diverse boards contribute to better environmental disclosure practices.

4) To assess the moderating role of environmental protection laws in the relationship between corporate governance mechanisms and EID.

This objective investigates whether the presence of environmental regulations, such as the *Environmental Protection Law*, strengthens or weakens the impact of governance mechanisms on firms' disclosure practices. It seeks to determine whether firms with stronger governance structures respond more proactively to legal pressures.

1.2.2 Research questions

Based on the research objectives, the following research questions are formulated to guide the study:

1) **How do board characteristics affect the level of EID in Chinese firms?**

This question seeks to uncover the relationship between different board characteristics (board size, meetings, independence, gender, and CEO duality) and the effectiveness of EID. It aims to determine whether specific board attributes enhance the board's capacity to oversee and promote comprehensive environmental disclosures.

2) **What is the relationship between ownership structure and EID in Chinese firms?**

This question explores how different ownership structures (ownership concentration, managerial ownership, institutional ownership, and state ownership) impact EID practices. It aims to identify whether certain ownership types are more conducive to high-level of environmental disclosures and transparency.

3) **How does board diversity influence EID in Chinese firms?**

This question examines the impact of board diversity (age, tenure, gender, and overseas background) on EID. It seeks to determine whether diverse boards, which bring a variety of perspectives and experiences, are more effective in promoting robust environmental disclosure practices.

4) **How do environmental protection laws influence the relationship between corporate governance and EID?**

This question examines whether the presence of environmental regulations, such as the *Environmental Protection Law*, strengthens or weakens the impact of governance mechanisms on firms' disclosure practices. It seeks to determine whether firms with stronger governance structures respond more proactively to legal pressures.

1.2.3 Hypotheses development

To address these research questions, the study formulates several hypotheses that will be tested through empirical analysis:

Board Characteristics and EID:

H1a: Larger board size is positively associated with higher levels of EID.

H1b: The frequency of board meetings is positively associated with higher levels of EID.

H1c: Board independence is positively associated with higher levels of EID.

H1d: CEO duality is negatively associated with higher levels of EID.

H1e: More women on board is positively associated with higher levels of EID.

Ownership Structure and EID:

H2a: Ownership concentration is negatively associated with the extent of EID.

H2b: Institutional ownership is negatively associated with the extent of EID.

H2c: Managerial ownership is positively associated with the extent of EID.

H2d: State ownership is negatively associated with the extent of EID.

Board Diversity and EID:

H3a: Board members' age is positively associated with higher levels of EID.

H3b: Board tenure is positively associated with higher levels of EID.

H3c: Gender diversity is negatively associated with higher levels of EID.

H3d: Greater diversity of board members' overseas background is positively associated with higher levels of EID.

By addressing these hypotheses, the study aims to provide a comprehensive understanding of the factors that influence EID practices in Chinese firms and offer insights into how corporate governance can be improved to promote greater transparency and accountability.

1.3 Significance of the Study

The culmination of three distinct yet interconnected empirical studies into a single thesis represents a comprehensive exploration of the intricate relationship between EID and corporate governance mechanisms in China. The significance of this thesis can be understood through several key aspects.

Firstly, this thesis addresses critical gaps in the existing literature on EID, particularly within the Chinese context. Previous research has predominantly

concentrated on Western countries or specific industries, leaving a notable gap in the understanding of EID practices in China. By extending the scope of investigation to encompass all industries in China, this study provides a more comprehensive and nuanced understanding of EID practices in one of the world's largest and most dynamic economies. The research thus enriches the body of knowledge in this field by offering insights into EID across a broad spectrum of industries in China, an area that has been relatively under-explored. This broader perspective contributes to a more detailed and contextually relevant understanding of EID practices, bridging gaps identified in prior studies (Li et al., 2013; Husted and de Sousa-Filho, 2019; Shaheen, Ullah and Sarwar, 2021).

Secondly, this thesis has important practical implications for policymakers, investors, and corporate leaders. The empirical evidence provided highlights critical factors influencing EID in China, offering a foundation for policymakers to develop more effective regulatory frameworks. These frameworks can enhance transparency and accountability in corporate environmental reporting, aligning with broader goals of environmental stewardship and public trust. For investors, the study's insights into the impact of corporate governance mechanisms on EID enable more informed decision-making. Investors can use this knowledge to assess the environmental performance and disclosure practices of potential investment opportunities, thereby aligning their portfolios with sustainability objectives and mitigating associated environmental risks. Corporate leaders can leverage the research findings to implement improved governance practices that emphasize environmental sustainability. By adopting these practices, organizations can enhance their EID, which in turn strengthens their reputation and supports long-term viability.

1.4 Research Contribution

This thesis contributes to the existing body of knowledge in multiple ways. Firstly, it integrates multiple theoretical perspectives, including agency theory, resource-based

view (RBV) theory, voluntary disclosure theory, legitimacy theory, upper echelon theory, and social identity theory. This multi-theoretical approach provides a comprehensive understanding of the complex interplay between corporate governance mechanisms and EID practices. By integrating these diverse theories, the research not only enhances the explanatory power of the study but also offers innovative insights into how various theoretical frameworks can collectively inform the analysis of EID. This approach addresses the intricate dynamics of corporate governance and environmental disclosure, offering a richer and more nuanced perspective than single-theory analyses. Additionally, the framework developed in this research sets a foundation for future studies, encouraging exploration of similar phenomena in different contexts.

Secondly, this thesis significantly advances academic discourse by deepening our understanding of the relationship between corporate governance mechanisms and EID, especially within the context of China's rapidly evolving economy. By synthesizing the findings from three distinct empirical studies into a unified narrative, this research consolidates existing knowledge and provides a comprehensive perspective on EID practices. The integration of these studies not only strengthens the theoretical and empirical framework of the research but also highlights new directions for future inquiry. This cohesive narrative offers a foundation for further scholarship, encouraging exploration of related topics and contributing to the broader academic conversation on corporate governance and environmental disclosure in dynamic and diverse economic contexts.

1.5 Structure of the Thesis

The remainder of this thesis is structured as follows:

Chapter 2: Literature Review - This chapter reviews the existing literature on corporate governance and EID, focusing on the theoretical frameworks and empirical findings related to board characteristics, ownership structure, and board diversity. It

synthesises key studies, identifies gaps in the literature, and sets the foundation for the empirical analyses conducted in the subsequent chapters.

Chapter 3: Methodology - This chapter describes the research design, data collection methods, and statistical techniques used to analyse the impact of corporate governance mechanisms on EID. It provides a detailed account of the dataset, variables, and econometric models employed, ensuring the robustness and validity of the findings.

Chapter 4: Board Characteristics and Environmental Information Disclosure - This chapter presents the first paper, which examines the impact of board characteristics on EID in Chinese firms. It discusses the theoretical underpinnings, formulates hypotheses, and presents empirical results along with their implications.

Chapter 5: Ownership Structure and Environmental Information Disclosure - This chapter presents the second paper, which analyses the role of ownership structure in influencing EID. It explores the effects of ownership concentration, managerial ownership, institutional ownership, and state ownership on EID, providing a comprehensive analysis of ownership dynamics in Chinese firms.

Chapter 6: In-depth Analysis of Board Diversity and Environmental Information Disclosure - This chapter presents the third paper, which provides a detailed analysis of how board diversity elements (age, tenure, gender, and overseas background) affect EID. It delves into the specific contributions of diverse board members to environmental governance, offering deeper insights into the mechanisms driving EID.

Chapter 7: Conclusion - This chapter summarises the key findings of the thesis, discusses the implications for theory and practice, provides policy recommendations, and suggests directions for future research. It reflects on the overall contributions of the thesis and highlights areas for further investigation.

Chapter 2

Literature Review

2.1 Introduction of Literature Review

This chapter provides a comprehensive examination of corporate governance and EID in China, addressing key definitions, concepts, origins, theories, and models. It explores how governance mechanisms influence EID practices through the lenses of various theories. The review highlights the unique challenges and opportunities within the Chinese context, shaped by economic reforms, regulatory changes, state ownership, and cultural factors. It critically reviews different corporate governance models, including the Anglo-American, Continental European, and Chinese models, and traces the development of EID practices from the 1970s to the present, discussing the benefits and challenges of transparency, standardization, and regulatory initiatives. Additionally, section 2.5 delves into the impact of the three specific corporate governance mechanisms, which are board characteristics, ownership structures, and board diversity, on EID, providing empirical evidence and theoretical insights, as well as research gaps and contribution to knowledge. Ultimately, the chapter concludes the contents above and underscores the essential role of robust corporate governance in promoting sustainability and improving environmental transparency, offering a solid foundation for the thesis.

2.2 Corporate Governance: Definition, Key Concepts, Origins, Theories, and Models

2.2.1 Definition

Corporate governance has been defined in various ways, reflecting its evolving nature and the perspectives of different scholars and institutions. The Cadbury Report (1992) is foundational in the field, defining corporate governance as "the system by which companies are directed and controlled". This definition emphasizes the importance of financial reporting and auditing standards, setting a high benchmark for transparency and accountability. However, it primarily focuses on financial aspects, which may

limit its scope in addressing broader governance issues such as ethical practices and stakeholder relations.

Donaldson and Davis (1991) contributed to the discussion by framing corporate governance through the lens of agency theory. They defined it as "the system by which firms are governed to align the interests of management with those of shareholders". This definition highlights the need to resolve conflicts between managers and shareholders, providing valuable insights into governance dynamics but primarily focusing on shareholder interests, potentially overlooking other stakeholders.

Shleifer and Vishny (1997) expanded the definition to encompass a broader perspective, describing corporate governance as "the system by which companies are directed and controlled". Their work integrates both structural and managerial aspects of governance, offering a comprehensive view of how firms are overseen and managed. While this definition captures a wide range of governance mechanisms, it may still not fully address the relational dynamics with external stakeholders.

Mallin (2016) refined the concept by focusing on the roles and responsibilities of boards of directors, defining corporate governance as "the system by which companies are directed and controlled", with particular emphasis on board effectiveness. This definition underscores the practical application of governance principles and the board's role in ensuring accountability. Nonetheless, it may not fully capture the importance of stakeholder engagement and external regulatory influences.

The Organisation for Economic Co-operation and Development (OECD, 2015) provides an inclusive definition, describing corporate governance as "the set of relationships between a firm's management, its board, its shareholders, and other stakeholders". This definition reflects a more holistic understanding by incorporating various stakeholder interests and emphasizing the balance required among them. It offers a broad perspective but may be critiqued for its expansive scope, which could obscure specific governance mechanisms and practices.

Together, these definitions highlight the evolution of corporate governance from

a focus on board responsibilities and financial accountability to a broader view that includes stakeholder relationships and structural mechanisms.

2.2.2 Key concepts and principles

Corporate governance principles encompass several critical aspects: accountability, transparency, fairness, responsibility, independence, and stewardship (Rizvi, Ayupp and Jaafar, 2019; Fama and Jensen, 1983; Donaldson and Davis, 1991). Accountability ensures that management is answerable to the board of directors (BoD), and the board is accountable to shareholders and other stakeholders (Jensen and Meckling, 1976). Transparency involves providing timely, accurate, and comprehensive information about the firm's activities, performance, and governance to stakeholders (Healy and Palepu, 2001). Fairness requires the equitable treatment of all stakeholders, particularly minority shareholders, to mitigate conflicts of interest (Shleifer and Vishny, 1997). Responsibility highlights a firm's ethical obligation to act in the best interests of its stakeholders and the community, including compliance with laws and regulations (Freeman, 1984). Independence entails unbiased and objective oversight by independent directors on the board (Fama and Jensen, 1983). Lastly, stewardship refers to the fiduciary duty of the firm's management and board to protect and enhance the value of the firm's assets and resources (Donaldson and Davis, 1991).

2.2.3 Origins and evolution of corporate governance frameworks

The origins of corporate governance can be traced back to the emergence of joint-stock firms in the 17th century, which required mechanisms to manage and control large pools of investor capital (Morck and Steier, 2005). The separation of ownership and control (Fama and Jensen, 1983), highlighted the potential for conflicts of interest between owners (shareholders) and managers, laying the groundwork for modern corporate governance frameworks. The development of joint-stock firms during the 17th and 18th centuries marked the beginning of formal corporate governance structures (Neal, 1993). These firms allowed for the pooling of capital from multiple investors, leading to the separation of ownership and control. Early

corporate governance mechanisms included the establishment of boards of directors to oversee management and protect the interests of shareholders (Clarke, 2004).

The Industrial Revolution of the 19th century led to the rapid growth of corporations and the need for more formal governance structures. The rise of large-scale enterprises, such as railroads and manufacturing firms, necessitated improved mechanisms for accountability and control (Hobsbawm, 1999; Jones, 2000; Landes, 2003). During this period, legal and regulatory frameworks began to emerge to govern corporate behavior and protect investors (Cheffins, 2001).

The 20th century saw significant advancements in corporate governance, driven by major economic and financial events. The stock market crash of 1929 and the subsequent Great Depression highlighted the need for stronger regulatory oversight and governance mechanisms (Financial Crisis Inquiry Commission, 2010). The United States introduced the *Securities Act of 1933* and the *Securities Exchange Act of 1934*, which established the SEC to regulate securities markets and protect investors (Coffee, 1984). The post-World War II era saw further developments in corporate governance, with the rise of institutional investors and the globalization of capital markets. The agency theory (Jensen and Meckling, 1976), provided a theoretical framework for understanding the conflicts of interest between shareholders and managers, emphasizing the need for mechanisms to align the interests of management with those of shareholders.

The late 20th and early 21st centuries were marked by significant corporate scandals, such as those involving Enron, WorldCom, and Parmalat, which underscored the weaknesses in existing corporate governance structures (Bavoso, 2014). These scandals led to the introduction of major regulatory reforms aimed at strengthening governance and enhancing corporate accountability (Clarke, 2004). In the United States, the Sarbanes-Oxley Act (SOX) of 2002 introduced stringent requirements for financial reporting, internal controls, and auditor independence, significantly impacting corporate governance practices (Coates, 2007).

Similarly, the United Kingdom introduced the *UK Corporate Governance Code*, first published in 1992 and regularly updated, which set standards for board

composition, accountability, and transparency (Mallin, 2016). The development of corporate governance codes in the UK can be traced back to the *Cadbury Report*, which was published in 1992 following several high-profile corporate scandals. The *Cadbury Report* set out recommendations to enhance corporate governance practices, focusing on the responsibilities of the board, the role of non-executive directors, and the need for effective internal controls (Cadbury, 1992). This report laid the foundation for the *UK Corporate Governance Code*. Subsequent revisions to the *UK Corporate Governance Code* have reflected evolving governance challenges and best practices. The *Greenbury Report* in 1995 addressed executive remuneration, emphasizing the need for transparency and alignment of executive pay with firm performance (Greenbury, 1995). The *Hampel Report* in 1998 consolidated previous recommendations and reinforced the importance of board effectiveness and shareholder engagement (Hampel, 1998). The *Turnbull Report* in 1999 provided detailed guidance on internal control and risk management, underscoring the importance of these mechanisms in safeguarding shareholder interests (Turnbull, 1999). In 2003, the *Higgs Report* focused on the role and effectiveness of non-executive directors, recommending measures to ensure their independence and contribution to board deliberations (Higgs, 2003). The *UK Corporate Governance Code* continues to evolve, with recent updates reflecting the growing emphasis on corporate culture, stakeholder engagement, and sustainability. The 2018 revision, for instance, highlighted the importance of long-term success and the need for boards to understand and meet the needs of a broader range of stakeholders (Financial Reporting Council, 2018). The 2023 revision of the *UK Corporate Governance Code* further emphasizes the importance of corporate culture, stakeholder engagement, and the long-term sustainability of businesses, aligning with global efforts to enhance corporate governance in the wake of the COVID-19 pandemic and the rise of ESG concerns (Financial Reporting Council, 2023).

The globalization of capital markets has driven the convergence of corporate governance standards across countries (Gilson, 2001). International organizations, such as the OECD and the International Finance Corporation, have developed

principles and guidelines to promote good governance practices globally. The *OECD Principles of Corporate Governance*, first issued in 1999 and revised in 2004 and 2015, provide a comprehensive framework for corporate governance that is widely recognized and adopted by countries around the world (OECD, 2015). It received further updates in 2023 to incorporate stronger provisions for ESG disclosure, digital governance, and board accountability in response to corporate scandals and the growing influence of institutional investors (OECD, 2023).

In Germany, the development of corporate governance frameworks has been shaped by the country's distinctive two-tier board system, which separates the management board from the supervisory board (Goergen, Manjon and Renneboog, 2008). This system is designed to ensure effective oversight and balance of power within corporations. The *German Corporate Governance Code*, introduced in 2002, aims to enhance transparency and accountability in German firms, with regular updates reflecting evolving standards and practices (Cromme, 2005). It was revised in 2022 to reinforce transparency, with increased requirements on executive remuneration disclosures and sustainability reporting (Commission on the German Corporate Governance Code, 2022). The French corporate governance code, known as the *Association Française des Entreprises Privées* (AFEP)-*Mouvement des Entreprises de France* (MEDEF) *Code*, was first introduced in 1995 and has undergone several revisions to address emerging governance issues (Wymeersh, 2006). France has developed and updated its governance frameworks, introducing new regulations in 2021 to mandate gender quotas on corporate boards, ensuring greater diversity and representation (AFEP-MEDEF, 2021), characterized by a focus on stakeholder engagement and the role of employee representatives on firm boards. Spain has seen significant reforms in corporate governance, particularly following the global financial crisis of 2008. The *Spanish Corporate Governance Code*, also known as the *Unified Good Governance Code*, was introduced in 2006 and has been updated to strengthen board independence, transparency, and shareholder rights (Carmona and Trombetta, 2008).

In the 21st century, there has been an increasing focus on sustainability and CSR

as integral components of corporate governance (Horrigan, 2007). Firms are expected to go beyond mere compliance with laws and regulations and to adopt practices that promote environmental sustainability, social equity, and ethical behavior (D'amato, Henderson and Florence, 2009). This shift is driven by growing stakeholder expectations, regulatory pressures, and the recognition that sustainable business practices can enhance long-term value creation (Eccles, Ioannou and Serafeim, 2014; OECD, 2023).

Emerging markets, including China, have witnessed significant changes in corporate governance practices, influenced by economic reforms, regulatory changes, and globalization (Wilkins, Trubek and Fong, 2020). In China, the transition from a centrally planned economy to a market-oriented economy has necessitated the development of corporate governance mechanisms to attract foreign investment and improve corporate performance (Leng, 2009). The establishment of stock exchanges in Shanghai and Shenzhen in the early 1990s marked a significant milestone in the evolution of corporate governance in China (Liu, 2006). These exchanges introduced rigorous disclosure requirements and enhanced investor protection, which promoted greater transparency and accountability. The creation of these exchanges spurred the development of legal and regulatory frameworks and facilitated corporate governance reforms (Reed, 2002). Additionally, they played a crucial role in the efficient allocation of capital, contributing to economic growth (Black, 2000; Coffee, 2006). The Chinese government has introduced a series of laws, regulations, and guidelines to enhance corporate governance, including the *Company Law* in 1993, the *Securities Law* in 1998, the *Code of Corporate Governance for Listed Companies* in 2002, and the 2021 revision of the *Code of Corporate Governance for Listed Companies*, which strengthens ESG reporting requirements and board accountability. These efforts aim to improve transparency, protect investor rights, and promote sustainable development (China Securities Regulatory Commission, 2021).

Despite significant progress, corporate governance continues to face challenges, including issues related to board effectiveness, executive compensation, shareholder activism, and the integration of ESG factors. The evolving nature of corporate

governance requires continuous adaptation to address emerging risks and opportunities, driven by technological advancements, regulatory changes, and shifting stakeholder expectations.

Table 4 compares corporate governance codes in both Global North economies and the BRIC nations.

Table 4: Comparison of Corporate Governance Codes between Global North Economies and the BRIC Nations

Aspect	Global North Economies	BRIC Nations
Primary Focus	Protection of shareholders, transparency, accountability	Protection of minority shareholders, state influence, evolving transparency
Key Regulations	- SOX (US) - *UK Corporate Governance Code* - *German Corporate Governance Code* - French AFEP-MEDEF *Code* - The *Spanish Corporate Governance Code*	- *Company Law* (China) - *Corporate Governance Code for Listed Companies* (China) - Novo Mercado (Brazil) - *Corporate Governance Voluntary Guidelines* (India) - *Code of Corporate Governance* (Russia)
Board Structure	Emphasis on independent directors, separation of CEO and chairman roles	Varies: Independent directors less common, significant state representation (particularly in China and Russia)
Disclosure Requirements	Rigorous financial reporting, mandatory ESG disclosures increasingly common	Disclosure practices improving, but variability in rigor and enforcement
Regulatory Bodies	SEC (US), Financial Reporting Council (UK), Federal Financial Supervisory Authority (Germany), Autorité des marchés financiers (France), Comisión Nacional del Mercado de Valores (Spain)	CSRC (China), Securities and Exchange Commission of Brazil (Brazil), Securities and Exchange Board of India (India), Central Bank of Russia (Russia)
Shareholder Rights	Strong protection mechanisms, active institutional investor involvement	Protection improving, but challenges with enforcement and state influence
Executive Compensation	Emphasis on aligning pay with performance, transparency in remuneration policies	Variable practices, increasing focus on aligning pay with performance, but less stringent compared to Global North

CSR and ESG Integration	High emphasis on CSR and ESG factors, integrated reporting frameworks adopted	Growing emphasis, but integration and reporting practices vary significantly
Recent Reforms	- Enhanced focus on ESG - Increasing emphasis on stakeholder engagement - Stricter regulations on executive remuneration - Gender quotas for corporate boards - Strengthened board independence, transparency, and shareholder rights	- Revised *Company Law* - New Securities and Exchange Board of India regulations (SEBI) - *Corporate Governance Code* revisions - Strengthened ESG disclosure requirements
Cultural and Institutional Context	Developed legal systems, high investor activism, strong regulatory frameworks	Emerging markets, varying degrees of regulatory enforcement, significant state involvement in certain markets

2.2.4 Theories of corporate governance

Agency theory (Jensen and Meckling, 1976) examines the relationship between principals (shareholders) and agents (management) and the conflicts of interest that arise due to the separation of ownership and control. It suggests that managers, as agents, may not always act in the best interests of shareholders, the principals. Various governance mechanisms, such as board oversight, executive compensation, and shareholder rights, are implemented to mitigate these conflicts (Fama and Jensen, 1983). For instance, independent boards and performance-based executive compensation are designed to align the interests of managers with those of shareholders, thereby reducing agency costs and enhancing firm performance (Eisenhardt, 1989). This alignment is crucial for EID, as strong governance structures can lead to more transparent and comprehensive environmental reporting. Empirical studies have demonstrated that firms with robust governance mechanisms, including effective board oversight and incentives tied to environmental performance, are more likely to engage in detailed and credible EID practices (Galbreath, 2011). By improving governance, firms can better manage environmental risks and opportunities, ultimately leading to enhanced stakeholder trust and improved environmental outcomes (Shleifer and Vishny, 1997; Hermalin and Weisbach, 1998; Hill and Jones, 1992; Daily, Dalton and Cannella, 2003).

The RBV theory (Barney, 1991) emphasizes the role of a firm's internal resources and capabilities in generating sustained competitive advantage. This theoretical framework posits that resources must be valuable, rare, inimitable, and non-substitutable to provide a firm with a competitive edge. Within the context of corporate governance, RBV extends this notion to include the BoD and governance structures as strategic resources (Barney, 1991). From an RBV perspective, the composition and capabilities of the BoD are critical determinants of a firm's ability to achieve superior performance and manage its strategic initiatives effectively (Hillman and Dalziel, 2003). Boards equipped with diverse skills, knowledge, and experiences are better positioned to oversee complex strategic decisions, including those related to environmental initiatives. The expertise of board members in areas such as environmental science, regulatory compliance, and sustainability can significantly enhance the board's capacity to guide and monitor environmental strategies (Hillman and Dalziel, 2003). Empirical studies support this view, showing that diverse boards are associated with better corporate environmental performance (Bear, Rahman and Post, 2010). Furthermore, RBV suggests that governance structures, such as the presence of specialized committees (e.g., sustainability or audit committees) and mechanisms for stakeholder engagement, function as strategic resources. These structures enable firms to align their environmental policies with best practices, enhance transparency, and ensure comprehensive EID (Barney, 1991; Godfrey, Merrill and Hansen, 2009). Effective governance structures facilitate rigorous oversight and accountability, which are crucial for accurate and detailed EID (Godfrey, Merrill and Hansen, 2009).

Stakeholder theory (Freeman, 1984) fundamentally challenges the traditional shareholder-centric view of corporate responsibility. Instead, it emphasizes that firms have ethical and strategic responsibilities to a broad spectrum of stakeholders, including employees, customers, suppliers, communities, and the environment, in addition to shareholders. Effective corporate governance, from this perspective, necessitates balancing these diverse interests to achieve long-term sustainability and success. In the context of EID, stakeholder theory underscores the critical role of

transparency and accountability. Firms are expected to provide comprehensive and truthful environmental disclosures not only to satisfy regulatory requirements but also to build trust and maintain positive relationships with all stakeholders (Freeman, 1984; Donaldson and Preston, 1995). By addressing the concerns and expectations of various stakeholder groups, firms demonstrate their commitment to ethical practices and social responsibility. Research supports the notion that firms with robust stakeholder engagement practices tend to disclose more detailed and meaningful environmental information. For instance, Roberts (1992) found that organizations actively engaging with stakeholders are more likely to produce comprehensive EID reports. This correlation reflects a broader commitment to corporate social responsibility and a proactive approach to managing environmental impacts. Furthermore, empirical studies indicate that firms integrating stakeholder perspectives into their governance frameworks are more effective in enhancing environmental transparency and sustainability performance (Clarkson et al., 2008; Kolk, 2008). Firms that prioritize stakeholder interests are not only better positioned to address environmental and social concerns but also enhance their reputation and operational resilience, contributing to their overall long-term success (Schaltegger, Hörisch and Freeman, 2019). This approach aligns with findings that show a positive relationship between stakeholder engagement and improved environmental performance, as firms adopt more sustainable practices to meet stakeholder expectations (Hillman and Keim, 2001; Aguilera et al., 2007). Additionally, firms that emphasize stakeholder theory principles often experience increased trust and loyalty from customers and employees, which can lead to a competitive advantage in the marketplace (Jones, 1995; Mitchell, Agle and Wood, 1997).

Legitimacy theory (Suchman, 1995) provides a framework for understanding how organizations strive to align their practices with societal expectations and norms to gain and maintain legitimacy. According to this theory, legitimacy is crucial for an organization's survival and success, as it affects the firm's ability to secure resources, attract investors, and sustain its operations. Organizations seek to operate within the boundaries established by societal values and expectations to ensure their activities

are perceived as acceptable and appropriate. In the context of EID, legitimacy theory posits that firms utilize disclosure practices as a means to demonstrate their commitment to environmental sustainability and to align their operations with societal norms (Nurhayati et al., 2016). By proactively sharing environmental information, organizations can address public concerns and expectations, thus reinforcing their legitimacy and reducing potential scrutiny (Suchman, 1995; Deegan, 2002). This alignment with societal values not only helps firms in managing their public image but also in avoiding potential conflicts with stakeholders and regulatory bodies. Empirical research supports the application of legitimacy theory to EID. For instance, Cho and Patten (2007) found that firms operating in industries with significant environmental impacts are more inclined to engage in comprehensive EID practices as a strategy to mitigate legitimacy threats. In industries where environmental concerns are heightened, such as the oil and gas or mining sectors, firms often face increased pressure from stakeholders and the public (Frynas, 2009). By providing detailed environmental disclosures, these firms can bette manage perceptions and demonstrate their efforts to mitigate environmental damage, thus preserving their legitimacy and fostering stakeholder trust. Additionally, it has been observed that firms with strong environmental disclosure practices often enjoy enhanced corporate reputation and stakeholder relations (Lindblom, 1994). This is particularly important in industries with high environmental impact, where public scrutiny and regulatory requirements are more intense. Such disclosures are not only a response to external pressures but also a strategic tool to build long-term legitimacy and ensure sustainable operations (Bebbington, Larrinaga and Moneva, 2008). Moreover, firms that effectively manage their legitimacy through transparent EID can achieve better financial performance and competitive advantage, as trust and credibility play pivotal roles in business success (Clarkson et al., 2008).

Stewardship theory (Davis, Schoorman and Donaldson, 1997) presents a perspective on corporate governance that contrasts with the traditional agency theory. It posits that managers, as stewards of the firm's resources, are inherently motivated to act in the best interests of shareholders. According to this theory, when managers are

trusted and given the autonomy to make decisions, they are more likely to be committed to the firm's long-term success, fostering a corporate culture that emphasizes transparency and accountability (Donaldson and Davis, 1991). Under stewardship theory, managers are viewed not merely as self-interested agents but as individuals who derive intrinsic satisfaction from achieving organizational goals and upholding the firm's values. This theoretical framework suggests that when managers are empowered and their stewardship role is acknowledged, they are more inclined to adopt practices that align with the organization's long-term interests (Sama, Stefanidis and Casselman, 2022), including enhanced transparency and accountability in reporting. Research supports the notion that stewardship-oriented governance structures can lead to superior environmental and social performance. For example, Davis, Schoorman and Donaldson (1997) found that firms with governance structures that emphasize stewardship and trust tend to prioritize long-term sustainability over short-term profits. This orientation is reflected in their environmental and social practices, where managers focus on integrating sustainable practices into their operations and ensuring comprehensive disclosure of environmental information. Such firms are often more proactive in addressing environmental and social issues, as they are committed to maintaining and enhancing their reputation and achieving sustainable growth. Furthermore, stewardship theory underscores the importance of creating a supportive organizational environment where managers are encouraged to act in the best interests of the firm (Davis, Schoorman and Donaldson, 1997). By fostering a culture of trust and autonomy, organizations can enhance managerial commitment to sustainability and transparency, ultimately leading to better environmental and social outcomes.

Institutional theory (DiMaggio and Powell, 1983) emphasizes how institutions—such as regulatory frameworks, industry standards, and cultural norms—influence organizational behavior. According to this theory, firms conform to these institutional pressures to gain legitimacy and social acceptance. Institutions shape not only the formal rules and regulations that govern corporate activities but also the informal norms and expectations that influence organizational practices,

including governance and disclosure behaviors. In the realm of EID, institutional theory suggests that firms are driven to align their practices with institutional norms to secure legitimacy and conform to societal expectations (Glover et al., 2014). Regulatory frameworks set the boundaries for mandatory reporting, while industry standards and cultural norms influence the extent and nature of voluntary disclosures. As a result, firms adopt best practices in EID to adhere to these expectations and maintain their legitimacy within their respective institutional environments (DiMaggio and Powell, 1983; Scott, 2008). Research supports the view that institutional pressures significantly impact EID practices. For instance, Kolk (2008) found that firms operating in countries with robust institutional frameworks for environmental protection are more likely to engage in comprehensive EID. In such environments, strong regulatory requirements and societal expectations compel firms to be more transparent about their environmental impacts and practices. This is consistent with the idea that firms conform to institutional pressures to enhance their legitimacy and meet the standards set by regulatory and societal institutions.

Signalling theory (Spence, 1973) explores how entities convey their quality and intentions through certain behaviors and practices to reduce information asymmetry in the market. In the context of corporate governance, firms utilize various disclosures, including EID, as a means to signal their commitment to good governance, sustainability, and ethical practices to investors and other stakeholders (Bae, Masud and Kim, 2018). This strategic use of disclosures helps to build trust, enhance corporate reputation, and attract investment by mitigating the information gap between the firm and its external environment (Spence, 1973; Connelly et al., 2011). Through high-quality environmental disclosures, firms can effectively signal their dedication to sustainable practices and responsible management. By providing comprehensive and transparent information about their environmental impacts and initiatives, firms demonstrate their alignment with global sustainability standards and societal expectations. This transparency is particularly important for investors and stakeholders who prioritize ESG criteria in their decision-making processes. Empirical studies support the idea that superior environmental disclosures are

associated with better financial performance. For instance, Clarkson et al. (2008) found that firms with high-quality environmental disclosures tend to attract socially responsible investors, who are increasingly seeking to invest in firms with strong ESG practices. These firms often enjoy enhanced reputational benefits, which can translate into competitive advantages and improved market performance. The signaling effect of comprehensive EID thus not only helps in building trust with stakeholders but also in enhancing the overall financial health and sustainability of the firm.

Table 5 summarizes the theories of corporate governance with respect to their implications for EID.

Table 5: Summary of the Theories of Corporate Governance and Their Implications for EID

Theory	Key Proponents	Core Principles	Implications for EID
Agency Theory	Jensen and Meckling (1976), Fama and Jensen (1983)	- Focuses on the relationship between principals (shareholders) and agents (management). - Governance mechanisms are implemented to mitigate conflicts of interest.	- Effective governance mechanisms (e.g., independent boards, performance-based compensation) lead to more transparent and comprehensive EID. - Firms with strong governance structures tend to engage in detailed and credible environmental reporting.
RBV	Barney (1991), Hillman and Dalziel (2003)	- Emphasizes the strategic role of a firm's internal resources and capabilities in achieving competitive advantage. - BoD and governance structures are considered strategic resources.	- Boards with diverse skills, knowledge, and experiences can better oversee and guide environmental initiatives. - Governance structures like specialized committees and stakeholder engagement mechanisms enhance transparency and comprehensive EID.
Stakeholder Theory	Freeman (1984), Donaldson and Preston (1995)	- Firms have ethical and strategic responsibilities to a broad spectrum of stakeholders, not just shareholders. - Effective governance requires balancing diverse stakeholder	- Emphasizes the importance of transparency and accountability to build trust with stakeholders. - Firms with robust stakeholder engagement practices tend to produce more detailed and meaningful EID.

		interests.	
Legitimacy Theory	Suchman (1995), Deegan (2002)	- Organizations strive to align their practices with societal expectations to gain and maintain legitimacy. - Legitimacy affects a firm's ability to secure resources and sustain operations.	- Firms utilize EID to demonstrate their commitment to environmental sustainability and align with societal norms. - Comprehensive EID helps firms manage public perceptions and reinforce their legitimacy.
Stewardship Theory	Davis, Schoorman, and Donaldson (1997)	- Managers are seen as stewards who are motivated to act in the best interests of shareholders. - Trust and autonomy are crucial for managers to focus on long-term goals.	- Stewardship-oriented governance structures foster a culture of transparency and accountability. - Firms with stewardship-oriented governance prioritize long-term sustainability, leading to enhanced environmental and social performance.
Institutional Theory	DiMaggio and Powell (1983), Scott (2008)	- Institutions shape organizational behavior through regulatory frameworks, industry standards, and cultural norms. - Firms conform to institutional pressures to gain legitimacy.	- Institutional pressures compel firms to adopt best practices in EID to maintain legitimacy. - Firms in countries with strong environmental protection frameworks are more likely to engage in comprehensive EID.
Signaling Theory	Spence (1973), Connelly et al. (2011)	- Entities convey quality and intentions through certain behaviors to reduce information asymmetry. - Disclosures signal commitment to good governance and sustainability.	- High-quality EID signals a firm's dedication to sustainable practices and responsible management. - Superior environmental disclosures attract socially responsible investors and enhance corporate reputation.

2.2.5 Critical review and controversies of corporate governance models

Corporate governance models vary significantly across regions, shaped by distinct historical, cultural, and institutional influences (Filatotchev, Jackson and Nakajima,

2013). This section critically reviews the Anglo-American model, the Continental European model, and the Chinese model, highlighting key controversies and their implications for EID.

The Anglo-American model emphasizes shareholder value maximization and relies heavily on market mechanisms to discipline corporate behavior (Wu and Patel, 2015). It promotes high levels of transparency and accountability through stringent disclosure requirements and active market oversight, which are critical for effective EID (Healy and Palepu, 2001). This model operates under the premise that well-informed investors can make better decisions, thereby improving market efficiency and corporate performance. Disclosure regulations such as the SOX in the United States mandate rigorous financial reporting standards, indirectly influencing firms to enhance their environmental disclosure practices as part of comprehensive risk management (Coates, 2007). However, the model is criticized for its tendency towards short-termism, driven by the emphasis on quarterly financial results, which can lead to underinvestment in long-term sustainability initiatives, including environmental projects (Gigler et al., 2012). This short-term focus is often exacerbated by the pressure on managers to meet or exceed quarterly earnings forecasts, resulting in prioritization of immediate financial performance over long-term strategic goals. Consequently, initiatives that may benefit the environment but require substantial upfront investment and longer time horizons to yield returns are often deprioritized (Porter, 1992). Furthermore, the reliance on market mechanisms and shareholder primacy in the Anglo-American model can sometimes undermine the interests of other stakeholders, including employees, customers, and the community. For example, in pursuing cost reductions to meet short-term earnings targets, firms might cut corners on environmental safeguards or reduce investments in sustainable technologies (Margolis and Walsh, 2003). This can result in negative externalities, such as pollution and resource depletion, which are not immediately reflected in the firm's financial statements but have long-term detrimental effects on both the environment and society. Empirical evidence also highlights the limitations of the Anglo-American model in fostering comprehensive EID. For instance, studies

have shown that while firms in the United States and the United Kingdom may disclose significant amounts of environmental information, the quality and depth of such disclosures can be inconsistent (Clarkson et al., 2008). This variability often arises from the voluntary nature of many environmental disclosures, where firms may choose to report selectively, highlighting positive achievements while omitting or downplaying negative impacts. Despite these criticisms, there are notable examples where the Anglo-American model has driven significant improvements in environmental performance. Firms like Apple and Microsoft have made substantial commitments to reducing their carbon footprints and investing in renewable energy, driven in part by shareholder activism and market expectations for corporate responsibility (Eccles, Ioannou and Serafeim, 2012). These cases demonstrate that market mechanisms, when coupled with strong investor interest in sustainability, can lead to meaningful environmental initiatives.

The Continental European model features concentrated ownership and a two-tier board structure, incorporating broader stakeholder interests into corporate governance (Belcredi and Ferrarini, 2013). This model promotes long-term sustainability and encourages firms to consider the broader impact of their operations, including environmental effects (Jackson and Moerke, 2005). However, it can lead to inefficiencies and slower decision-making processes due to the separation between the management board and the supervisory board (Weimer and Pape, 1999). Germany exemplifies the two-tier board structure, which includes a management board and a supervisory board (Moraru, Ungureanu and Constantin, 2018). The management board is responsible for day-to-day operations, while the supervisory board oversees and advises the management board, ensuring that broader stakeholder interests are represented. This structure is intended to provide checks and balances, promoting long-term strategic thinking and sustainability (Jackson and Moerke, 2005). For example, the supervisory board often includes employee representatives, which helps to ensure that decisions consider the welfare of the workforce and other social factors (Weimer and Pape, 1999). However, this separation can sometimes result in slower decision-making processes and potential conflicts between the two boards (Jackson

and Moerke, 2005). France offers a more flexible approach, allowing firms to choose between a two-tiered and a unitary board structure (Belot et al., 2014). In the unitary model, a single board of directors combines both oversight and managerial responsibilities. This can lead to more streamlined decision-making processes and a clearer strategic direction, as the same board is involved in both setting policies and executing them. However, the unitary structure might lack the rigorous checks and balances provided by the two-tier system, potentially reducing the thoroughness of oversight. French firms that opt for the two-tier system tend to mirror the German approach, aiming to balance management efficiency with comprehensive oversight (Weimer and Pape, 1999).

China's corporate governance model is distinct due to its significant state ownership and the integration of party committees within corporate structures. This hybrid model blends elements of market mechanisms with strong state control and oversight, allowing for the alignment of corporate strategies with national environmental and social objectives (Wang, Guthrie and Xiao, 2012). The Chinese government plays a substantial role in influencing corporate behavior, particularly in strategic sectors such as energy, telecommunications, and natural resources. This state-centric approach ensures that corporate activities are aligned with broader national goals, including environmental protection and sustainable development. A key feature of Chinese corporate governance is the presence of Communist Party committees within firms (Beck and Brødsgaard, 2022). These committees are integrated into the governance framework and often have significant influence over strategic decisions, ensuring that corporate actions are in line with party directives. This arrangement facilitates the implementation of government policies at the corporate level, including those related to environmental sustainability (Wang, Guthrie and Xiao, 2012). For instance, SOEs are often at the forefront of implementing national environmental policies, such as reducing carbon emissions and investing in renewable energy projects. China's corporate governance system also incorporates both two-tiered and unitary board structures, which has significant implications for board duality—a situation where the CEO also serves as the chairman

of the board (Haxhi, 2015). In a two-tiered board system, which separates the management and supervisory functions, board duality is structurally impossible since the CEO cannot be the chairman of the supervisory board. However, in a unitary board system, board duality can occur, potentially concentrating power in one individual and raising concerns about checks and balances within the governance structure. This mix of governance structures allows for some flexibility in corporate oversight but also introduces complexity in managing and regulating corporate behavior (Li and Qian, 2013).

The BRICS nations—Brazil, Russia, India, China, and South Africa have diverse governance structures influenced by unique historical, cultural, and institutional contexts. In Brazil, corporate governance is characterized by concentrated ownership with significant family-owned businesses and state influence (Coutinho and Rabelo, 2003). The Novo Mercado initiative has been a key reform to enhance transparency and protect minority shareholders, contributing to improved EID practices (Black, De Carvalho and Gorga, 2010). However, issues such as political interference and corruption remain significant challenges (La Porta, et al., 1999).

Russia's corporate governance is heavily influenced by state ownership and oligarchic control (Pöyry and Maury, 2010). The governance framework is evolving, with efforts to improve transparency and investor protection. However, the prevalence of state-owned enterprises and the influence of powerful business magnates often lead to governance practices that prioritize state and elite interests over minority shareholders and environmental considerations (Opdahl, 2020).

India presents a hybrid model with a mix of family-owned businesses, state enterprises, and a growing number of professionally managed firms (Subramanian, 2016). The governance reforms initiated by SEBI have focused on enhancing board independence, improving disclosure standards, and protecting minority shareholders (Saha and Kabra, 2022). These reforms have gradually improved corporate governance and EID practices, although challenges such as promoter dominance and regulatory enforcement persist (Wisea, Alib and Yadavc, 2014).

South Africa's corporate governance is guided by the *King Reports on Corporate Governance*, which emphasize ethical leadership, sustainability, and integrated reporting (Rossouw, 2005). The Johannesburg Stock Exchange (JSE) requires listed firms to adopt these principles, significantly advancing corporate governance and EID practices (Pahad, 2019). However, issues such as political influence and economic inequality continue to pose challenges (Ntim and Soobaroyen, 2013).

In conclusion, each corporate governance model has its strengths and weaknesses, and their effectiveness in promoting EID varies based on contextual factors. The Anglo-American model excels in transparency and market discipline but struggles with short-termism and dispersed ownership. The Continental European model promotes long-term sustainability and stakeholder involvement but can be inefficient and prone to concentrated ownership risks. The Chinese model offers rapid reform implementation and alignment with national goals but faces challenges in avoiding state interference and ensuring consistent governance practices. Similarly, the BRICS nations exhibit diverse governance structures with unique challenges and opportunities for enhancing EID. Understanding these dynamics is crucial for improving corporate governance frameworks to enhance environmental transparency and accountability in different contexts.

Table 6 highlights key controversies and their implications for EID between the Anglo-American, Continental European, and Chinese corporate governance models, as well as the BRICS nations.

Table 6: Comparison of Corporate Governance Models: Anglo-American, Continental European, Chinese, and BRICS Approaches

Model	Key Features	Strengths	Weaknesses
Anglo-American	Emphasizes shareholder value maximization; relies on market mechanisms for discipline (Wu and Patel, 2015).	High levels of transparency and accountability; stringent disclosure requirements; effective EID (Healy and Palepu, 2001).	Short-termism; underinvestment in long-term sustainability; potential neglect of broader stakeholder interests (Gigler et al., 2012; Margolis and Walsh, 2003).

Continental European	Concentrated ownership; two-tier board structure; incorporates broader stakeholder interests (Belcredi and Ferrarini, 2013).	Promotes long-term sustainability; considers broader impact including environmental effects (Jackson and Moerke, 2005).	Inefficiencies and slower decision-making; potential conflicts between management and supervisory boards (Weimer and Pape, 1999).
Chinese	Significant state ownership; integration of party committees within corporate structures (Beck and Brødsgaard, 2022).	Aligns corporate strategies with national goals; facilitates rapid reform implementation; significant role in environmental policies (Wang, Guthrie, and Xiao, 2012).	Challenges in avoiding state interference; inconsistent governance practices; potential for concentrated power and reduced checks and balances (Haxhi, 2015; Li and Qian, 2013).
Brazil (BRICS)	Concentrated ownership; significant family-owned businesses; state influence (Coutinho and Rabelo, 2003).	Novo Mercado initiative enhances transparency; protects minority shareholders; improved EID practices (Black, De Carvalho, and Gorga, 2010).	Political interference; corruption; challenges in governance reform (La Porta, et al., 1999).
Russia (BRICS)	Influenced by state ownership and oligarchic control; evolving governance framework (Pöyry and Maury, 2010).	Efforts to improve transparency and investor protection (Opdahl, 2020).	Prioritization of state and elite interests over minority shareholders and environmental considerations (Opdahl, 2020).
India (BRICS)	Hybrid model with family-owned businesses, state enterprises, and professionally managed firms (Subramanian, 2016).	SEBI reforms enhance board independence, disclosure standards, and minority shareholder protection (Saha and Kabra, 2022).	Promoter dominance; regulatory enforcement challenges (Wise, Ali, and Yadav, 2014).
South Africa (BRICS)	Guided by the *King Reports*; emphasizes ethical leadership, sustainability, and integrated reporting (Rossouw, 2005).	JSE principles advance corporate governance and EID practices (Pahad, 2019).	Political influence; economic inequality (Ntim and Soobaroyen, 2013).

2.3 Environmental Information Disclosure: Definition, Development, Impact, and Controversies

2.3.1 Definition and scope of EID

EID refers to the process through which firms communicate information regarding their environmental performance, policies, and impacts to their stakeholders (Adams, 2002). This encompasses a wide range of data, including but not limited to GHG emissions, energy usage, water consumption, waste management, biodiversity impacts, and compliance with environmental regulations (Kolk, 2008). EID is a critical component of CSR and sustainability reporting, aimed at enhancing transparency, accountability, and stakeholder trust (Adams, 2004; Clarkson et al., 2008).

The purpose of EID is multifaceted: it serves to inform stakeholders, including investors, regulators, customers, and the general public, about a firm's environmental impact (Gao, Heravi and Xiao, 2005; Adams, 2004); it enables stakeholders to assess the firm's commitment to environmental sustainability (Clarkson, Overell and Chapple, 2011; Dhaliwal et al., 2011); and it provides a basis for comparing the environmental performance of different firms (Kolk, 2008; Unerman and Bennett, 2004). Effective EID practices can lead to improved environmental performance, enhanced corporate reputation, and increased stakeholder engagement (Zhang and Ouyang, 2021; Jiang, Guo and Wu, 2021).

2.3.2 Development of environmental information disclosure

The concept of EID has evolved significantly over the past few decades, influenced by increasing environmental awareness, regulatory developments, and growing stakeholder demands for transparency (Wang et al., 2023; Zeng et al., 2010).

The initial focus on environmental reporting emerged in the 1970s and 1980s, driven by heightened environmental awareness and the introduction of environmental regulations in many countries (Berthelot, Cormier and Magnan, 2003). During this period, environmental disclosures were often voluntary and primarily qualitative, focusing on firms' environmental policies and initiatives (Gray, Kouhy and Lavers,

1995). The late 1980s and early 1990s saw the establishment of frameworks like the GRI, which provided standardized guidelines for sustainability reporting, including environmental disclosures (Brown, de Jong and Levy, 2009; Kolk, 2004).

The 1990s and 2000s witnessed a significant increase in regulatory initiatives aimed at promoting EID. The introduction of mandatory environmental reporting requirements in countries such as Denmark, France, and the UK marked a shift towards greater standardization and comparability of environmental information (Frost and Seamer, 2002; KPMG, 2008). The GRI guidelines gained widespread acceptance, providing a comprehensive framework for reporting on ESG issues (Searcy and Buslovich, 2014). Other initiatives, such as the CDP, focused specifically on climate-related disclosures, further enhancing the scope and detail of EID (Kolk, 2008; CDP, 2024).

The globalization of business and capital markets has driven the convergence of EID practices across countries. International organizations, such as the International Integrated Reporting Council (IIRC) and the TCFD, have developed comprehensive frameworks to integrate environmental disclosures into mainstream financial reporting (Gutterman, 2024). The IIRC's integrated reporting framework aims to enhance the way organizations communicate how their strategy, governance, performance, and prospects lead to the creation of value over the short, medium, and long term, including environmental considerations. The TCFD provides guidelines for disclosing clear, comparable, and consistent information about the risks and opportunities presented by climate change, focusing on governance, strategy, risk management, and metrics and targets related to climate impacts (O'Dwyer and Unerman, 2020). These initiatives aim to provide stakeholders with a holistic view of a firm's performance and its long-term sustainability risks and opportunities. The adoption of these frameworks has been supported by regulatory bodies and stock exchanges worldwide, promoting a higher level of transparency and consistency in EID (Eccles and Krzus, 2010; TCFD, 2017).

Recent advancements in technology and data analytics have transformed EID practices. Firms can now collect, analyze, and report environmental data more

efficiently and accurately. Technologies such as blockchain and artificial intelligence are being leveraged to enhance the transparency and traceability of environmental information (Ahmed et al., 2022). These technologies enable real-time monitoring and reporting of environmental performance, providing stakeholders with up-to-date and verifiable information (Deloitte, 2021).

2.3.3 Relevance and impact of environmental information disclosure

EID has become a critical aspect of corporate governance and sustainability, with significant implications for various stakeholders (Adams, 2002; Hahn and Kühnen, 2013; Gao, Heravi and Xiao, 2005). Investors increasingly consider environmental performance as a key factor in their investment decisions (Kocmanová, Karpíšek and Klímková, 2012). EID provides them with the necessary information to assess a firm's environmental risks and opportunities, informing their portfolio management strategies. Studies have shown that firms with robust EID practices tend to attract more socially responsible investment funds and enjoy lower cost of capital (Clarkson, Overell and Chapple, 2011; Dhaliwal et al., 2011; Amel-Zadeh and Serafeim, 2018). Effective EID practices help firms comply with environmental regulations and manage environmental risks. By disclosing comprehensive and accurate environmental information, firms can demonstrate their compliance with regulatory requirements and reduce the risk of legal and financial penalties. Furthermore, EID can enhance a firm's ability to anticipate and respond to emerging environmental risks, such as climate change and resource scarcity (KPMG, 2017; Freedman and Jaggi, 2005). Transparency in environmental reporting can significantly enhance a firm's reputation and brand value (Sari and Muslim, 2024). Stakeholders, including customers, employees, and the community, increasingly demand that firms demonstrate their commitment to environmental sustainability (Waddock, Bodwell and Graves, 2002). Firms that engage in comprehensive EID practices are often perceived as more trustworthy and socially responsible, which can lead to increased customer loyalty, employee satisfaction, and community support (Luo and Tang, 2014; Jones et al., 2007). EID can drive operational efficiency and innovation by

highlighting areas for improvement in environmental performance. Firms that systematically monitor and report their environmental impact are better positioned to identify inefficiencies and implement sustainable practices. This can lead to cost savings, improved resource management, and the development of innovative products and services that meet the growing demand for sustainability (Eccles, Ioannou and Serafeim, 2014; Hart and Milstein, 2003).

2.3.4 Challenges and controversies in environmental information disclosure

Despite the growing importance of EID, several challenges and controversies persist.

Greenwashing is one of the most significant controversies surrounding EID. This occurs when firms provide misleading or exaggerated claims about their environmental performance to appear more environmentally friendly than they are (Laufer, 2003). This practice, now increasingly sophisticated, includes tactics like "selective disclosure" of favorable ESG metrics while omitting adverse data (De Freitas Netto et al., 2020). Greenwashing undermines the credibility of EID and can erode stakeholder trust. It is often driven by the desire to gain a competitive advantage or avoid regulatory scrutiny without making genuine improvements in environmental performance (Delmas and Burbano, 2011). Recent studies also highlight how firms in high-impact industries strategically use materiality assessments to legitimize superficial disclosures (Torelli, Balluchi and Furlotti, 2020).

The debate over voluntary versus mandatory disclosure continues to be a contentious issue. Proponents of voluntary disclosure argue that it allows firms to tailor their reporting to their specific circumstances and encourages genuine commitment to sustainability (Cho et al., 2015). Critics, however, argue that mandatory disclosure (e.g., the EU's Corporate Sustainability Reporting Directive) is necessary to ensure consistency, comparability, and accountability across firms (Avram et al., 2018; Serafeim, 2020). Post-Paris Agreement regulatory shifts increasingly favor mandatory climate risk reporting to address systemic gaps in voluntary systems (Eccles, Lee and Stroehle, 2021), aligning with earlier arguments that compulsory standards prevent cherry-picking of data (Hahn and Kühnen, 2013).

The lack of standardized reporting frameworks poses a challenge for EID. While initiatives like the GRI and CDP have made strides in promoting standardized reporting, variations in reporting can make it difficult for stakeholders to compare and evaluate environmental performance accurately. Consistency and comparability are essential for stakeholders to make informed decisions, but achieving standardization across diverse industries and regulatory environments remains a challenge (Kolk, 2008).

Implementing comprehensive EID practices can be costly, particularly for SMEs. The costs associated with gathering, verifying, and disclosing environmental information can be significant (Simnett and Huggins, 2015). There is ongoing debate over whether the benefits of enhanced transparency and stakeholder trust outweigh these costs. While large firms increasingly justify costs through investor demand for ESG transparency (Amel-Zadeh and Serafeim, 2018), smaller firms face a "disclosure divide" due to resource constraints (Marquis, Toffel and Zhou, 2016). This risks entrenching inequalities, as SMEs struggle to meet the same standards as larger counterparts, potentially excluding them from sustainability-linked financing opportunities (Clarkson et al., 2008).

2.3.5 Reflection on EID and its connection to CSR and sustainability

EID is closely connected to CSR and the broader concept of sustainability. CSR encompasses a firm's efforts to operate in an economically, socially, and environmentally sustainable manner. Within this framework, EID serves as a crucial tool for achieving and demonstrating environmental sustainability.

Sustainability refers to meeting the needs of the present without compromising the ability of future generations to meet their own needs (Engelman, 2013). This concept emphasizes the interdependence of economic, social, and environmental dimensions. EID contributes to sustainability by providing transparency about a firm's environmental impact, thereby enabling stakeholders to make informed decisions that promote long-term ecological balance and social well-being (Adams, 2004).

The choice to focus on EID rather than CSR as a whole for this study is driven

by several factors. First, environmental sustainability is a pressing global issue with far-reaching implications for business, society, and the planet. The specific examination of EID allows for a deeper understanding of how firms address and communicate their environmental responsibilities. Second, EID practices are evolving rapidly, driven by regulatory changes, technological advancements, and increasing stakeholder expectations. This dynamic landscape offers rich insights into the challenges and opportunities associated with environmental transparency. Lastly, while CSR encompasses a broad range of social and ethical issues, the environmental dimension is often where the most significant regulatory and stakeholder pressures are concentrated, making it a critical area of study for understanding the impact of corporate governance on sustainability (Brammer and Pavelin, 2008; Hahn and Kühnen, 2013).

EID not only supports the environmental pillar of sustainability but also enhances overall corporate governance. By integrating EID into their operations, firms can improve risk management, enhance regulatory compliance, and foster innovation (Hörisch, Schaltegger and Freeman, 2020). These benefits contribute to long-term sustainability by ensuring that firms operate in a manner that is environmentally responsible, economically viable, and socially beneficial (Clarkson et al., 2008; Eccles, Ioannou and Serafeim, 2014).

2.4 Chinese Context of Corporate Governance and Environmental Information Disclosure

Corporate governance and EID in China have evolved significantly over the past few decades, influenced by the country's rapid economic development, unique regulatory environment, and cultural factors. This section provides an overview of the Chinese context, highlighting key developments and challenges in corporate governance and EID practices.

2.4.1 Evolution of corporate governance in China

China's corporate governance system has undergone substantial changes since the late 1970s, following the country's economic reforms and opening-up policy (Chen, Firth and Xu, 2009; Clarke, 2003). The establishment of stock exchanges in Shanghai and Shenzhen in the early 1990s marked a significant milestone in the development of corporate governance in China (Walter and Howie, 2012). These exchanges introduced market mechanisms and regulatory frameworks aimed at improving corporate governance practices and protecting investor interests (Liu, 2006). Post-2020, the Chinese government intensified reforms through the "Three-Year Action Plan for SOE Reform" (2020–2022), emphasizing mixed-ownership structures and market-oriented governance (Xu, Zhang and Zhao, 2022).

The Chinese government has played a pivotal role in shaping corporate governance through a series of laws, regulations, and guidelines. The *Company Law*, first enacted in 1993 and subsequently revised, provides the legal foundation for corporate governance in China (Schipani and Liu, 2017). It outlines the responsibilities and powers of the BoD, supervisory board, and management, emphasizing the protection of shareholder rights and the importance of transparency and accountability (China Securities Regulatory Commission, 2018). The *Code of Corporate Governance for Listed Companies*, introduced by China Securities Regulatory Commission (CSRC) in 2002 and updated in 2018, further enhances these principles by setting detailed standards for board composition, the role of independent directors, and information disclosure requirements (CSRC, 2018). In addition to the *Company La*w and the *Code of Corporate Governance*, other significant regulations have been introduced to strengthen corporate governance. The *Securities Law*, first enacted in 1998 and revised several times, including major amendments in 2019, aims to protect investors, ensure market integrity, and promote fair and efficient securities markets (National People's Congress, 2019). The *Guidelines for Articles of Association of Listed Companies*, issued by the CSRC in 2006, provide a detailed framework for the internal governance of listed firms, including the structure and functioning of corporate bodies (CSRC, 2006).

State ownership remains a defining feature of corporate governance in China. SOEs account for a significant portion of the economy and are subject to unique governance structures and regulatory oversight (Naughton, 2007; Lin and Milhaupt, 2013). The SASAC, established in 2003, oversees the management and reform of SOEs, aiming to enhance their efficiency and competitiveness (Wang, Guthrie and Xiao, 2012). Additionally, the presence of party committees within SOEs adds another layer of governance, with party officials playing a crucial role in strategic decision-making (Li and Qian, 2013). The Chinese government has also introduced regulations aimed at improving transparency and environmental responsibility. The *Green Finance Guidelines* by the People's Bank of China in 2017 emphasize the importance of EID and align financial flows with sustainability goals (People's Bank of China, 2017). Furthermore, the Ministry of Ecology and Environment issued the *Guidelines for Environmental Information Disclosure by Listed Companies* in 2020, mandating comprehensive environmental reporting for listed firms (Ministry of Ecology and Environment, 2020). These laws, codes, and regulations illustrate China's commitment to improving corporate governance and promoting sustainable development.

2.4.2 Environmental information disclosure in China

The increasing awareness of environmental issues and the need for sustainable development have driven the adoption of EID practices in China. The Chinese government has introduced various policies and regulations to promote environmental transparency and accountability among firms. Key regulatory initiatives include the *Environmental Protection Law*, the *Green Credit Guidelines*, and the *Guidelines for Environmental Information Disclosure by Listed Companies* (Zhao and Patten, 2016). Recent regulatory advancements, such as the 2023 amendments to the *Environmental Protection Law*, now mandate real-time pollution monitoring disclosures for heavy industries (Ministry of Ecology and Environment, 2023).

The *Environmental Protection Law*, revised in 2014, mandates that firms disclose information about their environmental impact and compliance with

environmental regulations (Situ and Tilt, 2018). This law aims to enhance public oversight and ensure that firms are held accountable for their environmental performance (Liu and Anbumozhi, 2009). The *Green Credit Guidelines*, issued by the China Banking Regulatory Commission (CBRC) in 2012, encourage financial institutions to consider environmental risks in their lending practices and promote green financing (CBRC, 2012). A 2023 update to these guidelines requires banks to disclose climate risk exposure and align lending portfolios with China's 2060 carbon neutrality target (People's Bank of China, 2023). Recent initiatives include the 2020 *Guidelines for Environmental Information Disclosure by Listed Companies* by the Ministry of Ecology and Environment, which mandate comprehensive environmental reporting for listed firms, enhancing transparency and accountability (Ministry of Ecology and Environment, 2020). Additionally, the *Green Bond Endorsed Project Catalogue*, updated by the People's Bank of China in 2021, sets clear criteria for green projects, ensuring that funds raised through green bonds are allocated to environmentally beneficial projects (People's Bank of China, 2021).

These regulations and guidelines reflect China's commitment to enhancing environmental transparency and promoting sustainable business practices, aligning corporate activities with national and global environmental goals.

2.4.3 Unique challenges and factors in the Chinese context

Despite the significant strides in regulatory frameworks, the implementation of EID in China faces unique challenges influenced by cultural, economic, and institutional factors.

Variability in disclosure quality is one of the primary issues. There is considerable inconsistency in the quality and comprehensiveness of EID among Chinese firms (Zeng et al., 2012). Large SOEs and multinational corporations often provide detailed environmental reports, whereas many smaller private firms, particularly those in less regulated industries, offer minimal information (Liu and Anbumozhi, 2009). This disparity is attributed to variations in awareness, resources, and the perceived importance of environmental issues (Zeng et al., 2012).

Furthermore, the lack of standardized reporting frameworks exacerbates the problem, making it difficult to compare and assess the reliability of disclosed information across different firms (Kolk, 2008). The Ministry of Ecology and Environment's 2022 *Unified ESG Reporting Standards* aimed to address this, but implementation remains fragmented (Ministry of Ecology and Environment, 2022).

Enforcement and compliance represent another significant challenge. The enforcement of EID regulations in China is inconsistent, with notable differences in compliance levels across various regions and industries (Meng et al., 2013). Local regulatory agencies frequently encounter resource constraints and conflicting priorities that hinder effective enforcement (Van Rooij, 2006). Limited financial and human resources impact the regulatory bodies' ability to perform their duties efficiently. Additionally, regulatory enforcement can be influenced by political and economic pressures, complicating efforts to maintain rigorous standards across sectors (OECD, 2020). The presence of guanxi, or personal relationships and networks, can also affect regulatory enforcement, leading to selective compliance and variations in disclosure practices (Li et al., 2008).

The role of state ownership introduces both opportunities and challenges for EID. SOEs, which dominate many sectors, are often at the forefront of implementing government-mandated environmental initiatives due to their alignment with national policies (Wang and Jin, 2007). However, the dual role of the state as both a regulator and an owner can lead to conflicts of interest, potentially impeding objective enforcement of environmental regulations (Li and Qian, 2013). This dynamic can impact the credibility and effectiveness of EID practices within SOEs.

Cultural factors also play a significant role in shaping EID practices. Traditionally, there has been less emphasis on environmental protection and public disclosure in Chinese business culture compared to Western contexts (Hofstede, 1984). Nevertheless, there is a gradual shift as environmental awareness increases and stakeholders, including consumers and investors, demand greater transparency and accountability. According to EY's "CEO Imperative Study", there is a notable shift in

corporate priorities towards sustainability and environmental responsibility as stakeholders exert more pressure for transparent practices (EY, 2021).

The influence of international standards is also shaping EID in China. Many Chinese firms, particularly those with international operations or foreign investors, are aligning their reporting practices with global frameworks such as the GRI and the CDP. This alignment enhances the comparability and credibility of their disclosures, though it presents challenges related to integrating these standards with local regulatory requirements (Liu and Anbumozhi, 2009).

In conclusion, the Chinese context presents unique challenges and opportunities for corporate governance and EID. The evolving regulatory landscape, the prominent role of state ownership, cultural factors, and the influence of international standards all shape the practices and effectiveness of EID in China. Understanding these dynamics is crucial for developing strategies to enhance environmental transparency and accountability within Chinese firms.

2.5 Corporate Governance Mechanisms and Environmental Information Disclosure: Theories and Empirical Studies

2.5.1 Overview

This section provides a comprehensive examination of the relationship between corporate governance mechanisms and EID, integrating insights from three distinct but interconnected studies. It explores the theoretical foundations and empirical evidence related to key corporate governance attributes, such as board characteristics, ownership structure, and board diversity, and their impact on EID. By leveraging theoretical perspectives such as agency theory and RBV theory, and stakeholder theory, voluntary disclosure theory, legitimacy theory, upper echelon theory, and social identity theory, the section aims to elucidate how these governance mechanisms influence firms' environmental transparency and accountability. The empirical findings presented highlight the multifaceted nature of these relationships, offering

valuable insights for scholars, policymakers, and practitioners seeking to enhance corporate environmental reporting and governance practices. Through this integrated analysis, the section underscores the critical role of robust corporate governance in promoting sustainable business practices and improving environmental disclosures.

2.5.2 Board characteristics and environmental information disclosure: theoretical framework and empirical studies

Agency theory, introduced by Jensen and Meckling (1976), addresses conflicts of interest between management (agents) and shareholders (principals). It emphasizes the need for corporate governance mechanisms to ensure management acts in shareholders' best interests. Effective governance enhances information disclosure, promoting transparency and reducing management's opportunistic behavior (Healy and Palepu, 2001; Liao, Luo and Tang, 2015; Agyemang et al., 2020). However, in contexts with weak minority shareholder protections, majority shareholders may exploit their control for private benefits at the expense of minority shareholders (Wright et al., 2005).

The RBV, introduced by Wernerfelt (1984), focuses on leveraging internal resources to achieve competitive advantages. It underscores the importance of unique, non-transferable resources, including board diversity. Board gender diversity, for example, enhances firm capabilities through diverse knowledge and expertise (Galbreath, 2005, 2016; Yu and Choi, 2016). RBV highlights the strategic role of board diversity in enhancing EID, unlike resource dependence theory which focuses on external dependencies (Reguera-Alvarado, de Fuentes and Laffarga, 2017).

The impact of board size on EID is mixed. Larger boards are argued to promote EID due to their diverse expertise (Agyemang et al., 2020; Cucari, Esposito De Falco and Orlando, 2018), but smaller boards may be more efficient and effective in supervision, thus enhancing EID (Peter and Romi, 2014; Mak and Li, 2001).

The presence of independent directors enhances EID by providing objective oversight and reducing opportunistic behaviors (Chen and Jaggi, 2000; Ntim and Soobaroyen, 2013). While most studies find a positive impact of independent

directors on EID (Agyemang et al., 2020; Hussain, Rigoni and Orij, 2018), some report no significant relationship (Michelon and Parbonetti, 2012).

The presence of female directors is linked to improved EID practices, as they bring unique perspectives prioritizing environmental issues (Liao, Luo and Tang, 2015; Mahmood et al., 2018). However, some studies find no significant or negative correlation, suggesting the influence of other factors like firm culture and industry (Amorelli and García-Sánchez, 2021).

Frequent board meetings can enhance EID by improving idea sharing and addressing agency problems (Yakob and Abu Hasan, 2021; Liao, Luo and Tang, 2015). However, the effectiveness of board meetings in enhancing EID may depend on other contextual factors (Giannarakis, 2014).

CEO duality, where the CEO also serves as the board chair, has both positive and negative impacts on EID. Concentration of power in a single individual can lead to prioritizing personal interests over those of shareholders (Ma et al., 2019). Several studies have found a negative correlation between CEO duality and EID levels, indicating that CEO duality may increase conflicts of interest and negatively affect transparency (Gerged, 2020; Alfraih, 2016; Chau and Gray, 2010). However, some research suggests that powerful CEOs may promote higher EID levels to enhance their perceived success and improve their tenure or salary prospects (Jizi et al., 2014).

Table 7 provides the selected literature review of key theories and findings on the impact of board characteristics on EID.

Table 7: Selected Literature Review on Board Characteristics and EID

Board Characteristic	Key Findings	Studies	Theoretical Support
Board Size	Positive impact on EID due to diverse expertise and viewpoints; Larger boards associated with higher EID levels; Coordination challenges in larger boards	Agyemang et al. (2020); Liao, Luo and Tang (2015); Peter and Romi (2014)	RBV Theory
Board Independence	Positive impact on EID through objective oversight; Independent directors reduce opportunistic behaviors; Mixed findings on overall effectiveness	Chen and Jaggi (2000); Gul and Leung (2004); Ntim and Soobaroyen (2013); Cucari, Esposito De Falco and Orlando (2018); Michelon and Parbonetti (2012)	Agency Theory
Board Gender Diversity	Positive correlation with EID; Gender-diverse boards more likely to disclose GHG information and engage in sustainability reporting; Contradictory findings in some studies	Liao, Luo and Tang (2015); Mahmood et al. (2018); Husted and de Sousa-Filho (2019); Amorelli and García-Sánchez (2021)	Stakeholder Theory; RBV Theory
Board Meetings	Frequent meetings positively correlated with EID; More opportunities to address environmental issues; Varied findings on effectiveness	Vafeas (1999); Agyemang et al. (2020); Liao, Luo and Tang (2015); Giannarakis (2014)	Agency Theory; RBV Theory
CEO Duality	Negative impact due to concentration of power; Mixed findings on the correlation with EID	Gerged (2020); Chau and Gray (2010); Jizi et al. (2014)	Agency Theory

2.5.3 Ownership structure and environmental information disclosure: theoretical framework and empirical studies

Voluntary disclosure theory posits that managers prefer to disclose positive rather than negative information (He and Loftus, 2014). Investors, sensing withheld information, may lower their valuations, pressuring managers to release positive data to regain confidence. Firms weigh the benefits of disclosing environmental information, such as improved reputation, against the costs. Voluntary disclosure often balances these better than mandatory disclosure, which can increase information

asymmetry and agency costs (Cheng and Feng, 2023). In emerging economies, where market mechanisms are less developed, voluntary disclosure can be particularly advantageous.

Legitimacy theory highlights the role of broader socio-political contexts in economic activities (Meng et al., 2013). Firms with poor environmental records face increased scrutiny and may engage in extensive EID to improve their image or address deficiencies (Li et al., 2017; Meng et al., 2013). Mandatory EID often serves more to establish legitimacy than to ensure accountability, with external pressures from government and public influencing firms' disclosure practices.

Ownership concentration—where large shareholders hold significant shares—affects EID with mixed results. In the UK and Canada, high ownership concentration correlates with less CSR disclosure, as major shareholders may prioritize short-term profits (Brammer and Pavelin, 2008; Cormier and Magnan, 1999). Conversely, in Bangladesh and Brazil, it is linked to more CSR disclosure, showing regional variability (Sufian and Zahan, 2013; Crisóstomo and Freire, 2015).

Institutional ownership impacts EID significantly, with institutional investors often demanding greater transparency due to their long-term perspectives (Velte, 2020). In China, however, some institutional investors' short-term focus may negatively affect EID (Gerged, 2020). In developed markets, institutional ownership typically promotes higher EID levels (Dyck et al., 2019).

Managerial ownership, where managers hold significant shares, generally leads to increased EID, aligning managerial interests with long-term sustainability goals (Donnelly and Mulcahy, 2008). Studies in the UK and Ireland confirm this positive correlation, although in China, the effect may be moderated by governance conditions and state ownership (Zeng et al., 2012).

State ownership, particularly in China, influences EID in complex ways. SOEs often disclose more information due to governmental pressures but may also face inefficiencies and conflicts of interest that undermine disclosure quality (Bai et al., 2004; Li and Qian, 2013; Meng et al., 2013).

The selected literature review of key empirical studies on the impact of

ownership structure on EID is provided in Table 8.

Table 8: Selected Literature Review on Ownership Structure and EID

Ownership Type	Impact on EID	Key Findings	References
Ownership Concentration	Negative/Variable	High ownership concentration often leads to lower EID due to prioritization of short-term gains over environmental responsibilities.	Brammer and Pavelin (2008); Cormier and Magnan (1999); Liu, Tian and Wang (2011)
Institutional Ownership	Positive/Negative	Institutional investors push for better transparency, but in China, the focus on short-term returns may reduce EID.	Velte (2020); Gerged (2020)
Managerial Ownership	Positive	Aligns managers' interests with those of shareholders, leading to enhanced EID.	Donnelly and Mulcahy (2008); Li et al. (2017)
State Ownership	Positive/Negative	SOEs align with government policies, but conflicts of interest can undermine EID effectiveness.	Bai et al. (2004); Li and Qian (2013); Meng et al. (2013)

2.5.4 Board diversity and environmental information disclosure: theoretical framework and empirical studies

Upper echelon theory asserts that a firm's strategy and performance are shaped by the characteristics of its top management (Muniandy et al., 2023; He et al., 2021; Shahab et al., 2020). CEOs, who are crucial in setting strategic goals, can align these with environmental and sustainability requirements, potentially enhancing corporate environmental sustainability disclosures (Hussain, Rigoni and Orij, 2018). According to Hambrick and Mason (1984), attributes like age are important in understanding firm decisions and performance. This theory highlights how personal characteristics of board members affect environmental disclosures and strategic decisions (He et al., 2021).

Social identity theory (Tajfel and Turner, 1979) explores how group affiliations shape behaviors and interactions (Hogg, 2006). In diverse boards, categorization by attributes such as gender can influence dynamics and decision-making, potentially

leading to inefficiencies or uncooperative behavior (Fernández-Temprano and Tejerina-Gaite, 2020; Liu, Su and Zhang, 2023).

The impact of gender diversity on EID is mixed. Some studies find that gender-diverse boards improve EID due to different perspectives and a focus on ethics (Bear, Rahman and Post, 2010; Hafsi and Turgut, 2013). Others report no significant effect or negative impacts due to cultural and institutional barriers (Agyemang et al., 2020; Zhuang, Chang and Lee, 2018). For instance, Katmon et al. (2019) and Husted and de Sousa-Filho (2019) found positive correlations in Malaysia, while findings in China and other contexts vary.

Board age diversity can influence EID, with older directors often bringing more experience and better moral reasoning, potentially enhancing environmental policies (Ferrell, Fraedrich and Ferrell, 2005; Elmagrhi et al., 2019). However, the effect is context-dependent, with mixed findings across different regions (Cucari, Esposito De Falco and Orlando, 2018; Katmon et al., 2019).

Board tenure affects EID with mixed results. Longer tenure provides experience but may lead to entrenchment and resistance to change (Hafsi and Turgut, 2013; Peng et al., 2021). While some studies find a positive relationship with CSR decision-making (Peng et al., 2021), others report negative associations (Khan et al., 2021).

Directors with overseas experience enhance EID by bringing international perspectives and practices (Zhuang, Chang and Lee, 2018; Shahab et al., 2020). Their global insights contribute to better environmental transparency and reporting quality (Masulis, Wang and Xie, 2012; Li et al., 2017).

Overall, the relationship between board diversity and EID is complex and context-dependent, influenced by various factors including cultural and regulatory environments. Effective corporate governance frameworks must consider these dynamics to promote environmental transparency and accountability. Table 9 shows the selected literature review on the relationship between board diversity and EID.

Table 9: Selected Literature Review on Board Diversity and EID

Board Diversity Element	Key Findings	Theoretical Support	References
Board Age	Positive impact on EID due to higher moral reasoning and experience	Upper Echelon Theory	Ma et al. (2019); Muniandy et al. (2023)
Board Tenure	Mixed effects; positive in stable contexts, negative in highly regulated industries	RBV Theory	Peng et al. (2021); Khan et al. (2021); Hafsi and Turgut (2013)
Gender Diversity	Varies by context; generally positive but can be negative due to cultural resistance	Social Identity Theory	Bear, Rahman and Post (2010); Hafsi and Turgut (2013); Agyemang et al. (2020); Zhuang, Chang and Lee (2018); Katmon et al. (2019)
Overseas Background	Positive impact due to exposure to global best practices	RBV and Upper Echelon Theory	Zhuang, Chang and Lee (2018); Shahab et al. (2020)

2.5.5 Research gaps and contribution to knowledge

This thesis addresses critical gaps in the literature on EID and corporate governance, particularly within the Chinese context. Existing research has predominantly focused on Western economies or specific industries, leaving a fragmented understanding of EID practices in China—the world's second-largest economy and a pivotal player in global sustainability efforts (Li et al., 2013; Husted and de Sousa-Filho, 2019; Shaheen et al., 2021). By extending the scope to encompass all industries in China, including SMEs often excluded from prior studies, this research offers a comprehensive and nuanced perspective on EID practices. This broader focus bridges a significant gap in the literature, which has traditionally overlooked the unique institutional, cultural, and regulatory dynamics shaping environmental transparency in China's hybrid governance model. For instance, while Western-centric studies emphasize agency theory or RBV theory, this thesis integrates these frameworks with legitimacy theory, voluntary disclosure theory, upper echelon theory, and social identity theory to account for China's state-driven governance structures, Communist Party oversight, and informal networks (guanxi). This multi-theoretical approach not

only enhances the explanatory power of the analysis but also provides innovative insights into how competing priorities—such as shareholder accountability, managerial identity, and societal legitimacy—collectively influence EID practices.

The synthesis of findings from three distinct empirical studies into a unified narrative consolidates fragmented knowledge on corporate governance mechanisms and their interplay with EID. By examining board characteristics, ownership structures, and board diversity holistically, the research reveals how formal governance mechanisms interact with informal institutions like guanxi to shape environmental transparency. For example, while SOEs align EID practices with national sustainability agendas to legitimize their operations, private firms and SMEs often prioritize compliance with local norms over global standards. These insights hold practical significance for policymakers, investors, and corporate leaders. Policymakers can leverage the findings to design inclusive regulatory frameworks that address regional enforcement disparities and incentivize SMEs to adopt robust EID practices. Investors gain tools to assess environmental risks in Chinese firms, aligning portfolios with sustainability objectives like the UN Sustainable Development Goals. Corporate leaders, particularly in understudied sectors like consumer staples and basic materials, can adopt governance strategies that balance regulatory compliance with strategic sustainability goals, enhancing long-term reputational equity.

Methodologically, the thesis advances scholarship by combining cross-sectoral and longitudinal analyses, overcoming limitations of prior cross-sectional or self-reported studies. This approach captures temporal shifts in governance practices, such as the impact of China's 2014 *Environmental Protection Law*, while providing empirical rigor to support causal inferences. By centering China's evolving governance landscape, the research sets a foundation for future studies on hybrid systems in emerging economies, encouraging exploration of how cultural norms and institutional reforms shape environmental accountability. Ultimately, this work redefines EID as both a strategic imperative and a reflection of socio-political context, enriching global discourse on corporate governance and sustainability.

2.6 Conclusion of Literature Review

This literature review comprehensively examined the impact of corporate governance mechanisms on EID, with a specific focus on the Chinese context. It explored various key theories such as agency theory, RBV theory, stakeholder theory, legitimacy theory, and stewardship theory, highlighting their relevance in understanding corporate governance and EID. These theoretical frameworks provide essential insights into how different governance mechanisms influence firms' environmental transparency and accountability.

The review critically analyzed different corporate governance models across regions. The Anglo-American model emphasizes transparency and shareholder value maximization but often struggles with short-termism. In contrast, the Continental European model incorporates broader stakeholder interests and promotes long-term sustainability, though it can be inefficient. The Chinese model, characterized by significant state ownership and the integration of party committees, blends market mechanisms with strong state control. This hybrid model presents unique opportunities and challenges for enhancing EID, necessitating a nuanced understanding of its dynamics.

Empirical findings indicated that board characteristics, ownership structure, and board diversity significantly influence EID practices. Larger boards, independent directors, and more board meetings generally enhance EID. Ownership structure, including ownership concentration, institutional ownership, managerial ownership, and state ownership, also plays a crucial role. The relationship between ownership structure and EID is complex, with both positive and negative associations observed in different contexts. Board diversity, encompassing age, tenure, gender, and overseas background, further influences the firm's environmental disclosures.

The Chinese context presents unique challenges and opportunities for corporate governance and EID. The evolution of corporate governance in China has been shaped by economic reforms, regulatory changes, and state ownership dynamics. Key regulatory initiatives, such as the *Environmental Protection Law* and *Green Credit*

Guidelines, aim to promote environmental transparency. However, challenges such as variability in disclosure quality, enforcement inconsistencies, and cultural factors continue to impact EID practices.

In conclusion, this literature review underscores the critical role of robust corporate governance mechanisms in enhancing EID. The findings highlight the necessity for well-structured boards, effective ownership structures, and comprehensive regulatory frameworks to foster sustainable corporate practices and improve environmental transparency. This synthesis provides a solid foundation for the subsequent empirical analysis in the thesis, emphasizing the importance of diverse and effective governance frameworks in promoting accountability and transparency in environmental reporting.

Chapter 3

Methodology

3.1 Introduction

This chapter outlines the research methodology employed to investigate the impact of corporate governance mechanisms on EID in Chinese firms. This comprehensive methodology chapter encompasses research philosophy, research design, data and sample, variables, hypotheses development, data analysis techniques, data management, and ethical considerations. The primary objective is to ensure that the research is conducted systematically and rigorously, providing reliable and valid results that contribute to the understanding of corporate governance and EID in the context of Chinese firms.

3.2 Research Philosophy

Research philosophy shapes the way knowledge is acquired and interpreted in research. Different philosophies offer varied approaches to understanding phenomena and guide methodological choices.

Positivism is a key philosophy that asserts knowledge should be derived from observable, measurable phenomena, which can be empirically tested (Saunders, Lewis and Thornhill, 2016). It emphasizes objective data collection and statistical analysis to validate hypotheses and uncover patterns, making it particularly suited for quantitative research. This approach facilitates a systematic examination of relationships and helps establish generalizable conclusions.

Interpretivism, on the other hand, focuses on understanding subjective meanings and experiences through qualitative methods like interviews and case studies (Bryman, 2016). It aims to explore how individuals perceive and interpret their social worlds, offering deep insights into contextual and nuanced aspects of research topics.

Critical realism acknowledges the existence of an objective reality while recognizing that our understanding is mediated by social constructs and perceptions. This philosophy advocates for a mixed-methods approach to explore underlying mechanisms that influence observable phenomena (Bhaskar, 2014).

Pragmatism is more flexible, emphasizing the practical utility of research findings. It supports the use of both qualitative and quantitative methods depending on what best addresses the research question (Creswell and Creswell, 2017). This approach prioritizes practical outcomes over theoretical consistency.

Previous studies in corporate governance and EID have successfully employed positivist approaches to analyze the impact of board characteristics, ownership structure, and other governance mechanisms on environmental reporting (Chen and Jaggi, 2000; Liao, Luo and Tang, 2015). These studies provide a solid foundation for adopting a positivist philosophy in this research.

EID, as a component of CSR, has been extensively studied through positivist approaches. Positivist research in EID often involves the analysis of annual reports, sustainability reports, and other corporate disclosures to quantify the extent and quality of environmental information provided by firms (Clarkson et al., 2008; Kolk, 2008). The positivist approach allows for the development of standardized measures of EID, such as disclosure indices, which can be used to compare the environmental performance of different firms (Fifka, 2013). By adopting a positivist philosophy, this research aims to contribute to the literature on EID by providing empirical evidence on the impact of corporate governance mechanisms in the context of Chinese firms.

The choice of a positivist approach is particularly pertinent given the objectives of this study, which include testing hypotheses about the relationships between corporate governance variables and EID. The positivist paradigm facilitates the use of statistical techniques to analyze quantitative data, providing robust and generalizable findings. Moreover, the positivist approach aligns with the use of secondary data from established databases, which are commonly employed in corporate governance research. These databases provide reliable and objective data on corporate governance practices and EID, ensuring the validity and reliability of the research findings (Saunders, Lewis and Thornhill, 2016).

While positivism offers several advantages, it is not without criticisms. Critics argue that positivism can be overly rigid and may overlook the complexity and contextual nuances of social phenomena (Guba and Lincoln, 1994). In the context of

corporate governance and EID, a purely positivist approach may fail to capture the subjective experiences and motivations of corporate actors. To address these limitations, the research incorporates robustness checks and sensitivity analyses to account for potential biases and ensure the validity of the findings. Additionally, the study acknowledges the potential influence of contextual factors, such as industry characteristics and regulatory environments, which may impact the relationships between corporate governance mechanisms and EID.

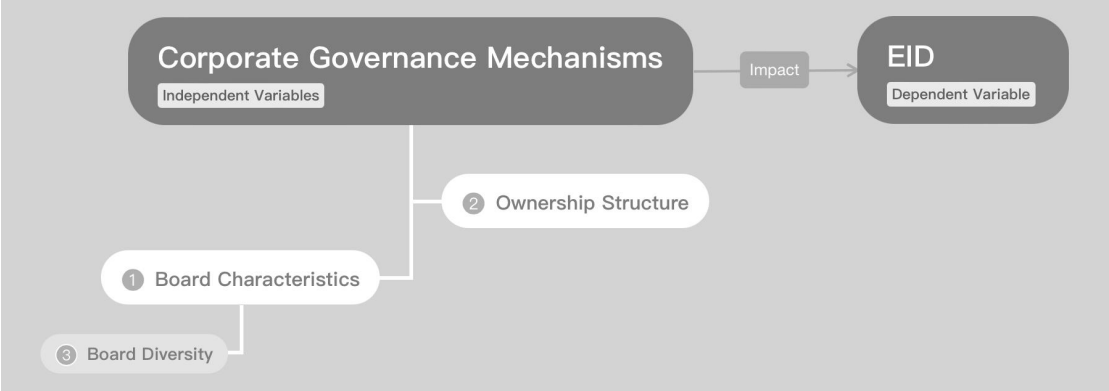
3.3 Research Design and Conceptual Framework

The study adopts a quantitative research approach, which is suitable for analyzing large datasets and providing generalizable findings (Creswell and Poth, 2018). The research design for this study is formulated to systematically investigate the impact of corporate governance mechanisms on EID within the context of Chinese firms over an 11-year period (2009-2019) using panel data. The research strategy integrates empirical data from multiple sources to examine the relationships between various corporate governance mechanisms and EID. This approach ensures a comprehensive analysis of the research problem and enhances the robustness of the findings.

The conceptual framework serves as the foundation for this study, outlining the hypothesized relationships between corporate governance mechanisms and EID. It integrates insights from various theoretical perspectives. This framework guides the selection of variables and the development of hypotheses to be tested empirically. Key constructs in the conceptual framework include board characteristics, ownership structure, and board diversity. These constructs are hypothesized to influence the extent of EID in Chinese firms, with EID operationalized as the dependent variable. The framework provides a clear roadmap for the empirical analysis, specifying the expected relationships between the independent variables (corporate governance mechanisms) and the dependent variable (EID) (Healy and Palepu, 2001; Hillman and Dalziel, 2003). Figure 3 illustrates the relationship between EID and the three

corporate governance mechanisms.

Figure 3: The Conceptual Framework of the Study



Source: Own researcher construct

3.4 Data and Sample

This study relies on secondary data obtained from two primary sources: Bloomberg and the China Stock Market & Accounting Research (CSMAR) database. These databases provide comprehensive and reliable data on corporate governance practices, financial performance, and environmental disclosures of publicly listed firms in China. Bloomberg is renowned for its extensive coverage of global financial markets, providing detailed information on various aspects of corporate governance, financial performance, and ESG metrics. The data from Bloomberg is highly regarded for its accuracy and depth, making it a valuable resource for academic research and practical applications. The database includes detailed information on board characteristics such as board size, independence, gender diversity, frequency of board meetings, and CEO duality. CSMAR database, specifically tailored for Chinese markets, provides accurate and detailed data on corporate governance, financial performance, and other relevant variables. It is widely used in academic research due to its reliability and comprehensive coverage of Chinese listed firms. The database offers granular details on ownership structures, including ownership concentration, institutional ownership, managerial ownership, and state ownership. It also provides data on board diversity, encompassing age diversity, tenure diversity, gender diversity, and the international

experience of board members. CSMAR's extensive historical data enables researchers to conduct robust longitudinal studies, making it an invaluable resource for examining trends and changes over time.

The sample for this study includes 300 publicly listed firms in China over an 11-year period, from 2009 to 2019. The year 2009 was chosen as the starting point for the study due to the limited availability of environmental disclosure data prior to this year. Significant regulatory changes occurred between 2006 and 2008, with China introducing the *Interim Measures for Public Participation in Environmental Impact Assessment* and the *Environmental Information Disclosure Measures* (Agyemang et al., 2020). Following the enactment of the *Clean Production Promotion Law* and the *Environmental Impact Assessment Law*, there has been an increased emphasis on public access to environmental information. This has led to the practical implementation of government and corporate EID initiatives. Firms from various industries are included to ensure the generalizability of the findings. This diverse sample allows for the examination of industry-specific effects and provides a comprehensive understanding of the relationship between corporate governance and EID across different sectors.

3.5 Variables

The selection of variables in this study is grounded in theoretical frameworks and empirical evidence from prior research. Below is a detailed justification for each variable category, including their operationalization and alignment with existing literature.

3.5.1 Dependent variable

The environmental disclosure score (EDS) is the primary dependent variable in this study. It is compiled by Bloomberg and provides a comprehensive measure of the extent and quality of environmental information disclosed by firms (Van Hoang et al.,

2021; Fahad and Nidheesh, 2021). The EDS encompasses various aspects of environmental performance, including emissions, resource usage, waste management, and environmental policies. It is designed to capture the transparency and thoroughness of a firm's environmental disclosures, thereby serving as a proxy for EID.

3.5.2 Independent variables

The primary independent variables of interest in this study are corporate governance mechanisms and EID. These variables are measured as follows:

Board characteristics includes variables such as board size (BS), board independence (BIND), board gender diversity (BGEN), frequency of board meetings (BM), and CEO duality (DUAL). These variables are measured using data from Bloomberg and CSMAR, with board size, meetings, gender diversity and independence being quantified by the number of directors (Agyemang et al., 2020), the number of meetings held by the board (Yakob and Abu Hasan, 2021), and the proportion of female and independent directors (Post et al., 2015), respectively. CEO duality is a binary variable, with 1 if the same person holds both the CEO and the chairman position, and 0 otherwise (Gerged, 2020).

Ownership structure encompasses ownership concentration (OWCONCEN), institutional ownership (INSTITOW), managerial ownership (MANGOW), and state ownership (STATEOW). Ownership concentration is measured by the proportion of shares held by the largest shareholders, while institutional and managerial ownership are measured by the percentage of shares held by institutional investors (Dyck et al., 2019) and managers, respectively. State ownership is determined by the proportion of shares held by government entities (Wang et al., 2022).

Board diversity includes age diversity (BAGE), tenure diversity (TENURE), gender diversity (BGEN[1]), and international experience of board members (OVERSEABACK). These variables are measured by calculating the average ages

[1] It is important to note that the measurement methodology for BGEN in this context differs from that used in the study on board characteristics.

(Sial et al., 2018) and tenures (Muniandy et al., 2023), the Blau index of gender (Sial et al., 2018) and international experience among board members (Zhuang, Chang and Lee, 2018).

3.5.3 Control variables

To ensure the robustness of the analysis, several key control variables are incorporated:

Firm Size (FS) is measured by the natural logarithm of total assets or revenues of the firm. Larger firms may have more resources to allocate to EID (Andrikopoulos and Kriklani, 2013). Industry (IND) is a categorical variable indicating the industry sector of the firm (Elfaitouri, 2014). Year (YEAR) is a dummy variable included to account for year effects (Wang et al., 2004). Different industries have varying levels of environmental impact and regulatory requirements (Clarkson et al., 2008). Financial Performance (ROA) is typically measured by return on assets (ROA) or return on equity (ROE). Financially healthier firms may invest more in environmental initiatives and disclosures (Haniffa and Cooke, 2005). Leverage (LEV) is meansured by the ratio of total debt to total assets. Higher leverage can impact a firm's ability to invest in environmental initiatives (Jaggi and Freedman, 1992). Tobin's Q ratio (TOBINQ) is calculated as the ratio of a firm's market value to the replacement cost of the firm's assets (Uyar et al., 2020). Big 4 (BIG4) is the dummy variable which is 1 if the listed firm is audited by the Big Four; otherwise, it is 0 (Gerged, 2020). Market-to-Book ratio (MKTB) is calculated by using the firm's market value divided by its book value (Wang et al., 2019).

These variables are critical in understanding the dynamics of corporate governance mechanisms and their influence on EID. By incorporating these variables into the analysis, the study aims to provide comprehensive insights into how various governance attributes contribute to the transparency and quality of environmental disclosures among Chinese firms.

3.6 Research Models by Chapter

This section presents the research models used in each chapter of this thesis. It provides a clear summary of the methodologies employed to examine the relationship between corporate governance mechanisms and EID in Chinese firms. The study employs panel data regression models, instrumental variable techniques, and robustness checks to ensure the reliability of findings.

3.6.1 Chapter 4: Board Characteristics and EID

Based on the prior studies (Agyemang et al., 2020; Wang et al., 2019), the analysis of board characteristics and EID in Chapter 4 utilizes a FE panel data regression model. This model examines how board size, board meetings, board independence, board gender diversity, and CEO duality influence EID. This approach ensures that the findings reflect the direct impact of board characteristics on EID while minimizing confounding effects.

$$EDS_{it} = c + \beta_1 BS_{it} + \beta_2 BM_{it} + \beta_3 BIND_{it} + \beta_4 DUAL_{it} + \beta_5 BGEN_{it} + Controls_{it} + \varepsilon_{it}$$

3.6.2 Chapter 5: Ownership Structure and EID

Based on previous studies (Acar, Tunca Çalıyurt and Zengin-Karaibrahimoglu, 2021; Akrout and Othman, 2016; Amosh and Mansor, 2020; Chang and Zhang, 2015; Ismail, Abdul Rahman and Hezabr, 2018), the analysis of ownership structure and EID in Chapter 5 utilizes a similar FE panel data regression model. This model examines how ownership concentration, managerial ownership, institutional ownership and state ownership influence EID. This approach ensures that the findings reflect the direct impact of ownership structure on EID while minimizing confounding effects.

$$EDS_{it} = c + \beta_1 OWCONCEN_{it} + \beta_2 INSTITOW_{it} + \beta_3 MANGOW_{it} + \beta_4 STATEOW_{it} + Controls_{it} + \varepsilon_{it}$$

3.6.3 Chapter 6: Board Diversity and EID

Drawing upon prior research (Muniandy et al., 2023; Katmon et al., 2019; Sial et al.,

2018; Agyemang et al., 2020), the analysis of board diversity and EID in Chapter 6 utilizes a similar FE panel data regression model. This model examines how board age, board tenure, board gender diversity, and board overseas background influence EID. This approach ensures that the findings reflect the direct impact of board diversity on EID while minimizing confounding effects.

$$EDS_{it} = c + \beta_1 BAGE_{it} + \beta_2 TENURE_{it} + \beta_3 BGEN_{it} + \beta_4 OVERSEABACK_{it} + Controls_{it} + \varepsilon_{it}$$

3.7 Data Analysis Techniques

To analyze the data, this study employs a variety of statistical techniques as follows.

3.7.1 Descriptive statistics

Descriptive statistics provide an initial overview of the data, summarizing the central tendencies, dispersions, and distributions of the variables involved. By examining the means, medians, standard deviations, and ranges of the key variables, the study identifies the general patterns and potential anomalies in the dataset. Descriptive statistics also facilitate a better understanding of the characteristics of the sample firms, including their corporate governance structures and EID practices.

3.7.2 Correlation analysis

Correlation analysis is conducted to examine the strength and direction of the linear relationships between the independent variables (corporate governance mechanisms) and the dependent variable (EDS). Pearson's correlation coefficient and variance inflation factor (VIF) are used to quantify the degree of association between pairs of variables, and help identify any potential multicollinearity problems among the independent variables, which is crucial for ensuring the validity of the regression models.

3.7.3 Panel data regression analysis

Panel data regression analysis is a cornerstone of this study, given the longitudinal nature of the data. Panel data, which combines cross-sectional and time-series data, allows for the control of unobserved heterogeneity by capturing individual firm effects that do not change over time (Baltagi, 2008). This study employs fixed effects (FE) and random effects (RE) models to analyze the impact of corporate governance mechanisms on EID.

The FE model controls for time-invariant characteristics of the firms, focusing on within-firm variations over time. This model is particularly useful for isolating the effects of corporate governance mechanisms on EID by accounting for firm-specific factors that might confound the results (Wooldridge, 2010).

The RE model assumes that the unobserved firm-specific effects are uncorrelated with the explanatory variables. This model is used to capture both within-firm and between-firm variations, providing a more generalized understanding of the relationship between corporate governance and EID (Wooldridge, 2010).

The Hausman test is employed to determine the appropriate model (Hausman, 1978). If the test indicates that the FE model is more suitable, it will be preferred; otherwise, the RE model will be used.

3.7.4 Robustness Checks

To ensure the reliability and validity of the results, several robustness checks are conducted. These checks include alternative specifications, endogeneity tests, and sensitivity analyses. These checks help confirm that the findings remain consistent under different analytical conditions.

This study examines different model specifications to verify the consistency of the findings. This includes adding additional control variables or interaction terms to explore potential moderating effects of environmental regulations on corporate governance and EID, incorporating lagged independent variables to address concerns of simultaneity bias, and testing alternative proxies for corporate governance variables, such as using the Blau index of board gender diversity instead of the percentage of female board members. This approach helps ensure that the results are not driven by a

specific model choice but are robust across various model configurations.

Since endogeneity may arise due to omitted variable bias, measurement errors, or reverse causality, the study employs instrumental variable (IV) techniques, such as two-stage least squares (2SLS) and lagged effect regression. IV techniques are used, where external instruments (e.g., lagged governance variables or political connections) help correct for endogeneity (Wooldridge, 2010). In addition, Durbin-Wu-Hausman Test is used to assess whether endogeneity is present in the regression models, determining if the FE model is preferable over an instrumental variable approach. These techniques help to ensure that the estimated relationships are not contaminated by reverse causality or omitted variable bias. Extreme values in governance or EID variables are also removed to test whether the findings are driven by outliers.

By conducting these rigorous robustness checks, this study ensures that the reported relationships between corporate governance mechanisms and EID are not driven by specific model choices, omitted variables, or sample biases, thus reinforcing the validity and reliability of the conclusions.

3.7.5 Additional analyses

In addition to the primary analyses, two main types of additional analyses are conducted to provide deeper insights into the relationship between corporate governance mechanisms and EID. These analyses include subgroup analyses and trend analysis and they help address specific research questions by identifying variations in governance effects across firm characteristics and tracking EID developments over time.

Subgroup (or subsampling) analyses is used to examine whether the impact of corporate governance mechanisms on EID differs across specific firm characteristics, such as firm size and industry type. This approach helps to uncover potential heterogeneity in the effects of governance practices on environmental disclosure. The rationale for this approach is based on prior research indicating that governance structures and disclosure practices are not uniform across firms (Li et al., 2013; Clarkson et al., 2008). Given that certain industries, such as energy and manufacturing,

are subject to stricter environmental regulations than service-based industries, the effectiveness of corporate governance mechanisms may vary depending on regulatory intensity. By dividing firms into highly regulated and less regulated sectors, the study assesses whether governance structures play a more significant role in driving EID in industries with greater compliance pressure. Besides, larger firms often face higher public scrutiny and greater regulatory expectations, leading to more comprehensive disclosure practices (Uyar et al., 2013). By separating firms into large-cap and small-cap groups, the study evaluates whether corporate governance mechanisms influence EID differently depending on firm size.

Trend analysis is conducted to examine changes in EID practices over time. By plotting the average EDS against time, the study can identify temporal patterns and potential shifts in corporate governance practices and environmental disclosure. By aligning trends with key policy changes, such as the 2014 *Environmental Protection Law*, the study evaluates whether regulatory reforms have strengthened governance-driven EID improvements over time (Situ and Tilt, 2018). In addition, a long-term view of EID trends helps determine whether improvements in corporate governance translate into sustained enhancements in environmental disclosure, rather than being temporary responses to external pressures, so longitudinal changes are assessed in this study. These analyses provide insights into how EID has evolved and whether there have been significant changes in response to regulatory developments or other external factors.

By employing subgroup and trend analysis, this study ensures a comprehensive investigation of governance mechanisms' influence on EID while accounting for variations across firms and tracking changes over time. The combination of panel data regression analysis, robustness checks, and additional analyses ensures the reliability and validity of the findings, contributing to the literature on corporate governance and environmental disclosure.

3.8 Data Management and Ethical Considerations

Effective data management and adherence to ethical standards are crucial for this research, given the sensitivity and confidentiality associated with corporate governance and environmental disclosure data. Stringent measures are employed to ensure data integrity, security, and ethical compliance throughout the research process.

The data for this study is sourced from Bloomberg and the CSMAR database, both of which are renowned for their comprehensive and reliable data coverage. Data collection involves obtaining relevant variables related to corporate governance mechanisms and EID, including board characteristics, ownership structures, financial performance, and EDS. Once collected, the data is meticulously cleaned to identify and rectify any inaccuracies, inconsistencies, or missing values. This involves cross-referencing data points with multiple sources where possible and applying statistical techniques to handle missing data, such as mean imputation or multiple imputation methods. All data is securely stored in a password-protected file, with regular backups to prevent data loss, complying with institutional data management policies and ensuring that only authorized personnel have access to the data.

Variables are coded appropriately to facilitate statistical analysis. This includes creating dummy variables for categorical data (e.g., CEO duality, industry sectors), and standardizing continuous variables (e.g., firm size, financial performance metrics). To maintain the confidentiality of the firms involved, all identifiable information is anonymized, ensuring that the data cannot be traced back to individual firms and protecting their privacy.

Comprehensive documentation is maintained for all data management processes, including data collection methods, cleaning procedures, and coding schemes, ensuring transparency and reproducibility of the research findings.

Ethical considerations are paramount, particularly given the use of secondary data and the potential implications for corporate entities. The study respects the principles of informed consent, relying on data that firms have voluntarily disclosed

in their annual reports, sustainability reports, and other public filings. The confidentiality of the firms' data is strictly maintained through anonymization techniques, protecting the firms' privacy and complying with data protection regulations.

In summary, the rigorous data management and ethical standards applied in this study ensure the integrity, security, and ethical compliance of the research process, ultimately contributing to the reliability and validity of the research findings on the impact of corporate governance mechanisms on EID among Chinese firms.

3.9 Conclusion

This chapter provides a comprehensive overview of the research methodology employed to investigate the impact of corporate governance mechanisms on EID in Chinese firms. The methodology is grounded in a positivist research philosophy, emphasizing objectivity, replicability, and generalizability, which is particularly suitable for the quantitative analysis conducted in this study. The research design involves a quantitative approach, leveraging panel data over an 11-year period from 2010 to 2021, and integrates empirical data from Bloomberg and the CSMAR database.

The study focuses on analyzing the relationships between various corporate governance mechanisms, including board characteristics, ownership structure, and board diversity, and their influence on EID. The primary dependent variable, the EDS, is compiled by Bloomberg and serves as a comprehensive measure of environmental transparency and disclosure quality. The independent variables encompass detailed aspects of board characteristics, ownership structures, and board diversity, with additional control variables such as firm size, industry, financial performance, and leverage to ensure robust analysis.

A range of statistical techniques, including descriptive statistics, correlation analysis, and panel data regression analysis (both FE and RE models), are employed

to analyze the data. Robustness checks, including alternative model specifications and endogeneity tests, are conducted to validate the findings. The methodology also includes additional analyses, such as subgroup and trend analyses, to provide deeper insights into the relationship between corporate governance mechanisms and EID.

Data management and ethical considerations are meticulously addressed, with stringent measures in place to ensure data integrity, security, and ethical compliance. The study relies on secondary data from reliable sources, ensuring the confidentiality and anonymity of the firms involved. Overall, the methodological framework outlined in this chapter aims to provide a systematic and rigorous approach to understanding the dynamics of corporate governance and environmental disclosure in Chinese firms, contributing valuable insights to the literature on corporate governance and EID.

Chapter 4

Board Characteristics

4.1 Brief Summary

Using a panel data set comprising 300 listed firms on Shanghai Shenzhen 300 Index (SHSZ300) from 2009 to 2019, this study aims to examine whether board characteristics (namely, board size, board independence, board gender diversity, board meeting and CEO duality) affect the EID of Chinese firms. This study shows that despite the increasing trend of China's EID practice in recent years, the level of EID is still relatively low compared to developed countries. Drawing upon agency theory and RBV theory, we find that board size, board meetings and board independence are positively associated with EID. However, board gender diversity and CEO duality have no significant impact on EID. Further analyses reveal that the relationship between EID and board characteristics is more pronounced in low-regulated industries. The enforcement of the 2014 *Environmental Protection Law of the People's Republic of China* plays a pivotal role in enhancing the nexus between EID and board independence.

4.2 Introduction

Damage caused by corporate activities has exceeded the natural repair capacity (Agyemang et al., 2020), which has led to a number of actions on climate change, such as the promulgation of the *United Nations Framework Convention on Climate Change* in 1992, the publication of the Kyoto Protocol in 1997, the COP21 in Paris in 2015, and the ratification at COP22 in Morocco in 2016. In one of the latest COP 28 held in the United Arab Emirates in 2023, countries aimed to turn the 2020s into a decade of climate action, thereby limiting the increase in global average temperature to less than 1.5 degrees. As global concerns about environmental protection have risen to prominence, there has been a concurrent increase in stakeholder demands for corporate EID in recent years (Zeng et al., 2012). EID refers to the practice of disclosing information about firms' activities related to the natural environment, environmental protection and resource usage (Zeng et al., 2010). This disclosure

approach enables investors, local communities, consumers, employees, and the public to exert more easily pressure on firms to become more environmentally friendly through access to direct information on environmental risks (Zeng et al., 2012). The benefits of corporate EID have been demonstrated in the studies of Aerts, Cormier and Magnan (2008), Clarkson et al. (2008), and Ozen and Kusku (2009). For example, details regarding environmental activities or incidents with enduring consequences, such as ecological accidents or Superfund sites, enable analysts to more effectively forecast a firm's future earnings (Aerts, Cormier and Magnan, 2008).

China is a large transitional economy that is shifting from a planned economy to a market economy and has now become the second largest economy in the world (Jiang and Kim, 2015). It is an interesting context to study because of its unique institutional environment and its development of corporate governance. On the one hand, China's economic environment is different from that of western countries. The market economy is still in its development stage, and state ownership plays a leading or even controlling role in the public listing of enterprises (Yuen et al., 2009). These unique characteristics lead to differences in the corporate governance mechanisms and the EID-related issues. On the other hand, the Chinese government has implemented several corporate governance[2] mechanisms with the aim of strengthening the internal supervision and control of listed firms and improve the information environment (Liu, 2015). In 2002, the CSRC and the State Economic and Trade Commission jointly issued the *Code of Corporate Governance for Listed Companies in China* in 2002. This code requires firms to fully and accurately disclose all information required by law. They should also voluntarily disclose any non-mandatory information that could have a material impact on shareholders and stakeholders.

Xiao and Yuan (2007) note that the direction of disclosure is significantly influenced by the cultural environment in which the firms operate. Chinese society is characterized by relatively high collectivism and power distance, as well as strong uncertainty avoidance. These social values suggest that the Chinese firms tend to

[2] Corporate governance can be considered as a series of mechanisms attempting to balance the economic and social interests of the firms, thereby aligning the interests of shareholders with those of the whole society (Gerged, 2020).

abide by rules and regulation. In terms of environmental issues, the most influential guidelines came into effect in 2011 when the Ministry of Environmental Protection (MEP) released the *Measures for the Disclosure of Environmental Information* (Qian, Zhu and Tilt, 2022). The measure details environmental disclosure guidelines and assessment methods. As a supplement, MEP issued the *Notice on Further Strengthening the Publicity of Environmental Protection Information* in 2012. In 2014, the National People's Congress of the People's Republic of China revised the *Environmental Protection Law*, strengthening the environmental responsibilities of governments, businesses and organizations. In 2015, the Shanghai Stock Exchange issued the *Evaluation Methods of Information Disclosure of List Companies*, which elaborated on the environmental information disclosure requirements of listed firms. Meanwhile, the Shanghai Stock Exchange has also intensified environmental supervision to protect shareholders' rights to obtain information from listed firms.

In the decision-making process, different corporate governance mechanisms, including board characteristics (i.e. board size, board independence, board gender diversity, board meetings, CEO duality), can play significant roles in safeguarding stakeholders' interests (Gerged, 2020). By increasing the EID level, information asymmetry can be reduced, which clarifies the conflict of interests between shareholders and the management and makes the management more responsible (Khaireddine et al., 2020). While among the key determinants that affect EID, the most commonly studied features are board size and board independence. For instance, Prado-Lorenzo and Garcia-Sanchez (2010) studied the board's role when disseminating environmental information from an international perspective. They found that the essential corporate governance mechanisms to improve environmental transparency are board size and board meetings, which are considered as two essential board characteristics elements. Ganapathy and Kabra (2017) examined whether corporate governance mechanisms of the most polluting Indian firms affect the firms' decision to release environmental information and found that board size is a vital determinant of the EID level.

This study aims to analyze the relationship between the EID and five board

characteristics (board size, board meetings, board gender diversity, board independence and CEO duality) and provide new insights into the factors that influence corporate EID decisions. Our contributions are fourfold, addressing critical gaps in the literature and offering novel insights for policymakers and practitioners. First, while previous studies have extensively explored the variability in CSR and ESG disclosure among western countries (e.g. Giannarakis, Andronikidis and Sariannidis, 2019; Kang, Cheng and Gray, 2007; Kathy Rao, Tilt and Lester, 2012), there is a few studies that specifically addresses EID, particularly in the context of developing countries (e.g. Gerged, 2020; Husted and de Sousa-Filho, 2019; Mohammad Rabi, 2019). Given China's unique corporate structure, state influence, and rapid regulatory changes, this study shifts the lens to China, where EID remains underexplored despite its growing environmental challenges. We systematically examine how the five board characteristics—board size, meetings, gender diversity, independence, and CEO duality — influence EID decisions, providing empirical evidence on the role of governance structures in driving transparency. By contextualizing these dynamics within China's transition from voluntary to mandatory EID frameworks, we illuminate how corporate governance acts as a catalyst for environmental accountability in emerging economies. Second, departing from prior studies that rely on a single theoretical lens (Zeng et al., 2012), we integrate agency theory and RBV to explain the interplay between governance and EID. Agency theory elucidates how independent boards mitigate managerial opportunism by demanding greater environmental transparency, while RBV highlights how gender-diverse and resource-rich boards enhance firms' capacity to disclose environmental data. This dual framework is particularly salient in China, where voluntary disclosure norms coexist with tightening state mandates, offering a nuanced understanding of how governance mechanisms operate under hybrid institutional pressures. Third, unlike earlier works that narrowly focus on high-pollution industries (Zeng et al., 2010; Agyemang et al., 2020; Tang and Luo, 2010), our analysis spans all sectors in China, revealing broader trends in EID adoption. This approach avoids overestimating national EID performance and demonstrates that governance-driven disclosure practices are

pervasive across industries, underscoring the universal relevance of board attributes in fostering environmental stewardship. Finally, a key novel contribution of this study is its investigation of the moderating role of the 2014 *Environmental Protection Law* in shaping the governance–EID relationship. The findings reveal that the enactment of this law has significantly strengthened the impact of board independence on EID, highlighting the role of regulatory interventions in reinforcing governance effectiveness. This insight is crucial for policymakers aiming to enhance corporate environmental accountability through governance reforms.

The remainder of this study is structured as follows. Related theories, previous studies and hypotheses are presented in the next section. The methodology is provided in the third section. The fourth section displays findings and discussions. The final section discusses the key findings, recommendations and future research.

4.3 Theoretical Framework and Hypotheses Development

4.3.1 Theoretical framework

Corporate governance models vary by country, firm, and industry (Oliveira, Ceglia and Antonio Filho, 2006). As an emerging market, China has a unique governance model, combining American and German board models with its own uniqueness (Ding et al., 2010). Among various theories[3] applied in the existing corporate governance literature, agency theory (Donaldson and Davis, 1991; Ferraro, 2018) is one of the general theoretical frameworks. Conceptualized by Jensen and Meckling (1976), agency theory provides rationales for establishing corporate governance mechanisms to resolve conflicts of interest between management and owners. It also provides a theoretical foundation for the crucial role of boards in overseeing and managing on behalf of shareholders (Fama and Jensen, 1983; Eisenhardt, 1989). According to agency theory, information disclosure can reduce information

[3] ***Appendix 1*** provides a brief overview of the theories in the relevant existing literature.

asymmetry between internal and external directors (Healy and Palepu, 2001; Jensen, 1988; Liao, Luo and Tang, 2015), and suitable corporate governance mechanisms can improve information disclosure quality. Furthermore, a competent board can reduce the management's opportunism and improve the firm's EID level (Agyemang et al., 2020). Nonetheless, agency theory could lead to issues related to the abuse or misuse of power. Many studies recognize that firms may have different types of principals whose interests and goals are not consistent (Wright et al., 2005). For example, in countries where the protection of rights of minority investors is relatively low, majority shareholders may abuse their power and try to capture the private interests of control at the expense of minority shareholders. Therefore, the main agency problem in this environment is not that professional managers fail to meet the goals of diversified shareholders but rather that controlling shareholders deprive minority shareholders.

Furthermore, according to RBV theory (Wernerfelt, 1984), firms design strategies by organizing internal resources to respond to environmental opportunities while balancing external threats and preventing internal weaknesses to gain competitive advantages. Several researchers have explained the importance of board diversification based on RBV theory (Barney, 1991; Galbreath, 2005, 2016; Yu and Choi, 2016). Barney (1991) outlined the heterogeneous resources in an enterprise, such as its assets, employee experience and competencies, and planning, controlling and coordinating systems. Nevertheless, resources owned by the firm may not be perfectly transformed among enterprises. Therefore, board gender diversity is the cornerstone of its uniqueness in line with the RBV theory, which supports the application of the knowledge, intelligence and expertise of various board members as valuable firm resources. We posit that RBV theory is a valuable starting point for EID analysis as it emphasizes the importance of intangible resources and capabilities (Gallego-Álvarez, Manuel Prado-Lorenzo and García-Sánchez, 2011). RBV theory is also different from the commonly used resource dependence theory. The latter emphasizes that the role of the boards is to connect firms with external organizations to solve environmental dependence problems (Reguera-Alvarado, de Fuentes and

Laffarga, 2017) and how external resources influence firms' behaviors, rather than utilizing the internal resources of the boards to create value to the firms as suggested by the RBV theory.

4.3.2 Board size and the EID levels

Previous studies have shown that board size might affect EID, however the results are mixed (Agyemang et al., 2020; Liao, Luo and Tang, 2015: Mohammad Rabi, 2019). For instance, some scholars (Cucari, Esposito De Falco and Orlando, 2018; Agyemang et al., 2020; Gerged, 2020; Ganapathy and Kabra, 2017; Liao, Luo and Tang, 2015) argue that firms with large boards are more likely to participate in EID practices. The reason is that an increase in the number of board members provides a variety of knowledge and expertise (Tang and Luo, 2010; Husted and de Sousa-Filho, 2019) that can reduce agency problems and help improve the capabilities of board members who can help enhance the EID practices (Mohammad Rabi, 2019; Gerged, 2020). Agyemang et al. (2020) found a positive correlation between board size and firms' EID levels, aligning with the findings of Donnelly and Mulcahy (2008). The latter argued that firms reduce the information asymmetry among their managers and other stakeholders by adopting a larger board size. According to RBV theory, a larger board size can contribute additional intangible resources and capabilities to firms (Gallego-Álvarez, Manuel Prado-Lorenzo and García-Sánchez, 2011). In addition, agency theory posits that these resources can alleviate agency problems or costs and information asymmetry between internal and external directors (Healy and Palepu, 2001; Jensen, 1988; Liao, Luo and Tang, 2015). In contrast, Peter and Romi (2014) found that a smaller board size may be more likely to improve board efficiency, leading to more effective supervision and encouraging the firm to disclose environmental information. Some researchers, such as Mak and Li (2001), Yoshikawa and Phan (2003), Yatim, Kent and Clarkson (2006) and Khanchel (2007), suggest that boards should be small because it is difficult to organize large boards of directors. In light of the above discussion, this study proposes the following hypothesis:

H1 Larger board size is positively correlated with higher EID levels.

4.3.3 Board meetings and the EID levels

Vafeas (1999) revealed that board activities, measured by the frequency of board meetings, are an essential dimension of board operations, contributing to the resolution of agency conflicts. The number of board meetings represents the time capacity of the board, as the frequency of meetings reflects the level of board activity (Hu and Loh, 2018). The low frequency of board meetings affects the control of management and delays the provision of critical decisions and information to various stakeholders. With enhanced interaction through board meetings, directors will better monitor requests and meet stakeholders' needs to ensure legitimacy. Increasing the number of board meetings also can promote idea sharing, EID level, and the ability to solve agency problems (Yakob and Abu Hasan, 2021). Thus, researchers generally believe that the quality of the environmental information disclosed tends to improve as the number of board meetings increases (Peter and Romi, 2014; Agyemang et al., 2020). For instance, Liao, Luo and Tang (2015) found that firms holding more board meetings are more likely to disclose carbon information voluntarily. A study by Frias-Aceituno, Rodriguez-Ariza and Garcia-Sanchez (2013) used a sample of 568 firms from 15 countries from 2008 to 2010 to demonstrate the impact of specific board characteristics including board meetings. Their results show a positive relationship between board meetings and environmental information transparency. Moreover, Husted and de Sousa-Filho (2019) contend that the number of board meetings is significantly and positively correlated with environmental information quality. However, Giannarakis (2014) studied the impact of board meetings on CSR disclosure and found an insignificant impact. Therefore, this study proposes the following hypothesis:

H2 The frequency of board meetings is positively correlated with higher EID levels.

4.3.4 Board independence and the EID levels

The representation of independent directors on the board is deemed an essential

element of corporate governance mechanisms. Independent directors are those whose interests are not directly involved in corporate activities (Akbas, 2016). According to agency theory, independent boards play an effective oversight role by objectively questioning and evaluating the management, reducing agency costs (De Villiers, Naiker and Van Staden, 2011; Florackis and Ozkan, 2004). Since independent directors are not involved in the day-to-day operations and have non-material economic interests in the firm, they are less influenced by the management (Liao, Luo and Tang, 2015). As a result, they are more likely to curb opportunistic behaviors of managers, provide more objective feedback on firms' operations, and improve management supervision (Hillman and Dalziel, 2003; Coffey and Wang, 1998; Liao, Luo and Tang, 2015).

The findings of Chen and Jaggi (2000), Gul and Leung (2004), Byard, Li and Weintrop (2006), Cheng and Courtenay (2006), and Ahmed, Hossain and Adams (2006) show that a greater proportion of independent directors on the board, the more transparent of the environmental information disclosed by the firm as independent directors will be able to encourage the management to disclose more information. According to Ntim and Soobaroyen (2013), independent directors bring greater diversity to the firm's board, including knowledge, skills, and business connections. This opinion aligns with RBV theory which supports that independent directors can successfully address stakeholders' interests by providing new resources and insights and leveraging their connections and business expertise (Barney, 1991). Although CEOs may be reluctant to increase firms' EID levels since such actions may pay off in the long run, independent directors are more likely to be aware of the potential of EID-related projects and resist any pressure from the management of ignoring such opportunities. They are also more willing to advocate costly climate-friendly policies (Johnson and Greening, 1999). Research has shown that independent directors play a role in controlling the management's interests for personal gain (Agyemang et al., 2020). Hussain, Rigoni and Orij (2018) found that a more independent BoD plays a significant role in promoting sustainable performance. According to Chan, Watson and Woodliff (2014), independent directors on the board relates to more CSR

disclosures. Other scholars, such as Cucari, Esposito De Falco and Orlando (2018) and Husted and de Sousa Filho (2019), have also found that the percentage of independent directors has a significant positive impact on the firm's EID level. In contrast, Michelon and Parbonetti (2012) found no significant relationship between board independence and sustainability disclosure, but board independence had a significant negative impact on environmental disclosure. Therefore, this study proposes the following hypothesis:

H3 Board independence is positively correlated with firms' EID levels.

4.3.5 CEO duality and the EID levels

CEO duality refers to the concept that the firm's chairman also serves as the CEO. Due to the concentration of power, when the chairman and the general manager are the same person, he/she will pay more attention to personal issues and ignore the interests of shareholders (Ma et al., 2019), but sometimes the needs of stakeholders and the interests of managers may converge. For example, business investments aimed at reducing gas or waste emissions may make cities more receptive to the firm's proposal to expand the scope of operations. However, in some cases, convergence may become divergence because allocating resources to meet the needs of interest groups indicates reducing the means for managers to carry out the diversification process (Hill and Jones, 1992). Moreover, agency costs are believed to increase under this condition (Jensen and Meckling, 1976; Giannarakis, Andronikidis and Sariannidis, 2019). As is held by agency theory that agency costs will be increased when one person holds the two roles (Jensen and Meckling, 1976; Giannarakis, Andronikidis and Sariannidis, 2019); while the separation of these two roles is conducive to improving the quality of supervision and information transparency (Sundarasen, Je-Yen and Rajangam, 2016).

However, Donaldson and Davis (1991) argue that stewardship theory emphasizes the beneficial impact of authority structures on shareholder returns, and this structure unifies command by allowing the same person to play both the role of CEO and that of the chairman. Some studies have found that there is a negative correlation between

CEO duality and the EID level, indicating that CEO duality may increase conflicts of interests, thereby affecting the firm's transparency process (Gerged, 2020; Alfraih, 2016; Chau and Gray, 2010; Freitas Neto and Mol, 2017). Lagasio and Cucari (2019) applied meta-analysis to a sample of 24 empirical studies and found that CEO duality cannot significantly improve the firms' ESG disclosure, which is in line with the findings of Abdul Razak and Mustapha (2013). However, Jizi et al. (2014) studied major U.S. commercial banks from 2009 to 2011 and pointed out a positive correlation between CEO duality and the EID. One potential reason may be that more powerful CEOs promote the EID level, making them considered successful and increasing their tenure or salary prospects. Supported by agency theory, this study proposes the following hypothesis:

H4 CEO duality is negatively correlated with firms' EID levels.

4.3.6 Board gender diversity and the EID levels

Board gender diversity refers to the presence of women on boards of directors. Most recent studies show that board gender diversity positively impacts the firms' EID level (e.g. Wang, Wilson and Li, 2021; Lagasio and Cucari, 2019). According to recent research using an agency theory lens, a competent BoD can reduce the management's opportunism and improve the firm's EID (Agyemang et al., 2020). Gender diversity on boards contributes to this competence by bringing diverse perspectives and enhancing the board's effectiveness in monitoring and decision-making. Taking a RBV perspective, Haque (2017) contends that female board members can bring human capital and contribute to the disclosing activities. They may provide firms with critical advice and resources to engage in sustainable corporate initiatives, such as compliance with sustainability-related regulations and strengthening stakeholder relationships (Haque, 2017; Uyar et al., 2020). In addition, RBV theory argues that synergies between male and female interactions on boards are valuable "as a source of competitive advantage" (Gallego-Álvarez, Manuel Prado-Lorenzo and García-Sánchez, 2011). Besides, a more diverse BoD should be able to provide broader guidance, so it is expected that more women on the board will positively

impact the EID issues (Wang, Wilson and Li, 2021). Moreover, the participation of female board members strengthens board supervision, thereby improving corporate governance mechanisms and bringing strategic advantages to the firm (Marzuki et al., 2019). Board gender diversity helps firms understand the importance of environmental protection and enhance legitimacy (Wang, Wilson and Li, 2021).

Liao, Luo and Tang (2015) examined the impact of the firms' board characteristics on their voluntary GHG disclosure in the form of a Carbon Disclosure Project report by using a sample of 329 largest firms in the UK. They found that board gender diversity is positively correlated with the tendency to disclose GHG information. Mahmood et al. (2018) pointed out that a large BoD composed of female directors can help to disclose sustainability information better. Husted and de Sousa-Filho (2019) also found that the proportion of female directors significantly positively impacts firms' EID levels. On the contrary, although Amorelli and García-Sánchez (2021) show that although more than 75% of the prior studies showed a positive impact on the relationship between female directors and CSR or CSR disclosure, they found no significant or negative correlation between the presence of women and CSR performance and CSR reporting practices. Therefore, in line with the findings of prior literature, this study proposes the following hypothesis:

H5 Board gender diversity is positively correlated with firms' EID levels.

4.4 Research Methodology

4.4.1 Data and sample

This study employs data from Bloomberg and CSMAR from 2009 to 2019. Information regarding EDS which measures the level of EID per firm, BS, BM, DUAL, BIND, BGEN, ROA, LEV, Tobin's Q (TOBINQ), FS and IND was collected from Bloomberg. Ownership data was extracted from CSMAR. 2009 was selected as the beginning time point because data for EDS was limited before 2009. In 2006 and 2008, China issued the *Interim Measures for Public Participation in Environmental*

Impact Assessment and the *Environmental Information Disclosure Measures*, respectively (Agyemang et al., 2020). Under the *Clean Production Promotion Law* and *Environmental Impact Assessment Law*, public access to environmental information has been implemented in recent years. Subsequently, government EID and corporate EID have been initiated in practical implementation.

This study selects 300 Index (SHSZ300) A shares with large market capitalization and good liquidity as the research sample. The sample firms are across 11 industries: financials, real estate, telecommunications, consumer discretionary, industrials, technology, health care, consumer staples, basic materials, energy, and utilities. To prevent anomalies and extreme outliers, firms with missing values have been excluded from the study. The total number of observations is 2025.

4.4.2 Variable definitions and measurement

To explore the impact of board characteristics on the firms' EID in China, EDS is used as the dependent variable to measure the level of environmental information disclosure (Van Hoang et al., 2021; Fahad and Nidheesh, 2021). EDS is part of the Bloomberg ESG disclosure score, which quantifies the transparency of firms in disclosing environmental, social, and governance information, ranging from 0.1 to 100. The higher the score, the more transparency of environmental issues. Data sources include firm annual reports, CSR reports, press releases, sustainability reports, firm websites, Bloomberg survey and third-party research (Ifada and Indriastuti, 2021; Fahad and Nidheesh, 2021).

In regards to the independent variables: BS is the total number of directors on the board (Gerged, 2020); BM refers to the total number of meetings held by the board within a year (Agyemang et al., 2020); DUAL, which is a binary variable, is set to 1 if the same person holds both the CEO and the chairman position at the same time, otherwise, it is 0 (Gerged, 2020); BIND is measured by using the number of independent non-executive directors divided by the number of board members (Wang et al., 2019); and BGEN is defined by the percentage of female directors on the board.

For control variables, this study selects OWCONCEN, MANGOW, STATEOW,

TOBINQ, FS, LEV, IND, and year, given their potential impact on the EID. As Wang et al. (2019) suggested, firm size should be considered. Zeng et al. (2010) found that the EID level increases with the firm's size. Larger firms are more likely to be subject to public scrutiny. In addition, large listed firms are willing to disclose environmental information to reduce agency costs (Cormier and Gordon, 2001). Previous research has also shown that the size of an enterprise is related to public pressure on environmental management (Deegan and Gordon, 1996). Moreover, LEV is defined as the ratio of total debts to total assets (Brammer and Pavelin, 2006, 2008; Karim, Lacina and Rutledge, 2006; Wang et al., 2019). McGuire, Sundgren and Schneeweis (1988) and Orlitzky and Benjamin (2001) have provided empirical evidence that the firm's financial leverage positively correlates with the EID level. Eng and Mak (2003) and Cormier and Magnan (2003) found a significant negative correlation between these two elements, while Alsaeed (2006) did not find any relationship between financial leverage and EID levels. Another control variable, denoted as TOBINQ, is calculated as the ratio of a firm's market value to the replacement cost of the firm's assets (Uyar et al., 2020). In general, the literature has not yet arrived at a consensus regarding the association between these control variables and the level of EID. Nevertheless, it is worth noting that some of these variables do exert an influence on EDS, and as such, they retain their significance within the scope of this study.

OWCONCEN is the percentage of ordinary shares held by the largest shareholder. MANGOW is the proportion of the shares held by the board members and their relatives to the total number of issued shares. Gerged (2020) found that managerial ownership and ownership concentration negatively correlate with the amount of environmental information disclosed in the Jordanian context. Considering the cost of EID, owners seem to be more concerned about any reduction in their shares and, therefore, may be reluctant to disclose their firm's environmental information. STATEOW represents the percentage of shares held by the state. Liu (2015) found a negative relationship between state ownership and corporate disclosure in China if state ownership is over 33%. On the one hand, the substantial state ownership concentration may hinder the advancement of high-quality corporate

disclosure. This is because government entities, being insiders, can directly access private information from corporations. On the other hand, the dominance of state ownership may lead to less effective management monitoring and internal control, further contributing to a negative impact on corporate disclosure.

In order to control industry and year, dummy variables of these two factors are also included (Elfaitouri, 2014). Industry is considered as an essential factor affecting EID (Bewley and Li, 2000; Boesso and Kumar, 2007; Cormier and Gordon, 2001; Li, Richardson and Thornton, 1997; Wang et al., 2004). Firms in environmentally sensitive industries may disclose environmental information to show the legitimacy of their operations (Boesso and Kumar, 2007). Heavy pollution firms face stricter government supervision and need to disclose environmental information (Meng et al., 2013). However, Alsaeed (2006) found no significant relationship between industry type and the EID level. Gamerschlag, Möller and Verbeeten (2010) hold that firms in the energy supply and consumption industries seem to disclose environmental information more than those in the service and other industries. This result is consistent with a study by Yekini, Adelopob and Andrikopoulos (2015). For the year dummy variable, EDS can change from year to year due to related regulations or firms' disclosing activities, so it is crucial to control the year.

4.4.3 Model specification

Based on the prior studies (Agyemang et al., 2020; Wang et al., 2019), Model (1) was proposed to examine the relationship between board characteristics and EID:

$$EDS_{it} = c + \beta_1 BS_{it} + \beta_2 BM_{it} + \beta_3 BIND_{it} + \beta_4 DUAL_{it} + \beta_5 BGEN_{it} + Controls_{it} + \varepsilon_{it} \quad (1)$$

Where EDS is environmental disclosure score, ranging from 0.1 to 100, and the higher the score, the higher the transparency of its environmental-related issues. BS is board size, which is the number of board members; BGEN is board gender diversity, measured by the percentage of female board members; BM is the number of board meetings, which means how many board meetings held by the firm annually; BIND is

board independence, measured by the percentage of independent board members; DUAL is CEO duality, indicating that if the same person holds the CEO and the chairman positions, the dummy variable is set to 1, otherwise it is 0. Control variables (Controls) include OWCONCEN, MANGOW, STATEOW, FS, TOBINQ and LEV. Industry effect and year effect were also controlled through dummy variables. Detailed variable definitions can be found in Table 10.

In order to select the most suitable model among pooled OLS model (linear), FE model and RE model to assess the relationship between EID and the five board characteristics, Breusch and Pagan (1980) Lagrangian multiplier (LM) test, F test and Hausman test are conducted. Regarding the independent variables, both the LM test and F test show that the RE model has a higher degree of fitting than pooled OLS model since the *p*-value is 0.0000 (lower than 0.05). In addition, the Hausman test (1978) reports that the FE model is more suitable than the RE model because the corresponding *p*-value is 0 ($p<0.01$). Thus, the FE model is optimal for this study among these three regression models.

Table 10: Variable Definitions and Measurement

	Variable name	Abbreviation	Definition/Measurement
Dependent Variables	Environmental disclosure score	*EDS*	Compiled based on the firm's environmental disclosure level, ranging from 0.1 to 100. An indicator of environmental transparency. The higher the score, the more the transparency of environmental issues.
Independent Variables	Board size	*BS*	The total number of directors on the board.
	Board meetings	*BM*	The total number of meetings held by the board, either regular or emergency meetings per year.
	CEO duality (Dummy 0/1)	*DUAL*	If the same person holds the CEO and the chairman positions, the dummy variable is set to 1, otherwise it is 0.
	Board independence	*BIND*	The number of independent non-executive directors divided by the number of board members. Independence is defined according to the firm's own criteria.
	Board gender diversity	*BGEN*	The number of female directors divided by the number of board members.
	Ownership concentration	*OWCONCEN*	The percentage of ordinary shares held by the largest shareholder.
	Managerial ownership	*MANGOW*	The proportion of the shares held by the board members and their relatives to the total number of issued shares.
	State ownership	*STATEOW*	The percentage of shares held by the state.
Control Variables	Tobin's Q	*TOBINQ*	The ratio of the market value of a firm to the replacement cost of the firm's assets.
	Leverage	*LEV*	The ratio of total debts to total assets.
	Firm size	*FS*	The natural logarithm of total (short and long-term) assets reported by the firm.
	Industry (Dummy)	*IND*	1-11 for eleven industries which are financials, real estate, telecommunications, consumer discretionary, industrials, technology, health care, consumer staples, basic materials, energy and utilities.

4.5 Findings and Discussions

4.5.1 Descriptive analysis

Table 11 presents the descriptive analysis for all variables in this study. According to the results, EDS ranges from 0.423 to 51.938, with a mean and a median value of 15.012 and 12.403, respectively. Therefore, the overall level of EID is below average, meaning that most firms disclosed inadequate environmental information to their

stakeholders. Since there is no previous literature in the Chinese context using the same EDS proxy, we only compare the findings of the EID level but not the figures. In a recent paper by Wang, Wilson and Li (2021), it is stated that the environmental responsibility score of state-owned enterprises is lower than that of private enterprises in China. Additionally, Ane (2012) applied a numerical rating system to describe the EID score, focusing on the heavily polluted firms in China and found that the EID level is low; the overall quality of EID is poor; the firms have weak environmental awareness. However, the number of disclosing firms is increasing. Similar results were found by Tang and Luo (2010) when they studied 169 Chinese firms in 21 different industries in 2008. Their study adopts a direct aggregation method to measure the EID level. Despite the overall low level of EID, heavy pollution industries disclose a higher level of environmental information than non-polluting ones. Moreover, Meng et al. (2013) used a disclosure-scoring method to measure the EID and concluded that both the quantity and quality of the firms' EID are relatively low due to stakeholders' rare participation in EID activities.

Table 11: Descriptive Statistics

Variable	Obs	Mean	Median	Std.Dev.	Min	Max
EDS	1896	15.012	12.403	9.928	.423	51.938
BS	2005	10.207	9	2.824	5	19
BM	2006	10.876	10	5.678	2	57
DUAL	2008	.165	0	.372	0	1
BIND	2006	38.34	36.364	6.882	10	80
BGEN	2008	10.8	9.091	11.1	0	57.143
OWCONCEN	1907	40.61	39.78	17.75	4.08	100
MANGOW	2022	3.51	.003	10.313	0	77.988
STATEOW	2025	8.362	0	18.343	0	92.191
TOBINQ	2005	2.102	1.363	1.811	.663	15.771
LEV	2016	11.367	2.745	1.855	6.383	17.22
FS	2017	5.126	11.168	3.025	1	11

Furthermore, we have also examined EDS for each industry to find out whether industry category is a significant factor contributing to the low level of environmental disclosure (see Table 12). The results show that most firms within their industry have relatively low disclosure levels compared to their industry average EID level and the range of EDS from the minimum to the maximum is relatively wide (from about 1 to

50), except for technology sector and consumer staples sector (from around 2 to 40). However, among these industries, EDS differences are minor (approximately from 9 to 21). In particular, firms in the energy sector disclose the most information, followed by those in telecommunications (around 18). The rest of the sectors vary from approximately 11 to 14. Figure 4 shows the mean, minimum and maximum values of EDS by industry category. It is evident that basic materials has the widest range of variation, but energy sector has the narrowest variation. However, if considering the average EDS, energy sector has the highest mean value, which indicates that energy firms disclose relatively more information compared to firms in the other sectors. The real estate and technology sectors disclose relatively less environmental information. Figure 5 then describes the trend of EDS from 2009 to 2019. Despite occasional declines over the years, the general trend for EID is on the rise. Therefore, it can be concluded that the industry category is not a significant factor contributing to the overall low level of EID; particular industries (such as energy) have disclosed relatively more environmental information; and, China has improved its EID level over the past years.

Table 12: Descriptive Statistics of EDS by Industry Category

Industry	Obs	Mean	Median	Std.Dev.	Min	Max
Financials	408	13.86	10.714	9.453	2.326	48.214
Real estate	70	11.628	9.302	9.67	2.326	44.961
Telecommunications	56	18.434	14.729	11.583	1.55	51.938
Consumer discretionary	264	14.386	11.628	9.409	1.55	48.837
Industrials	362	15.517	13.178	9.057	1.087	50.388
Technology	105	11.591	9.302	6.607	2.326	39.535
Health care	148	15.583	10.078	11.972	2.326	48.062
Consumer staples	105	13.293	11.628	7.612	1.933	40.31
Basic materials	209	16.847	13.178	11.432	.423	51.938
Energy	92	21.354	17.442	11.67	1.933	42.636
Utilities	77	14.839	14.729	7.501	4.651	41.085

Figure 4: The Mean, Minimum and Maximum Values of EDS by Industry Category

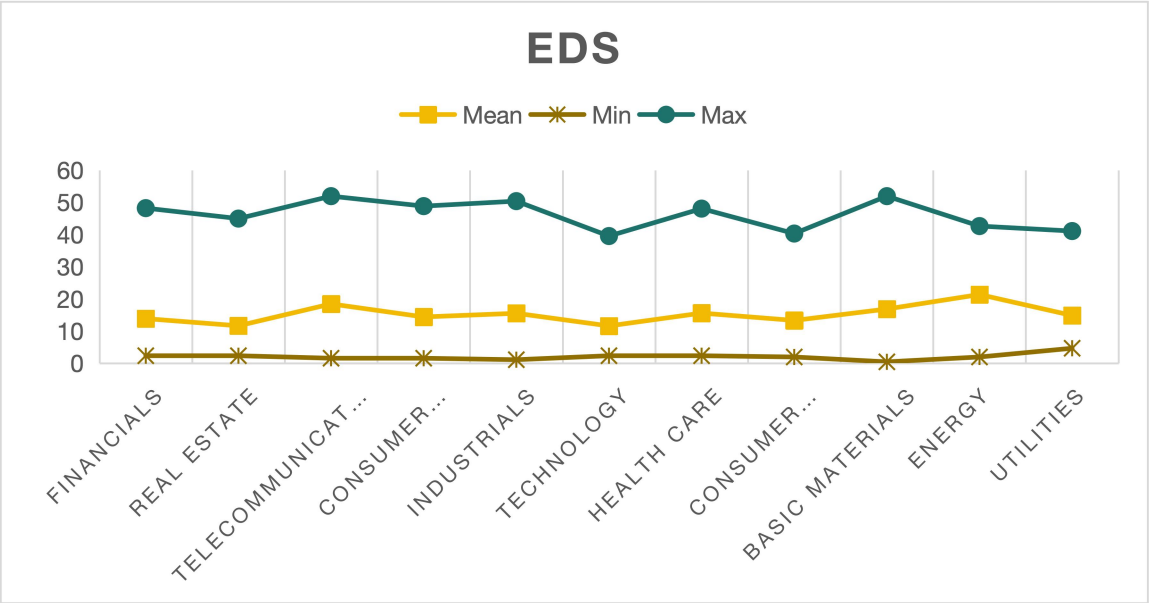
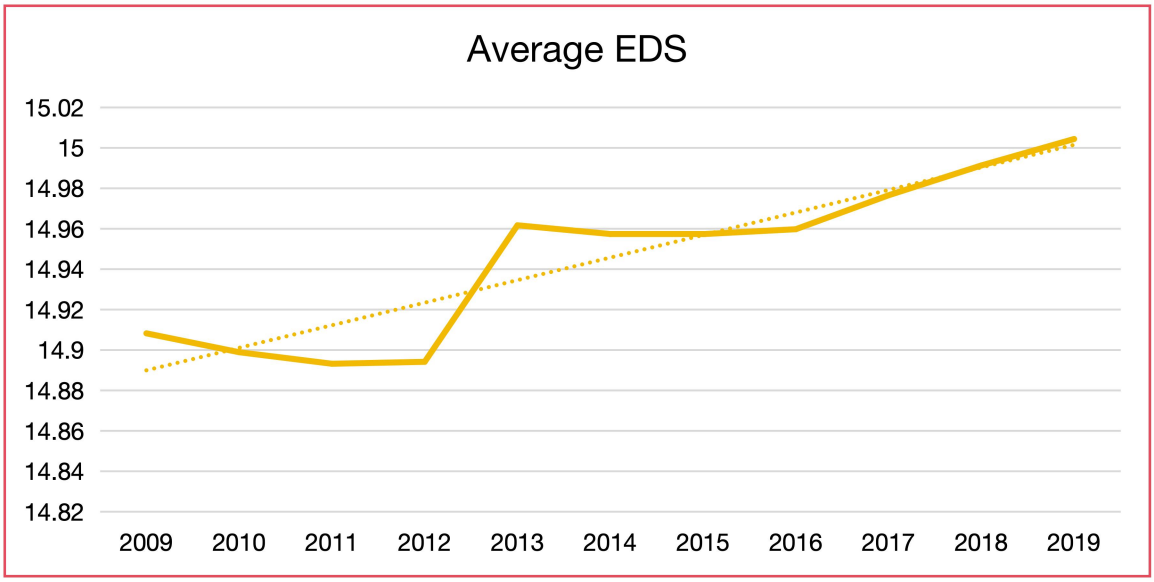


Figure 5: The Trend of EDS from 2009 to 2019



In terms of explanatory variables, the average for BM is 10.876, meaning that, on average, firms hold around 11 meetings per year. The minimum and maximum figures are 2 and 57, respectively, which indicates that some Chinese firms are flexible with holding board meetings. It is regulated in China that the BoD must meet at least twice a year (Jiang and Kim, 2015). Agyemang et al. (2020) found that the minimum, maximum, and standard deviation of board meetings in their study are 2, 32, and 3.4195, respectively, with a mean of 8.2399. It shows that most sample firms held about 8 board meetings annually. DUAL has a mean value and standard

deviation of 0.165 and 0.372, respectively, which suggests that most firms separate the role of CEO and chairman, and managers of listed firms may also serve as directors in China (Jiang and Kim, 2015). Moreover, the highest value for BGEN is 57.143%, and its average is 10.8%. It means that male members still dominate most of the Chinese firms' boards. The mean value is consistent with the result displayed by Wang, Wilson and Li (2021) that 11% of the board members are female. One can also observe that BIND is still relatively low, holding an average of 38.34%, but it has a minimum and maximum of 10% and 80%, respectively. The minimum figure is not consistent with the regulation in China because since June 30, 2003, firms must have at least one-third of their BoD composed of independent directors (Jiang and Kim, 2015). Tang and Luo (2010) obtained similar results with a mean value of 36.11, indicating that independent board members are not dominant. However, the figures for BS are consistent with the literature, with a mean, minimum, and maximum of 10.207, 5, and 19, respectively (approximately 10 members on each board on average) because listed firms must have a minimum of 5 directors and a maximum of 19 directors in China (Jiang and Kim, 2015). It is consistent with the study by Agyemang et al. (2020), who stated that the mean, median, and standard deviation of board size are 9.8406, 9, and 2.3653, respectively. The maximum and minimum in this study are also similar to their findings.

4.5.2 Correlation analysis

Table 13 provides results of the correlation matrix for all variables. Among the independent variables, BM and BIND are significantly and positively correlated with EDS, whereas BGEN has a negative correlation with EDS. Furthermore, according to Wang et al. (2019), the pairwise correlations show no potential multicollinearity in the model because the level of these correlations is relatively low. Additionally, Table 14 confirms that there is no multicollinearity problem in this study as the values of VIF are lower than 4.

Table 13: Pairwise Correlations

Variable	EDS	BS	BM	DUAL	BIND	BGEN	OWCONCEN	STATEOW	MANGOW	TOBINQ	LEV	FS
EDS	1											
BS	0.025	1										
BM	0.118***	-0.045**	1									
DUAL	-0.031	-0.107***	0.020	1								
BIND	0.086***	-0.349***	0.046**	0.071***	1							
BGEN	-0.059**	-0.023	-0.000	0.087***	-0.086***	1						
OWCONCEN	-0.033	0.037	-0.004	-0.053**	0.005	-0.060***	1					
STATEOW	-0.106***	0.087***	-0.067***	-0.056**	0.049**	-0.080***	0.084***	1				
MANGOW	-0.013	-0.214***	0.071***	0.246***	-0.013	0.134***	-0.180***	-0.143***	1			
TOBINQ	-0.203***	-0.237***	-0.092***	0.158***	-0.007	0.064***	-0.058**	-0.079***	0.338***	1		
LEV	0.033	0.553***	0.055**	-0.069***	-0.062***	0.028	0.040**	0.008	-0.181***	-0.351***	1	
FS	0.280***	0.485***	0.062***	-0.135***	0.053**	-0.054**	0.089***	0.023***	-0.287***	-0.578***	0.762***	1

Table 14: Variance Inflation Factor

Variable	VIF	1/VIF
FS	3.33	0.300
LEV	2.75	0.363
BS	1.79	0.559
TOBINQ	1.62	0.617
BIND	1.26	0.794
MANGOW	1.24	0.804
DUAL	1.08	0.925
BGEN	1.06	0.941
OWCONCEN	1.05	0.951
STATEOW	1.05	0.953
BM	1.04	0.964
Mean_VIF	1.57	

4.5.3 Regression analysis

Table 15 compares the results of pooled OLS, RE and FE regression. First, based on the FE regression, the impact of BS on EDS is significant and positive at the 5% significance level, which indicates that firms with more board members are more likely to disclose environmental information. Therefore, this finding is consistent with **H1**. A larger board size, as per RBV theory (Gallego-Álvarez, Manuel Prado-Lorenzo and García-Sánchez, 2011), can provide additional intangible resources and capabilities to firms. Agency theory suggests these resources may mitigate agency problems and information asymmetry between internal and external directors (Healy and Palepu, 2001; Jensen, 1988; Liao, Luo and Tang, 2015). Scholars (Cucari, Esposito De Falco and Orlando, 2018; Agyemang et al., 2020; Gerged, 2020; Ganapathy and Kabra, 2017; Liao, Luo and Tang, 2015) argue that larger boards encourage greater participation in EID practices, providing diverse knowledge and expertise (Tang and Luo, 2010; Husted and de Sousa-Filho, 2019) to reduce agency problems and improve board capabilities, thus enhancing EID (Mohammad Rabi, 2019; Gerged, 2020). Agyemang et al. (2020) discovered a positive correlation between board size and firms' EID levels, supporting Donnelly and Mulcahy's (2008) assertion that larger boards reduce information asymmetry among managers and stakeholders. However, the positive impact of board size on EID in this study

contradicts with the study of Peter and Romi (2014) which reports a negative relationship between EID and board size.

Table 15: Pooled OLS, RE and FE Regression Results

	Pooled OLS	RE	FE
Variable	EDS	EDS	EDS
BS	0.231***	0.075	0.231**
	(3.775)	(0.415)	(2.351)
BM	0.218***	0.153***	0.218***
	(5.314)	(3.076)	(5.947)
DUAL	-0.466	-0.323	-0.466
	(-1.097)	(-0.325)	(-0.855)
BIND	0.065*	-0.023	0.065**
	(2.181)	(-0.420)	(1.962)
BGEN	-0.013	0.003	-0.013
	(-0.574)	(0.090)	(-0.683)
OWCONCEN	-0.017**	-0.040	-0.017
	(-2.878)	(-1.411)	(-1.474)
STATEOW	-0.033***	-0.006	-0.033***
	(-3.520)	(-0.466)	(-2.707)
MANGOW	0.087***	0.029	0.087***
	(5.357)	(0.716)	(3.716)
TOBINQ	-0.478***	-0.018	-0.478***
	(-3.490)	(-0.086)	(-2.903)
LEV	-0.584***	-0.133	-0.584***
	(-3.709)	(-0.638)	(-7.087)
FS	3.302***	1.955***	3.302***
	(7.271)	(3.691)	(14.787)
Constant	-31.388***	-14.228**	
	(-5.535)	(-2.465)	
F-value	.		43.768
R-squared	0.331		0.331
Industry control	Yes	Yes	Yes
Year control	Yes	Yes	Yes
Observations	1766	1766	1766

t statistics in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Second, there is a positive relationship between BM and EDS at the 1% significance level. Thus, **H2** is supported. According to agency theory, the lower frequency of board meetings affects the control of management and delays the

provision of critical decisions and information to various stakeholders (Hu and Loh, 2018). Increasing the number of board meetings can promote idea sharing, EID performance, and the ability to solve agency problems (Yakob and Abu Hasan, 2021). This result also affirms the opinions of Peter and Romi (2014), Andrikopoulos and Kriklani (2013), Husted and de Sousa-Filho (2019), and Agyemang et al. (2020), as they demonstrate that the quality of EID tends to improve as the number of board meetings increases. Liao, Luo and Tang (2015) found that firms holding more board meetings are more likely to disclose carbon information voluntarily. Another study by Frias-Aceituno, Rodriguez-Ariza and Garcia-Sanchez (2013) demonstrates that the more meetings the board holds, the higher the environmental information transparency. However, Prado-Lorenzo and Garcia-Sanchez (2010) hold the opposite opinion that there is a significant and negative relationship between these two factors.

Third, BIND is positively correlated with EDS at the 5% significance level, thus **H3** is supported. This finding is consistent with both agency theory and RBV theory. Coffey and Wang (1998) and Liao, Luo and Tang (2015) adopt an agency theory lens to demonstrate that independent boards are more likely to curb opportunistic behaviors of managers, provide more objective feedback on disclosure mechanisms, such as EID, and improve management supervision. Similarly, RBV theory suggests that independent board members can successfully address stakeholders' interests by providing new resources and insights and leveraging their connections and business expertise. Gerged (2020) and Cucari, Esposito De Falco and Orlando (2018) hold that board independence is significantly positively related to EID levels. According to Ntim and Soobaroyen (2013), independent directors bring greater diversity to the firm's board, including knowledge, skills, and business connections. Hussain, Rigoni and Orij (2018) argued that a more independent BoD plays a significant role in promoting sustainable performance. Chan, Watson and Woodliff (2014) also stated that the existence of independent directors is related to more CSR disclosures.

Fourth, DUAL has an insignificant impact on EDS, so **H4** is not supported. The finding is consistent with that of Lagasio and Cucari (2019) and Abdul Razak and Mustapha (2013), who hold that there is no significant relationship between CEO

duality and the firms' ESG disclosure. Finally, BGEN is insignificantly correlated with EDS, so **H5** is rejected. This finding is consistent with that of Amorelli and García-Sánchez (2021), who showed that while over 75% of previous studies demonstrated a positive impact on the correlation between female directors and CSR disclosure, they observed no significant correlation between the presence of women and CSR performance/CSR reporting practices. Table 16 summarizes the relationship of all the five board characteristics and EID, and whether the five hypotheses are supported (with theoretical underpinning) or rejected.

Table 16: Summary of FE Regression Results and Corresponding Theoretical Underpinning

Variable Name	Relationship with EDS	Hypothesis Accepted/ Rejected	Theoretical Underpinning
BS	Significant at 5% Positive (+)	Accepted (√)	Agency theory and RBV theory
BM	Significant at 1% Positive (+)	Accepted (√)	
DUAL	Insignificant	Rejected (×)	
BIND	Significant at 5% Positive (+)	Accepted (√)	Agency theory and RBV theory
BGEN	Insignificant	Rejected (×)	

4.5.4 Robustness tests and additional analyses

We perform two additional tests which are 2SLS regression and lagged effect regression to check the robustness of our findings (Wang et al., 2019). In a FE model (our baseline model), firm-specific fixed effects are incorporated by adding firm-specific indicator variables or using internal differencing to remove time-invariant components (Ullah, Akhtar and Zaefarian, 2018). This eliminates unmeasured variables at the time-invariant industry and firm levels. However, FE estimation is used when addressing endogeneity in cases where firm-specific attributes (time-invariant) correlate with the explanatory variable. According to Fulgence et al. (2022), while FE may ease the impact of unobservable firm-specific factors, it might not entirely eliminate endogeneity. For example, board characteristics

can impact EID, but it is plausible that EID may also influence board characteristics. Board members increasingly consider environmental factors in their decision making process, and the extent of EID can influence the management of the firms, thereby impacting board characteristics over time. Therefore, we employed the 2SLS method with instrumental variables in our analysis, following the study of Wang et al. (2019). In addition, as Wang et al. (2019) suggested, the lag values can be considered appropriate instrumental variables related to the explanatory variables but not related to the error term. Thus, in the lagged effect regression, the corresponding one-year lag variables of the five board characteristics are used as the instruments. The results of both tests shown in Table 17 are similar to our main findings in the FE regression of Table 15.

Table 17: Two-Stage Least Squares and Lagged Effect Regression Results

	2SLS	Lagged Effect
Variable	EDS	EDS
BS	0.337***	0.337***
	(2.697)	(2.669)
BM	0.264***	0.264***
	(5.164)	(5.110)
DUAL	-1.086	-1.086
	(-1.455)	(-1.440)
BIND	0.085*	0.085*
	(1.754)	(1.736)
BGEN	-0.028	-0.028
	(-1.147)	(-1.135)
OWCONCEN	-0.011	-0.011
	(-0.869)	(-0.860)
STATEOW	-0.020	-0.020
	(-1.352)	(-1.338)
MANGOW	0.095***	0.095***
	(3.495)	(3.459)
TOBINQ	-0.634***	-0.634***
	(-3.196)	(-3.162)
LEV	-0.642***	-0.642***
	(-6.847)	(-6.776)
FS	3.392***	3.392***
	(13.620)	(13.478)
Constant	-29.896***	
	(-8.412)	
F-value		38.807
R-squared	0.342	0.342
Industry control	Yes	Yes
Year control	Yes	Yes
Observations	1498	1498

t statistics in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

In order to increase the robustness of the findings, this study conducts two additional analyses. First, we divide the firms into two sub-samples: high-regulated industries (i.e. financials, telecommunications, industrials and energy) and low-regulated industries (i.e. real estate, consumer discretionary, technology, health

care, consumer staples, basic materials and utilities)[4]. Figure 6 shows that high-regulated industries disclose more environmental information on average than low-regulated ones, which can be caused by strict regulations on high-regulated industries. In addition, since low-regulated industries account for a large proportion of all industry types, this study includes both high-regulated and low-regulated industries and attempts to investigate these two sub-samples by undertaking the FE regression. On the one hand, the results for high-regulated industries shown in Table 18 are not consistent with those in Table 15 for the whole sample because only board size has a significant and positive impact on EID. One potential reason for the insignificant relationship between board meetings and EID could be the overshadowing of corporate board oversight by other factors. For instance, external ownership might assume the monitoring role traditionally associated with corporate boards. In such instances, boards of high-regulated firms may be primarily responsible for addressing social and environmental issues at the policy level rather than in the actual implementation. Consequently, regardless of the frequency of board meetings, EID policies and practices may remain unaffected. Thus, the impact of board meetings on these firms' EID might be insignificant. Moreover, regulations can hinder the board independence of firms in high-regulated industries when guiding management to disclose additional voluntary information, so there is an insignificant impact of board independence on EID On the other hand, the results for low-regulated industries in Table 18 are consistent with our main findings in Table 15. Therefore, it can be inferred that for low-regulated industries, boards may play a more dominant role in the EID activities than those of high-regulated industries.

[4] In this study, high-regulated industries are financials, telecommunications, industrials and energy, and low-regulated industries are real estate, consumer discretionary, technology, health care, consumer staples, basic materials and utilities. The classification rule comes from the *Regulations of Environmental Inspection on Companies Assessing to or Refinancing on the Stock Market*, which defines the following industries as polluting: metals, mining, construction, electricity, petroleum and chemicals, food and beverages (Lu and Abeysekera, 2014). The following industries have high consumer awareness in China: banking and insurance, telecommunications and transportation. All polluting industries and industries with high consumer awareness are high-regulated industries. The other industries are low-regulated industries.

Figure 6: The Average EDS of High-Regulated and Low-Regulated Industries

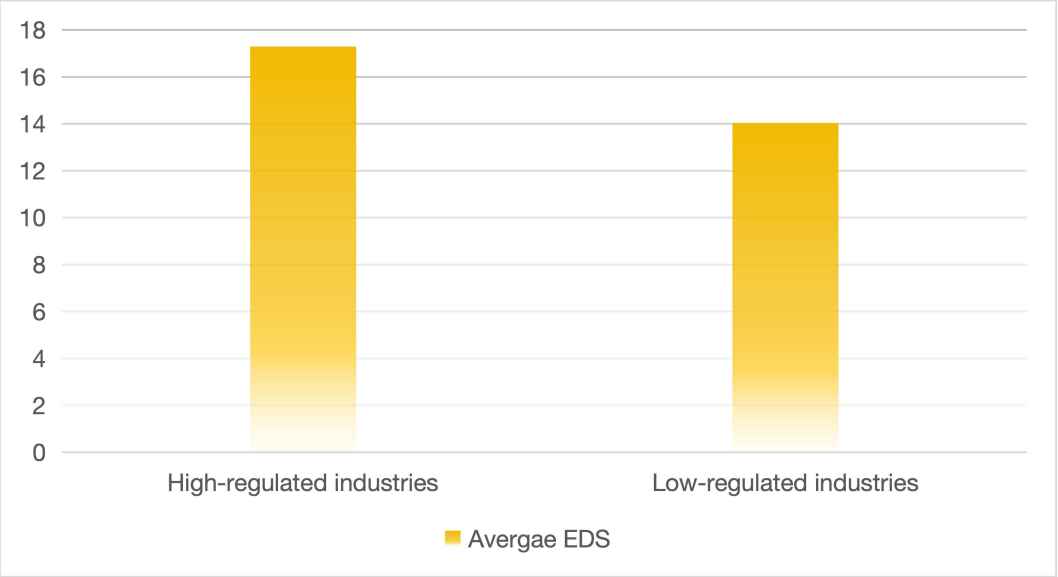


Table 18: FE Regression Results of Sub-Samples and Interaction Terms of Board Characteristics

	Industry Type		Moderating effect of the *Environmental Protection Law*
	High-regulated	Low-regulated	
Variable	EDS	EDS	EDS
BS	0.244*	0.268*	0.142
	(1.884)	(1.724)	(1.038)
BM	-0.035	0.262***	0.163***
	(-0.438)	(6.379)	(2.833)
DUAL	0.133	-1.072	-0.028
	(0.166)	(-1.467)	(-0.027)
BIND	0.062	0.126**	-0.016
	(1.396)	(2.514)	(-0.298)
BGEN	0.035	-0.037	0.079**
	(1.184)	(-1.528)	(2.140)
EPL			0.000
			(.)
BS*EPL			0.158
			(0.999)
BM*EPL			0.090
			(1.268)
BIND*EPL			0.134**
			(2.051)
DUAL*EPL			-0.546
			(-0.460)
BGEN*EPL			-0.124***
			(-2.989)
Control variables	Yes	Yes	Yes
Industry control	Yes	Yes	Yes
Year control	Yes	Yes	Yes
Observations	833	933	1766
F-value	17.494	31.881	31.400
R-squared	0.345	0.357	0.337

t statistics in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Second, rather than performing a sub-sample analysis based on pre- and post-2014 periods, we tested the moderating effect of the 2014 *Environmental Protection Law* (EPL) by incorporating interaction terms between board characteristics and the law in our regression models. The rationale for this approach is

that the law introduced a more stringent regulatory framework to enhance EID in China, as previously discussed. The 2014 *Environmental Protection Law* expanded corporate accountability, assigning responsibility for environmental protection to both individuals and organizations, while also imposing clear penalties for environmental misconduct at the corporate and governmental levels (Ullah et al., 2022). The findings presented in Table 18 indicate that board independence and board gender diversity interaction terms are statistically significant, confirming that the law moderates their effects on EID in opposite directions. Board independence exhibits a positive coefficient, meaning that after the implementation of the law, the role of independent directors in enhancing EID became stronger. This suggests that regulatory enforcement complemented board oversight, making independent directors more effective in holding management accountable for environmental disclosure. This aligns with prior research indicating that independent directors improve governance transparency and mitigate managerial discretion, especially in response to external regulatory pressures (Cheng and Courtenay, 2006). The results imply that board independence became a more critical factor in ensuring environmental accountability following the implementation of the law, reinforcing the importance of independent oversight in driving corporate transparency. Conversely, board gender diversity has a negative and significant interaction coefficient, suggesting that after the implementation of the law, gender-diverse boards were associated with lower EID. This finding contradicts conventional expectations and requires further interpretation. One possible explanation is that, in a more regulated environment, firms may prioritize compliance-driven governance mechanisms, such as board independence, over voluntary diversity-related governance initiatives. Additionally, gender diversity in Chinese corporate boards is still evolving, and the impact of female directors on corporate strategy may be constrained by traditional board dynamics and institutional barriers (Wang, Wilson and Li, 2021). This suggests that while gender diversity is an important governance factor, its interaction with regulatory frameworks may differ depending on the corporate environment and external enforcement mechanisms.

4.6 Conclusion

In recent years, EID has been considered as a practical approach to dealing with corporate environmental pollution with the increasingly severe environmental degradation. China has now become the second largest economy in the world (Jiang and Kim, 2015) and as the largest carbon emitter, its impact on environmental issues should not be overlooked. However, previous literature is still limited, especially in the Chinese context, and most of the relevant studies focus on one particular industry in China.

Therefore, we aim to fill in this gap by examining the relationship between board characteristics (i.e. board size, board gender diversity, board independence, board meetings and CEO duality) and firms' EID using a sample of 300 listed firms on SHSZ300 from 2009 to 2019. It employs EDS as the dependent variable and applies the FE model for the empirical analysis. First, we find that although there is an increasing trend of EID over the years, Chinese firms still need to improve their EID levels since the EDS is relatively low compared to western countries such as the United States. For instance, Giannarakis, Andronikidis and Sariannidis (2019) studied firms in the US and found that the mean value for environmental disclosure level is about 0.56 out of 1, which means that on average, firms disclose 56% of their environmental information. Second, particular industries (such as energy) disclose relatively more environmental information compared to the other sectors, which is consistent with prior studies (Zeng et al., 2010; Agyemang et al., 2020; Tang and Luo, 2010). It indicates that more regulations for all industries but not for particular ones should be strengthened (Agyemang et al., 2020; Tang and Luo, 2010). Third, the industry category is not a significant factor contributing to the overall low level of environmental disclosure because the levels for all industries do not vary widely, and they are relatively low. Fourth, when firms have larger board sizes (Cucari, Esposito De Falco and Orlando, 2018; Agyemang et al., 2020; Gerged, 2020; Ganapathy and Kabra, 2017; Liao, Luo and Tang, 2015) and more independent board members (Chen and Jaggi, 2000; Gul and Leung, 2004; Byard, Li and Weintrop, 2006; Cheng and

Courtenay, 2006; Ahmed, Hossain and Adams, 2006), and hold more board meetings (Andrikopoulos and Kriklani, 2013; Agyemang et al., 2020), they are likely to disclose more environmental information. However, board gender diversity and CEO duality have no significant impact on the EID level. Finally, low-regulated industries account for a large proportion of all industry types, so it is essential and necessary to include them when studying EID in China although they have a relatively lower EID level compared to high-regulated industries, and boards of low-regulated industries can engage more in the EID activities in the future in order to make more impact in EID-related decision-making process. Furthermore, the enforcement of the *Environmental Protection Law of the People's Republic of China* in 2014 has been instrumental in significantly amplifying the impact of board independence in driving environmental transparency in China.

These findings have important implications for the managers, owners, policymakers in China, and even other emerging markets. First, since the overall EID level is still relatively low, relevant regulations or laws should be implemented, and stricter supervision over firms' EID should be strengthened. Second, there are no apparent differences among the 11 industries regarding EDS, so the general improvement of EID issues is needed, not only for particular industry types. Although some literature focuses on the heavy pollution industry stating that it has a relatively high EID level compared to the other industries, the disclosure degree is only slightly higher if considering all industries, as shown in this study. Third, it is suggested that firms allow more independent board members to increase board independence and ensure the size of the board is not too small. Otherwise, it may reduce the efficiency of decision-making and the EID level. Besides, they should hold more board meetings annually to improve information transparency, thereby increasing the EID level.

Apart from the findings and recommendations above, this study still has some limitations. First, it is restricted to unbalanced panel data due to the lack of data for some variables and the changing constituent stocks over these 11 years. Future studies may consider focusing on recent years if data is accessible. Second, EDS is used as the proxy for the EID level, and it is compiled by Bloomberg, but there are no

alternative proxies to check its robustness. Future studies can attempt to utilize other methods to measure the EID level. Third, this study focuses on board gender diversity and it could be in the future enlarged to other aspects of diversity, such as board members' education background, nationality, and tenure. Future studies can include more aspects of board diversity as it will lead to more persuasive and comprehensive results regarding board diversity.

Appendix 1: An Overview of the Theories in the Existing Literature

Year	Author	Title of the Paper	Theories Applied
2021	Solikhah and Maulina	Factors influencing environment disclosure quality and the moderating role of corporate governance	Legitimacy theory and stakeholder theory
2021	Wang, Wilson and Li	Gender attitudes and the effect of board gender diversity on corporate environmental responsibility	Gender socialization theory, resource dependence theory, agency theory and role congruency theory
2020	Gerged	Factors affecting corporate environmental disclosure in emerging markets: The role of corporate governance structures	Agency theory and stakeholder theory
2020	Agyemang et al.	Impact of board characteristics on environmental disclosures for listed mining firms in China	Stakeholder theory, agency theory and stewardship theory
2019	Jacoby et al.	Corporate governance, external control, and environmental information transparency: Evidence from emerging markets	Agency theory, legitimacy theory and resource dependence theory
2019	Ma et al.	The influence of top managers on environmental information disclosure: The moderating effect of firm's environmental performance	Gender socialization theory, legitimacy theory, Upper Echelons theory and Natural-Resource-Based theory
2017	Ganapathy and Kabra	The impact of corporate governance attributes on environmental disclosures: Evidence from India	Agency theory and legitimacy theory
2016	Amico et al.	Factors influencing corporate environmental disclosure	Legitimacy theory, agency theory and stakeholder theory
2015	Chang and Zhang	The effects of corporate ownership structure on environmental information disclosure—empirical evidence from unbalanced penal data in heavy-pollution industries in China	Stakeholder theory and traditional environment theory
2013	Meng, Zeng and Tam	From voluntarism to regulation: A study on ownership, economic performance and corporate environmental information disclosure in China	Legitimacy theory, stakeholder theory and signaling theory
2012	Zeng et al.	Factors that drive Chinese listed firms in voluntary disclosure of environmental information	Institutional theory
2010	Tang and Luo	An empirical analysis on determinant factors of environmental information disclosure: Evidence from A-share listed firms in Shenzhen in China	Agency theory, contract theory and signaling theory

Chapter 5

Ownership Structure

5.1 Brief Summary

EID plays a crucial role in promoting sustainable practices and enhancing environmental accountability. The ownership structure of firms, which varies across different institutional settings, can significantly influence the extent to which they are willing and able to disclose environmental information. Drawing on voluntary disclosure theory and legitimacy theory, this study examines whether ownership structure (e.g. ownership concentration, institutional ownership, managerial ownership, and state ownership) influences the environmental information disclosure of Chinese firms. Using a panel data set of firms listed on the SHSZ300 from 2009 to 2019, the results show that there has been an increase in environmental information disclosure in China in recent years. Furthermore, we find that managerial ownership is positively associated with environmental disclosure, whilst institutional ownership and state ownership are negatively associated with environmental disclosure. Additional analyses show that the relationship between EID and ownership structure is stronger in low-regulated industries, and the effects of managerial and state ownership on EID vary by firm size. The enforcement of the 2014 *Environmental Protection Law of the People's Republic of China* has also played a pivotal role in enhancing the nexus between EID and ownership structure.

5.2 Introduction

In recent years, stakeholders' demands for EID have been growing as environmental protection has become the focus of global attention (Zeng et al., 2010). At the recent UN COP26 in Glasgow, countries adopted the *Glasgow Climate Pact*, which aims to transform the 2020s into a decade of climate action to limit the rise in global average temperatures to less than 1.5 degrees. The aim of the EID approach is that with direct information readily available about a business's environmental risks, investors, local communities, consumers, employees, and the public can force firms to become

greener (Zeng et al., 2012). EID has emerged as a vital component in the annual reports of firms as well as in other reports focusing on social responsibility and sustainability (Cheng and Feng, 2023). Gerged (2020) demonstrates the benefits of enterprise EID, which pertains to a firm's interaction with its surroundings and includes actions undertaken by management to improve and protect the overall environment. The utilization of EID initiatives and protocols can serve as effective measures to curb market inefficiencies, by reducing information asymmetry between managers and their stakeholders (Li et al., 2021).

Chinese listed firms have experienced increasing pressure to disclose their environmental impact from society, the media, and the government. An example of the latter is the progressive implementation of various regulations (e.g. the *Guidelines on Environmental Information Disclosure for Listed Firms* and the *Environmental Protection Law of the People's Republic of China*) on EID. As a result, firms are increasingly recognizing the significance of EID (Chang, 2013). Ownership structure has been recognized as an important corporate governance mechanism that might affect the level of EID (Baba and Baba, 2021). While existing research has explored the influence of ownership structure on EID (Khaireddine et al., 2020; Brammer and Pavelin, 2008; Cormier, Magnan and Van Velthoven, 2005), they tend to focus on developed countries, with only a limited number of studies looking at developing/emerging countries (Li et al., 2022; Diantimala and Amril, 2018; Amosh and Mansor, 2020). Thus, this study aims to examine whether ownership structure can explain the observable differences in the level of EID by using a sample of firms listed on the Shanghai Shenzhen 300 Index from 2009 to 2019.

Our findings are threefold. First, our study reveals that, notwithstanding the recent increase in EID, Chinese firms present lower levels of EID compared with their counterparts in developed economies. While specific sectors, such as the energy industry, exhibit a higher level of EID than others, it is noteworthy that the industry classification itself does not significantly contribute to the overarching dearth of EID within the Chinese context. This is underscored by the observation that there is minimal variance in EID levels across industrial sectors. Second, we find that firms

with lower levels of institutional ownership, higher levels of managerial ownership, and lower levels of state ownership tend to disclose more environmental information. Third, additional analyses report a more pronounced correlation between EID and ownership structure in industries characterized by lower regulatory oversight, as opposed to those subject to stringent regulatory frameworks. This relationship holds for both small and large firms. Importantly, the enforcement of the *Environmental Protection Law of the People's Republic of China* in 2014 plays a crucial role in shaping the relationship between EID and ownership structures.

This study contributes to the existing literature in several ways. First, as pointed out by Li et al. (2013), the country of origin may play a significant role in determining the extent of CSR disclosure. While previous studies have examined the variability in CSR disclosure among developed countries (e.g. Sufian and Zahan, 2013; Mohd Ghazali, 2007; Rashid and Lodh, 2008; Oh, Chang and Martynov, 2011), only a limited number of studies have addressed the EID aspect, especially in the context of developing countries (e.g. Wang, O and Claiborne, 2008; Xiao and Yuan, 2007; Chen et al., 2021; Li et al., 2013). Furthermore, little attention has been paid so far to the subject of EID in the context of China. Thus, we refine the scope of the existing literature and aim to enhance the understanding of how ownership structure might influence the level of EID in China, an area that is still under-researched. Second, we employ both voluntary disclosure theory and legitimacy theory due to the unique features of the Chinese setting, where environmental information is largely disclosed on a voluntary basis, while mandatory EID is gradually being required by the government. Our study provides novel theoretical insights into the relationship between EID and ownership structures, in contrast to previous literature that relied on agency theory or stakeholder theory (Wang, O and Claiborne, 2008; Chen et al., 2021; Li et al., 2013). Third, unlike previous studies (Zeng et al., 2010; Chang and Zhang, 2015) that concentrate on specific industries, our research considers all the different industries in China. This broader approach avoids potential bias in asserting inflated EID levels for the country, which might have resulted from the exclusive focus on selected industries in prior studies. Fourth, to the best of our knowledge, this study is

the first to examine the role of implementing the *Environmental Protection Law of the People's Republic of China* on the relationship between EID and ownership structure. We demonstrate that this new initiative has had a significant effect on enhancing the relationship between EID and ownership structure in China, a finding that previous studies have not identified.

The remainder of this study is structured as follows. Section 2 presents the background, theoretical framework, and hypotheses development. The data and methodology are described in Section 3. Section 4 presents the findings and discussion. Section 5 concludes the study.

5.3 The Chinese Context, EID Regulations and Their Evolution

China[5] has successfully transitioned from a planned economy to a market economy and has now become the world's second-largest economy (Jiang and Kim, 2015). As a result, China has witnessed a significant rise in its environmental challenges (Khan et al., 2021). In 2020, Chinese President Jinping Xi proclaimed that the nation's carbon emissions are projected to reach their peak in 2030, and that, concurrently, China is committed to actively working towards achieving carbon neutrality by 2060 (Lu, Wang and Liu, 2023; Gu, Wu and Du, 2023; Li et al., 2023; Wang and Zhao, 2023). Consequently, corporate EID has become the focus of attention in recent years.

In its commitment to advancing sustainable economic development, the Chinese government has elevated the importance of environmental concerns and has issued various regulations to oversee the EID of publicly listed firms (Gu, Wu and Du, 2023). For instance, between 2003 and 2005, the Ministry of Ecological Environment in China initiated a phased approach, which mandated enterprises to 1) disclose environmental data; 2) establish environmental-quality announcement systems; 3) routinely disseminate pertinent environmental protection metrics; 4) promptly release

[5] Defining the status of China, the second-largest economy, as developing, emerging or developed is subject to debate among experts. Beijing classifies China as a "developing" country in the World Trade Organization. However, the World Bank and United Nations Development Program classify China as an "upper middle income" country, while the International Monetary Fund calls the country an "emerging and developing economy."

information regarding pollution incidents, and 5) advocate for environmental public interest litigation (Gu, Wu and Du, 2023). Subsequently, China introduced measures for the experimental implementation of an EID system in 2007, formally delineating the rights and responsibilities of enterprises and government entities concerning EID (He, Xu and Shi, 2023; Lu, Wang and Liu, 2023). To incentivize enterprises to proactively disclose environmental information to the public, the Chinese government and the Shanghai Stock Exchange undertook significant measures in 2008. These initiatives entailed issuing regulations such as the *Guiding Opinions on Reinforcing the Oversight and Administration of Environmental Protection for Listed Firms* and the *Guidelines on Environmental Information Disclosure for Listed Firms*. The primary objectives of these measures were to promote the transparency of environmental governance and foster greater environmental accountability (Zhao et al., 2023). For the first time, explicit requirements were established for the EID of listed firms (Wu and Hąbek, 2021). These requirements were particularly focused on firms operating in industries with significant environmental implications, including thermal power generation, steel production, cement manufacturing, electrolytic aluminium production, and mineral mining. Moreover, they were applicable to listed firms that featured on the list of severely polluting entities compiled by the environmental protection department. Thus, both mandatory and voluntary environmental information reporting requirements have coexisted (Wu and Hąbek, 2021).

In 2014, the Standing Committee of the National People's Congress of the People's Republic of China enacted a revised iteration of the *Environmental Protection Law of the People's Republic of China*. This revised legislation mandated that entities categorized as "key polluters" were obligated to transparently disclose certain information to the general public. This included: releasing the names of the major pollutants they produced or discharged; providing details of their discharge methodologies, discharge concentrations and quantities, and instances of excessive discharges; and disclosing information about the establishment and operation of pollution mitigation facilities. This was done to ensure firms were subject to societal

oversight (Zhang et al., 2023). In 2021, the General Office of Ecology and Environment of the State Council released the *Reform Plan of the Environmental Information Disclosure System in Accordance with the Law*. This plan categorically stipulated the gradual establishment and implementation of a compulsory EID system by the year 2025 (Gu, Wu and Du, 2023). The progression of laws, regulations, and guidelines associated with the disclosure of environmental information reflects the Chinese government and regulatory bodies' growing interest in the environmental dimension of CSR.

Nevertheless, it is worth noting that the disclosure of environmental information presently exists within a semi-mandatory and voluntary framework that is characterized by limited engagement, incomplete data, and a lack of standardization (Wang et al, 2023). A fully-fledged compulsory EID system has not been implemented to date, and EID remains reliant on voluntary participation (Gu, Wu and Du, 2023). Overall, environmental information/ESG disclosure in China is still largely voluntary (Cheng and Feng, 2023; Wang et al., 2023). Figure 7 shows the milestones in the evolution of major EID regulations in China from 2003 to 2021.

Figure 7: The Timeline/Milestones/Evolvement of EID regulations in China

Note: From 2003 to 2021, major regulations related to EID in China are shown under the corresponding years.

5.4 Theoretical framework and Hypothesis Development

5.4.1 Theoretical framework

Economic and socio-political theories serve as the foundation for elucidating the rationale behind firms' EID and their corporate governance mechanisms. These theories contribute to our understanding of corporate environmental reporting strategies which, in turn, underpin our ability to make predictions regarding the relationship between corporate governance mechanisms and the EID. Because EID in China currently operates as a combination of semi-mandatory and voluntary mechanisms, we employ voluntary disclosure theory (Bewley and Li, 2000) and legitimacy theory (Deegan, C., Rankin, M. and Tobin, 2002; Naser et al., 2006) to explain the association between EID and ownership structures. Specifically, voluntary disclosure theory is employed to explain voluntary disclosures, whereas legitimacy theory is utilized to shed light on mandatory disclosures.

Voluntary disclosure theory, an economic theory, posits that managers are motivated to share positive information while withholding negative news (He and Loftus, 2014). When investors recognize that management is withholding information, but are uncertain of its content, they tend to reduce their estimate of the firm's value until a threshold point is reached. At this juncture, managers are incentivized to disclose positive information and withhold any potentially more adverse information they might possess (He and Loftus, 2014). Voluntary disclosure theory also offers a framework for rationalizing the factors influencing EID, as it contends that firms engage in cost-benefit analysis when deciding whether to disclose environmental information, and choose to do so only when the anticipated advantages surpass the associated costs (Li et al., 2017). For instance, a firm will disclose more environmental information when the perceived advantages of EID (such as the potential to enhance the firm's reputation) are heightened. In the Chinese context, EID is primarily voluntary despite the existence of a growing body of regulatory requirements (Cheng and Feng, 2023). However, voluntary disclosure may prove to be more effective than mandatory disclosure in comparing costs and benefits. For

instance, while mandatory EID has been associated with increased corporate innovation and decreased industrial pollution, it may also exacerbate information asymmetry and give rise to agency costs (Cheng and Feng, 2023). This concern is particularly pertinent in emerging economies, where market mechanisms may lack the complexity and refinement typically observed in more advanced economies. In contrast, voluntary disclosure demonstrates a proactive willingness on the part of corporations to share internal information with the public.

Legitimacy theory underscores the necessity of considering the broader political, social, and institutional context when examining economic issues (Meng et al., 2013). Firms with inferior environmental performance face heightened political and social pressures that jeopardize their legitimacy. Consequently, it is anticipated that they would engage in more comprehensive EID in their financial reports, either as a means of compensation or to enhance their environmental image (Li et al., 2017; Meng et al., 2013; Deegan, C., Rankin, M. and Tobin, 2002; Naser et al., 2006). Within the framework of mandatory regulations, EID predominantly serves as a tool for establishing legitimacy rather than functioning as an accountability mechanism (Meng et al., 2013) because corporations proactively react to governmental demands and adhere to legal requirements in their pursuit of legitimacy. As per this theory, EID is a consequence of external pressures, primarily stemming from government and public sources. Government pressure is evident in the direct implementation of laws and regulations, while public pressure takes an indirect and comparatively less forceful form, manifesting in public sentiment and market dynamics. In the Chinese setting, firms that are required to disclose environmental information face greater public scrutiny, and these social and political pressures lead to greater legitimacy concerns (Li et al., 2017; He and Loftus, 2014). The increased disclosure of environmental information is driven by the mounting demands of stakeholders aiming to legitimize their existence in response to the growing emphasis on environmental concerns (Li et al., 2017; Meng et al., 2013).

5.4.2 Ownership concentration and EID

In developed countries, corporate shares are distributed amongst a large number of shareholders whilst in emerging nations a high degree of ownership concentration is prevalent (Ismail, Abdul Rahman and Hezabr, 2018). The majority of shares in Chinese publicly-traded corporations are held by a limited number of shareholders (Chen et al., 2021). Ownership concentration is an important factor affecting Chinese enterprises' environmental responsibility. In the pursuit of maximizing profits, major shareholders frequently prioritize their own interests over those of other stakeholders. In situations where resources are limited and the primary objective is to enhance shareholder wealth, these major shareholders often opt for production and management strategies that yield immediate financial gains, while placing less emphasis on fulfilling environmental responsibilities (Chen et al., 2021). Brammer and Pavelin (2008) find a significant negative correlation between CSR disclosure and ownership concentration in the United Kingdom. Similarly, Cormier and Magnan (1999) reveal similar results in the Canadian context, although their focus is on firms' EID instead of CSR disclosure. They believe that where firms are closely held by individuals or families, there may be less pressure to publicly disclose additional information because it is already available to major shareholders. This aligns with legitimacy theory which posits that the extent of disclosure is contingent upon the level of exposure to public pressure (Li et al., 2017). In the context of environmental disclosure, rather than serving solely as a means to inform market investors, EID can also be utilized as a tool to mitigate the perceived risk of encountering social pressures. It can also be seen as a mechanism for managing the image of a firm's environmental practices. From the voluntary disclosure theory perspective, a higher degree of ownership concentration can increase costs because of the existence of asymmetric information between the firm and its stakeholders (Chang, 2013); thus, the firm would not voluntarily disclose environmental information if associated costs surpass the benefits (Li et al., 2017). However, Sufian and Zahan (2013) and Crisóstomo and Freire (2015) find that there is a positive association between ownership concentration and CSR disclosure in Bangladesh and Brazil, respectively. Muttakin and Subramaniam (2015) show that there is no significant relationship

between ownership concentration and CSR disclosure in Indian firms, whilst Ismail, Abdul Rahman and Hezabr (2018) find no significant relationship between ownership concentration and the quality of firms' EID at the international level. According to the theoretical discussions above and the previous literature, this study proposes the following hypothesis:

H1: Ownership concentration is negatively associated with firms' EID levels.

5.4.3 Institutional ownership and EID

Institutional ownership relates to stock market investments by institutional investors, such as banks, corporations, pension funds, insurance firms, and mutual funds (Velte, 2020; Chang and Zhang, 2015). Institutional owners, who place greater emphasis on short-term financial gains, demonstrate reduced responsiveness to the requirements of society and other stakeholders. As a result, they are less inclined to legitimize their actions through EID as a means of projecting a favourable image to the market (Acar, Tunca Çalıyurt and Zengin-Karaibrahimoglu, 2021), as suggested by legitimacy theory. Moreover, a potential issue of free riders within the shareholder base can arise when only a fraction of shareholders bears the costs of actively engaging with the firm's management, but the benefits are shared amongst all, including those who have not contributed (Li et al., 2022). This free-rider dilemma can manifest between institutional investors and other shareholders. Therefore, greater institutional ownership may lead to more free riders and increase firms' costs because these institutional owners focus on short-term returns but also enjoy the benefits of long-term investments, such as EID practices. According to voluntary disclosure theory, firms are less likely to share environmental information if the associated costs outweigh the potential benefits (Li et al., 2017). Empirical research suggests an inverse relationship between institutional ownership and ESG disclosure/EID (Siew, Balatbat and Carmichael, 2016). For instance, Acar, Tunca Çalıyurt and Zengin-Karaibrahimoglu (2021) show that there is a negative correlation between institutional ownership and EID using a sample of 72 countries and economic zones. Diantimala and Amril (2018) also found the same result in the Indonesian context

from 2010 to 2014. However, Habbash (2016) contends that there is a positive correlation between institutional ownership and firms' EID in Saudi Arabia. One potential reason is that institutional owners have substantial voting power compared to other shareholders, and they tend to be more actively involved in corporate environmental management practices than non-institutional owners (Ismail, Abdul Rahman and Hezabr, 2018). In contrast, Sartawi et al. (2014) find an insignificant relationship between institutional ownership and voluntary disclosure in Jordan, whilst Ismail, Abdul Rahman and Hezabr (2018) argue that there is no significant relationship between institutional ownership and the quality of firms' EID. Therefore, based on the discussions above, this study proposes the following hypothesis:

H2: Institutional ownership is negatively associated with firms' EID levels.

5.4.4 Managerial ownership and EID

Managerial ownership refers to the percentage of common shares owned by the CEO and executive directors (Eng and Mak, 2003). Managers who hold ownership stakes perceive that EID serves as a means to foster improved relations between the corporation and its stakeholders. They believe that robust EID enhances the firm's social image, particularly in terms of its commitment to environmental responsibility (Chang and Zhang, 2015), which is a way to gain legitimacy. Previous literature has reported mixed findings on the correlation between EID and managerial ownership. For instance, Uwuigbe and Olusanmi (2011) suggest that managerial ownership has a significant positive impact on the level of CSR disclosure in Nigeria. This finding indicates that firms with a higher degree of managerial ownership are more likely to prioritize environmental issues, as managerial owners are linked to the long-term survival of firms (Khlif, Ahmed and Souissi, 2017). However, Amosh and Mansor (2020) revealed that managerial ownership has no impact on firms' EID in Jordan. On the other hand, Mohd Ghazali (2007) finds that lower managerial ownership is associated with more CSR disclosures based on data from Malaysian firms. Similar results are shown by Diantimala and Amril (2018).

If an increase in managerial ownership motivates managers to emulate

shareholder behaviour, then a higher level of managerial ownership is anticipated to result in greater EID (Donnelly and Mulcahy, 2008). This is indicated by legitimacy theory since the growing emphasis on environmental concerns has led to increased demand from stakeholders seeking to legitimize their existence, which, in turn, leads to a heightened disclosure of environmental information (Li et al., 2017; Meng et al., 2013). In China, managers typically do not hold significant shares (Jiang and Kim, 2015), which means that the level of managerial ownership is low. The practice of granting executive stock options to managers remains uncommon, and firms generally do not provide shares, restricted shares, or performance shares as part of managerial compensation packages, so it is difficult for managers to establish an entrenchment effect within the firm. This situation is markedly different from many developed countries, where a manager with even a small fraction of the firm's shares can become entrenched. Thus, we posit that the alignment effect may have a stronger impact in the Chinese context and greater managerial ownership can mitigate firms' costs by aligning the interests of management with those of other shareholders (Xiao and Yuan, 2007). Firms are more likely to disclose an enhanced level of environmental information voluntarily when its perceived benefits are dominant, as indicated by voluntary disclosure theory (Li et al., 2017). Therefore, supported by the theoretical discussions in the Chinese setting, we propose the following hypothesis:

H3: Managerial ownership is positively associated with firms' EID levels.

5.4.5 State ownership and EID

Governments are frequently identified as significant stakeholders with the capacity to shape corporate strategy and performance, including disclosure practices (Acar, Tunca Çalıyurt and Zengin-Karaibrahimoglu, 2021). In China, SOEs are either owned or under the control of the central or local government (Meng et al., 2013), whereas non-SOEs are either owned or controlled by collective entities, foreign investors, or individuals. Previous literature presents conflicting viewpoints and diverse outcomes concerning the link between government ownership and EID/CSR (Ismail, Abdul Rahman and Hezabr, 2018). Some scholars advocate for a positive association

between government ownership and disclosure. For example, Acar, Tunca Çalıyurt and Zengin-Karaibrahimoglu (2021), Calza, Profumo and Tutore (2016), Eng and Mak (2003), Naser et al. (2006), and Haddad et al. (2015) show a positive relationship between EID/CSR levels and state ownership. Others, such as Xiao and Yuan (2007), find no significant association between state ownership and corporate voluntary disclosure in China.

However, it has been contended that SOEs experience fewer incentives for EID, for which there are several contributing factors. First, state-owned shares are not publicly tradable, and state shareholders often prioritize wealth distribution and the preservation of social order over enhancing shareholder value (Xiao and Yuan, 2007). The differing priorities of state owners from other types of shareholders mean that, for SOEs, developing EID incurs higher costs, and, therefore (according to volunteer disclosure theory) reduces the incentive to disclose. Second, given that the government typically serves as the sole or majority shareholder in SOEs, it has alternative sources of environmental information and relatively easier access to various financing channels compared with non-SOEs (Eng and Mak, 2003). Third, social and environmental reports from such firms often face less scrutiny from civil society groups in comparison to non-SOEs (Ismail, Abdul Rahman and Hezabr, 2018). This leads to less pressure on SOEs to disclose environmental information in China, as indicated by legitimacy theory. Finally, SOEs are less reliant on capital markets when financing their projects and may not have the incentive to provide information to improve their image, while firms with lower levels of state ownership are more likely to disclose environmental information and establish a good relationship with the capital market and the government (He and Loftus, 2014). A study by Argento et al. (2019), in the Swedish context, suggests that enterprises fully owned by the state tend to disclose less sustainability information compared with those partially owned by the state. In contrast to SOEs, which often receive government backing to meet political and societal objectives (Meng et al., 2013), non-SOEs possess stronger motivations for informing investors and other stakeholders through voluntary disclosure of additional environmental information. They aim to enhance

communication with external investors regarding their firms' existing or potential competitive advantages, and EID is a means by which they also gain legitimacy. Therefore, from both the perspectives of SOEs and non-SOEs, greater state ownership indicates less EID in the Chinese setting. In accordance with the above evidence and discussion, this study proposes the following hypothesis:

H4: State ownership is negatively associated with firms' EID levels.

5.5 Research Methodology

5.5.1 Data and sample

This study employs the data from Bloomberg and CSMAR from 2009 to 2019. The data on EDS, BS, DUAL, BIND, audit type (BIG4), ROA, market-to-book ratio (MKTB), LEV, FS, and IND was obtained from Bloomberg. Data for BM, OWCONCEN, INSTITOW, MANGOW and STATEOW was obtained from CSMAR. We chose 2009 as the starting point since the data on EDS is limited before 2009. In 2006 and 2008, China issued the *Interim Measures for Public Participation in Environmental Impact Assessment* and the *Environmental Information Disclosure Measures*, respectively (Agyemang et al., 2020). According to the *Clean Production Promotion Law* and *Environmental Impact Assessment Law*, enterprise EID has begun to be implemented since 2003. This study selects SHSZ300 Index A-shares with large market capitalization and good liquidity as the sample. The CSI 300 has two sub-indices: the CSI 100 index and the CSI 200 index, and its current total assets under management are around 11,016 million dollars based on the data from Bloomberg. Therefore, this index is considered to be the reference for Chinese stock exchanges, and also the equivalent of the Standard & Poor's (S&P) 500 Index. The sample firms cover 11 industries: financials, real estate, telecommunications, consumer discretionary, industrials, technology, health care, consumer staples, basic materials, energy, and utilities. Firms that did not have the necessary data for the analysis were excluded. The final sample consists of 300 firms with 2,025 firm-year

observations.

5.5.2 Variable definitions and measurement

To explore the impact of the four ownership structures on the EID of Chinese firms, EDS was used to measure the level of EID (Van Hoang et al., 2021; Fahad and Nidheesh, 2021). The EDS is part of the Bloomberg ESG disclosure score. Bloomberg compiled the indicator directly from firms' environmental disclosure levels, which range from 0.1 to 100. According to Bloomberg, the higher the score, the more transparent the environmental issues. Data sources include firm annual reports, CSR reports, press releases, sustainability reports, firm websites, Bloomberg surveys, and third-party research (Ifada and Indriastuti, 2021; Fahad and Nidheesh, 2021).

Regarding independent variables, OWCONCEN is a unique indicator for Chinese firms extracted from CSMAR, which is measured by the percentage of common stock held by the top ten largest shareholders. INSTITOW is the percentage of shares held by institutional investors (Gerged, 2020); MANGOW is the percentage of shares held by managers and board members; STATEOW is a dummy variable, which equals 1 if the firm is a SOE and 0 otherwise (Meng et al., 2013).

For control variables, BIG4, ROA, MKTB, LEV, FS, BS, BM, DUAL, BIND, IND, and year were selected for this study to consider their potential impact on EID (Gerged, 2020; Wang, O and Claiborne, 2008; Xiao and Yuan, 2007). BIG4 is the dummy variable which is 1 if the listed firm is audited by the Big Four; otherwise, it is 0 (Gerged, 2020). Odoemelam and Ofoegbu (2018) find that audit type is significantly positively associated with overall environmental reporting in South Africa and Nigeria. ROA is measured by using the ratio of net income to total assets (Gerged, 2020). Tang and Luo (2010) argue that high-profit firms voluntarily disclose more information than low-profit firms to highlight their differences and avoid unnecessary losses. The next control variable is MKTB, using the firm's market value divided by its book value (Wang et al., 2019). Andrikopoulos and Kriklani (2013) find that the market-to-book (P/B) ratio is significantly correlated with the breadth of

EIDs. LEV is defined as the ratio of total debt to total assets (Brammer and Pavelin, 2006, 2008; Karim, Lacina and Rutledge, 2006; Wang et al., 2019). Empirical evidence from McGuire, Sundgren and Schneeweis (1988) and Orlitzky and Benjamin (2001) shows that a firm's financial leverage is positively related to EID levels. Eng and Mak (2003) and Cormier and Magnan (2003) find a significant negative correlation between these two factors. FS is measured using the natural logarithm of total assets (Meng et al., 2013). Wang et al. (2019) suggest that firm size should be considered, and Zeng et al. (2010) find that EID levels increase with firm size as larger firms are more likely to be subject to public scrutiny. They are also more willing to disclose environmental information to reduce agency costs (Cormier and Gordon, 2001).

BS is measured by the total number of directors on the board (Gerged, 2020). Some researchers, such as Mak and Li (2001), Yoshikawa and Phan (2003), Yatim, Kent and Clarkson (2006) and Khanchel (2007), suggest that boards should be small because it is difficult to organize large boards. In contrast, other scholars (Cucari, Esposito De Falco and Orlando, 2018; Agyemang et al., 2020; Gerged, 2020; Ganapathy and Kabra, 2017; Liao, Luo and Tang, 2015) argue that large boards of directors may lead to greater corporate participation in EID practices. The reason for this is that increasing the number of board members expands the breadth of knowledge and expertise within it, thus reducing agency problems, and enabling board members to develop their own capabilities and, in turn, enhance their firm's EID level. BM refers to the total number of board meetings held each year (Agyemang et al., 2020). Vafeas (1999) reveals that board activities, measured by the number of board meetings, are an essential dimension of board operations, and they help overcome agency conflict. A reduction in the frequency of board meetings affects management's control and delays the delivery of critical decisions and information to various stakeholders. Researchers generally agree that the quality of disclosed environmental information tends to improve as the number of board meetings increases (Peter and Romi, 2014; Agyemang et al., 2020). Furthermore, DUAL is a binary variable, set to 1 if the same person holds both the CEO and

chairman positions and 0 otherwise (Gerged, 2020). Several studies have found that CEO duality is inversely associated with EID levels, suggesting that CEO duality may increase conflicts of interest that can impact a firm's transparency process (Gerged, 2020; Alfraih, 2016; Chau and Gray, 2010; Freitas Neto and Mol, 2017). However, Jizi et al. (2014) pointed out that there is a positive correlation between CEO duality and EID. A reason for this might be that powerful CEOs raise their firms' EID levels, an action which enhances their professional reputation, and raises their tenure and compensation prospects. BIND is calculated by dividing the number of independent non-executive directors by the number of board members (Wang et al., 2019). Chen and Jaggi (2000), Gul and Leung (2004), Byard, Li and Weintrop (2006), Cheng and Courtenay (2006), and Ahmed, Hossain and Adams (2006) conclude that the higher the proportion of independent directors on the board, the more transparent the firm's environmental information is, as independent directors will be able to encourage management to disclose more information. In contrast, Michelon and Parbonetti (2012) find that board independence has a significant negative impact on environmental disclosure.

To control for industry and year, dummy variables (IND and YEAR) for these two factors were also included (Elfaitouri, 2014). "Industry" is considered a significant factor affecting EID (Bewley and Li, 2000; Boesso and Kumar, 2007; Cormier and Gordon, 2001; Wang et al., 2004). Firms in environmentally sensitive industries may disclose environmental information to justify their operations (Boesso and Kumar, 2007). Heavily polluting firms face stricter government regulations and are required to disclose environmental information (Meng et al., 2013). Yekini and Jallow (2012) observe that well-known industries tend to develop high levels of EID to meet public expectations. Gamerschlag, Möller and Verbeeten (2010) argue that firms in the energy supply and consumption industries appear to disclose more environmental information than firms in the service and other industries. This result is consistent with the study by Yekini, Adelopob and Andrikopoulos (2015). For the year dummy variable, EDS may change from year to year due to relevant regulations or corporate disclosure activities, so it is crucial to control for the year.

5.5.3 Model specification

Based on previous studies (Acar, Tunca Çalıyurt and Zengin-Karaibrahimoglu, 2021; Akrout and Othman, 2016; Amosh and Mansor, 2020; Chang and Zhang, 2015; Ismail, Abdul Rahman and Hezabr, 2018), the following model is proposed to examine the relationship between the four types of ownership structure and EID:

$$EDS_{it} = c + \beta_1 OWCONCEN_{it} + \beta_2 INSTITOW_{it} + \beta_3 MANGOW_{it} + \beta_4 STATEOW_{it} + Controls_{it} + \varepsilon_{it} \quad (2)$$

Where EDS is the environmental disclosure score, extracted from Bloomberg based on a firm's level of environmental disclosure. Bloomberg summarizes a firm's EDS (on a scale of 0.1 to 100), with higher scores indicating higher levels of environmental disclosures. OWCONCEN is ownership concentration, which is the percentage of common stock held by the top ten shareholders; INSTITOW is institutional ownership, measured by the percentage of shares held by institutional investors; MANGOW is the shares held by board members and their relatives as a percentage of total issued shares; STATEOW is a dummy variable, which equals 1 if the firm is a SOE and 0 otherwise. Control variables (Controls) include audit type (BIG4), profitability (ROA), market-to-book ratio (MKTB), leverage (LEV), firm size (FS), board size (BS), board meetings (BM), CEO duality (DUAL) and board independence (BIND). Industry effect and year effect are also controlled by dummy variables: i is the firm and t is the year. β is the regression coefficient; c is the constant term; ε is the error term. All definitions and measurements of variables used in the study are shown in Table 19.

Table 19: Variable Definitions and Measurement

	Variable Name	Abbreviation	Definition/Measurement
Dependent Variables	Environmental disclosure score	*EDS*	Compiled based on the firm's environmental disclosure level, ranging from 0.1 to 100. An indicator of environmental transparency. The higher the score, the more transparency of environmental issues.
Independent Variables	Ownership concentration	*OWCONCEN*	The percentage of ordinary shares held by the top ten largest shareholders.
	Institutional ownership	*INSTITOW*	The percentage of shares held by institutional investors.
	Managerial ownership	*MANGOW*	The percentage of shares held by board members and their relatives from the total number of issued shares.
	State ownership (Dummy 0/1)	*STATEOW*	If more than 50% of the shares owned by the state (SOEs), the dummy variable is set to 1, otherwise, it is 0 (non-SOEs).
Control Variables	Audit type (Dummy 0/1)	*BIG4*	If the listed firm is audited by the big 4 auditing firms, the dummy variable is set to 1, otherwise, it is 0.
	Profitability	*ROA*	The ratio of net income to the total assets.
	Market-to-book ratio	*MKTB*	The firm's market value divided by its book value.
	Leverage	*LEV*	The ratio of total debts to total assets.
	Firm size	*FS*	The natural logarithm of total (short and long-term) assets reported by the firm.
	Board size	*BS*	The total number of directors on the board.
	Board meetings	*BM*	The total number of meetings held by the board, either regular or emergency meetings per year.
	CEO duality (Dummy 0/1)	*DUAL*	If the same person holds the CEO and the chairman positions, the dummy variable is set to 1, otherwise, it is 0.
	Board independence	*BIND*	The number of independent non-executive directors divided by the number of board members. Independence is defined according to the firm's criteria.
	Industry (Dummy)	*IND*	1-11 for eleven industries which are financials, real estate, telecommunications, consumer discretionary, industrials, technology, health care, consumer staples, basic materials, energy and utilities.

This study conducted the Breusch and Pagan (1980) LM test and Hausman (1978) test to select the most suitable model for examining the relationship between EID and the four ownership structures, which included pooled ordinary least squares (OLS)/linear, FE, and RE. First, the LM test indicates that the RE model has a better fit than the pooled OLS model, as the p-value is 0.000 (lower than 0.05). In addition,

the Hausman test reports that the FE model is more suitable than the RE model because the corresponding p-value is 0 ($p<0.01$). Therefore, among the three regression models, the FE model is considered the most suitable one for this study. However, we present the results of three regression models for comparison purposes.

5.6 Findings and Discussion

5.6.1 Descriptive statistics

Table 20 presents the descriptive statistics for all variables used in this study. According to the results, the EDS ranges from 0.423 to 51.938, with mean and median values of 15.012 and 12.403, respectively. The overall level of EID is below average, which means that most firms do not disclose enough environmental information to their stakeholders. Pan (2012) applied a numerical rating system to describe EID scores, focusing on heavily polluting firms in China, and finds that EID levels are low, the overall quality of EID is poor, and firms have limited environmental awareness. However, the number of disclosing firms is increasing. Tang and Luo (2010) found similar results after they studied 169 Chinese firms in 21 different industries in 2008. Furthermore, Meng et al. (2013) use a disclosure score to measure EID and conclude that both the quantity and quality of corporate EID are relatively low due to the infrequent stakeholder involvement in EID activities.

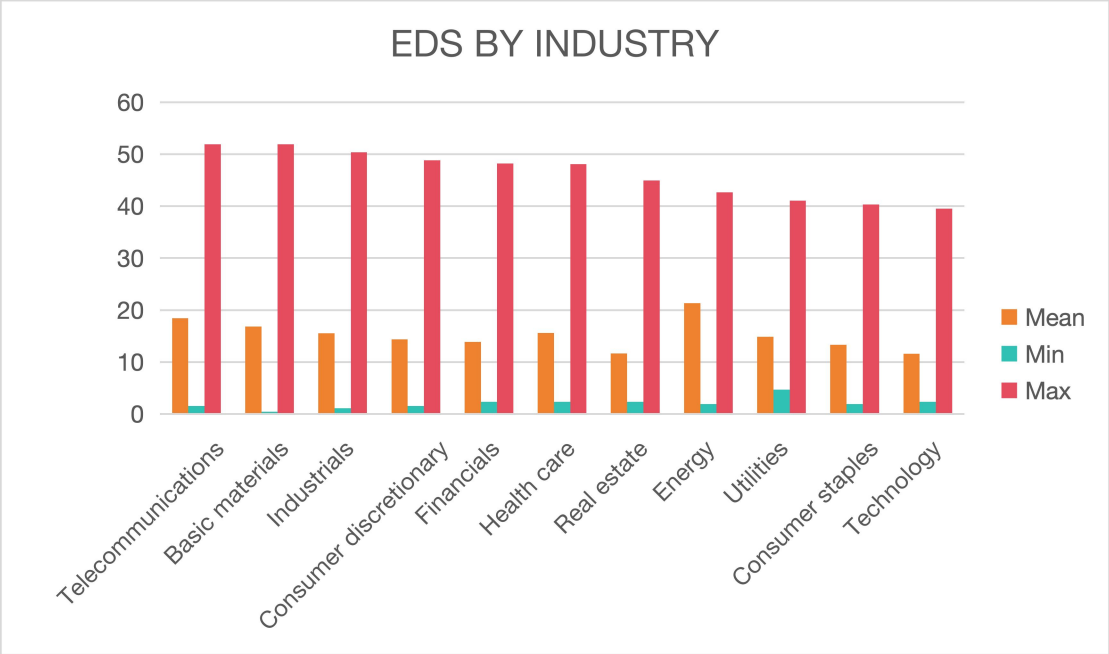
Table 20:Descriptive Statistics

Variable	Obs	Mean	Median	Std.Dev.	Min	Max
EDS	1896	15.012	12.403	9.928	.423	51.938
OWCONCEN	2022	67.017	67.305	16.302	20.79	100.00
INSTITOW	2004	68.334	71.350	18.853	3.77	100.00
MANGOW	2022	3.51	0.003	10.313	0	77.988
STATEOW	2025	.069	0	.253	0	1
BS	2005	10.207	9	2.824	5	19
BM	2006	10.876	10	5.678	2	57
DUAL	2008	.165	0	.372	0	1
FS	2017	11.37	11.168	1.855	6.383	17.22
BIND	2006	38.34	36.364	6.882	10	80
ROA	2015	5.923	3.659	6.272	-16.412	43.381
MKTB	2020	3.222	2.228	2.944	.481	38.436
LEV	2016	4.558	2.745	4.514	1.039	28.81
BIG4	1657	.998	1	.049	0	1

Furthermore, this study examines the EDS for each industry to determine whether the category of industry plays a significant role in influencing low levels of environmental disclosure. Table 21 shows that most firms within their industry have relatively low levels of environmental disclosure compared to their industry average EID levels and have a relatively wide range of EDS from minimum to maximum (from 1 to 50), except for the technology sector and consumer staples sector (from 2 to 40). However, the difference in EDS between industries is not obvious. Generally, firms in the energy industry disclose the most information (21.354 on average), followed by firms in the telecommunications industry (about 18). The rest of the industries range from approximately 11 to 14. Figure 8 shows the average, minimum and maximum values for EDS by industry category. It reveals that the basic materials category has the widest variation, with both maximum and minimum values occurring within this industry, but that the energy sector has the narrowest variation. When considering mean EDS, the energy sector has the highest average value, which suggests that energy firms disclose relatively more information than firms in other sectors. In contrast, real estate and technology disclose relatively less environmental information. Figure 9 depicts the trends in EDS from 2009 to 2019. While there have been some fluctuations, the general trend in EID has been on an upward trajectory.

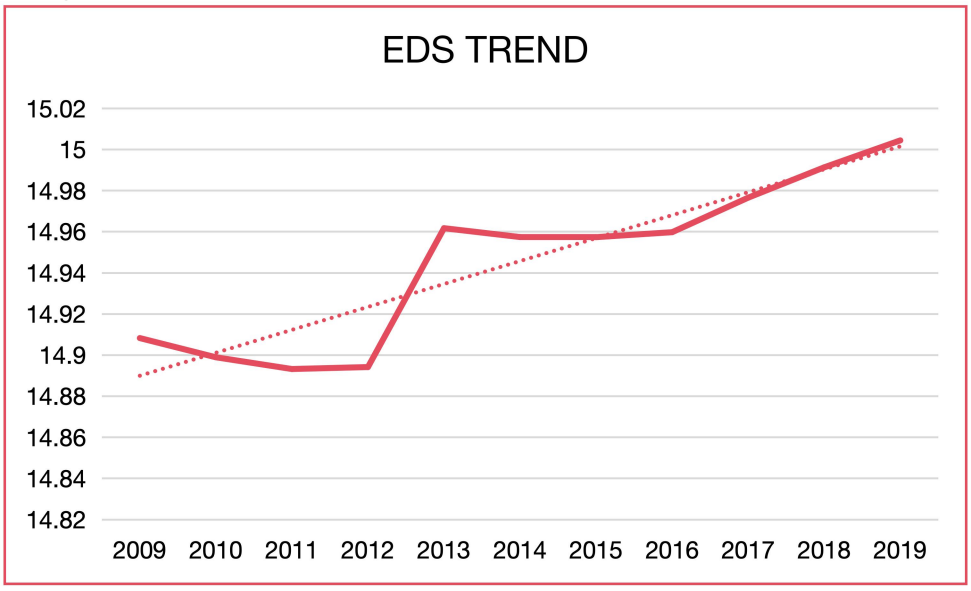
This implies that certain sectors, such as the energy industry, tend to provide more environmental information; and highlights that China has made some progress in enhancing its EID practices over the past 11 years. However, the Giannarakis, Andronikidis and Sariannidis (2020) study of firms in the United States finds that the average environmental disclosure level is around 0.56 out of 1, which means that, on average, firms disclose 56% of their environmental information. Thus, when compared with developed countries (e.g. the United States), the EID level of 15% (0.15 out of 1) in China is relatively low.

Figure 8: Histogram of EDS by Industry



Notes: The orange, blue and green bars stand for the average, minimum and maximum values of EDS, respectively. Each group of three-colored bars belongs to one industry. The horizontal axis shows the industry categories and the vertical axis is the EDS.

Figure 9: Line Chart of Environmental Disclosure Trend from 2009 to 2019



Notes: The full line stands for the actual environmental disclosure score over the 11 years, and the dotted line shows the general trend of the environmental disclosure. The horizontal axis is the year and the vertical axis is the environmental disclosure score.

In terms of independent variables, the average for OWCONCEN is 67.017, meaning that, on average, around 67% of ordinary shares are held by the top ten largest shareholders. This indicates a high level of ownership concentration in China. The minimum and maximum[6] figures are 20.79 and 101.16, respectively. The average value of INSTITOW is 68.334, indicating that institutional owners hold the majority of shares in most firms. Moreover, the maximum and minimum for MANGOW are 77.988 and 0, respectively, and its average is 3.51, which means that on average, managers hold 3.5% of the equity or shares in the firms. This finding is consistent with the previous study by Diantimala and Amril (2018) that around 3% to 4% of the total issued shares are held by managers. The data reveals that STATEOW exhibits an average value of 0.069, given the median concentration at 0. This suggests that a significant majority of firms within our sample are non-SOEs, contributing to a relatively moderate mean despite the maximum value of 1.

[6] The maximum is not an extreme outlier because the reason for 101.16 higher than 100 is that OWCONCEN uses total shares outstanding as its denominator, but some shareholders also possess shares that are not outstanding.

Table 21: Descriptive Statistics of EDS by Industry Category

Industry	Obs	Mean	Median	Std.Dev.	Min	Max
Financials	408	13.86	10.714	9.453	2.326	48.214
Real estate	70	11.628	9.302	9.67	2.326	44.961
Telecommunications	56	18.434	14.729	11.583	1.55	51.938
Consumer discretionary	264	14.386	11.628	9.409	1.55	48.837
Industrials	362	15.517	13.178	9.057	1.087	50.388
Technology	105	11.591	9.302	6.607	2.326	39.535
Health care	148	15.583	10.078	11.972	2.326	48.062
Consumer staples	105	13.293	11.628	7.612	1.933	40.31
Basic materials	209	16.847	13.178	11.432	.423	51.938
Energy	92	21.354	17.442	11.67	1.933	42.636
Utilities	77	14.839	14.729	7.501	4.651	41.085

5.6.2 Correlation analysis

Tables 22 and 23 present the results of the correlation matrix and VIF for all variables. Among the independent variables, only MANGOW is insignificantly correlated with EDS. OWCONCEN is significantly positively correlated with EDS, and INSTITOW and STATEOW are significantly negatively associated with EDS. The pairwise correlations do not show potential multicollinearity issues in the model because the differences between these independent variables are relatively low. Furthermore, Table 23 again confirms that there is no multicollinearity problem since the values of VIF are below 10 (Wang et al., 2019).

Table 22: Pairwise Correlations

Variable	EDS	OWCONCEN	INSTITOW	MANGOW	STATEOW	BIG4	ROA	MKTB	LEV	FS	BS	BM	DUAL	BIND
EDS	1.000													
OWCONCEN	0.173***	1.000												
INSTITOW	-0.136***	-0.353***	1.000											
MANGOW	-0.013	-0.055**	0.061***	1.000										
STATEOW	-0.089***	0.195***	-0.070***	-0.092***	1.000									
BIG4	0.023	-0.014	0.021	-0.007	0.019	1.000								
ROA	-0.150***	-0.061***	0.160***	0.269***	-0.112***	0.028	1.000							
MKTB	-0.199***	-0.120***	0.104***	0.306***	-0.032	0.031	0.598***	1.000						
LEV	0.033	0.045**	-0.220***	-0.181***	0.008	-0.035	-0.434***	-0.318***	1.000					
FS	0.280***	0.294***	-0.316***	-0.287***	0.026	-0.042*	-0.537***	-0.563***	0.762***	1.000				
BS	0.025	-0.017	-0.082***	-0.214***	0.087***	-0.000	-0.263***	-0.215***	0.553***	0.343***	1.000			
BM	0.118***	-0.038*	0.017	0.071***	-0.067***	-0.007	-0.118***	-0.065***	0.055**	0.006	-0.045**	1.000		
DUAL	-0.031	-0.112***	0.086***	0.246***	-0.056**	0.022	0.131***	0.153***	-0.069***	-0.076***	-0.107***	0.020	1.000	
BIND	0.086***	0.127***	-0.074***	-0.013	0.049**	-0.009	-0.002	-0.022	-0.062***	-0.008	-0.349***	0.046**	0.071***	1.000

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 23: Variance Inflation Factor

Variable	VIF	1/VIF
FS	4.691	.213
LEV	3.363	.297
MKTB	2.179	.459
ROA	1.84	.543
BS	1.831	.546
OWCONCEN	1.486	.673
INSTITOW	1.305	.766
BIND	1.259	.794
MANGOW	1.225	.817
DUAL	1.095	.913
STATEOW	1.061	.943
BM	1.038	.963
BIG4	1.005	.995
Mean_VIF	1.798	.995

5.6.3 Regression analysis

Table 24 presents and compares the pooled OLS, RE and FE (baseline model) estimates of the impact of the four types of ownership structure on the EDS. First, OWCONCEN is insignificantly correlated with EDS. which is not in line with **H1**. This is consistent with the study of Muttakin and Subramaniam (2015) who report that there is no significant correlation between ownership concentration and CSR disclosure in the Indian context. Ismail, Abdul Rahman and Hezabr (2018) discovered no significant association between ownership concentration and the firms' EID on a global scale. One potential reason for this is that the significant ownership concentration (within a few families and the government) minimizes the concern for accountability (Naser et al., 2006), such as EID. Consequently, firms have limited motivation to engage with EID.

Second, INSTITOW is negatively correlated with EDS at the 1% significance level, suggesting that firms with greater institutional ownership disclose less environmental information. Thus, **H2** is supported. Our results are consistent with Siew, Balatbat and Carmichael (2016) who propose an inverse relationship between

institutional ownership and ESG disclosure, including EID. Similarly, Diantimala and Amril (2018) discovered a negative association between institutional ownership and EID in the Indonesian context during the period from 2010 to 2014. This can be ascribed to the challenge of free riders within the shareholder base, wherein a subset bears the costs of engaging with the firm's management but the rewards are distributed to all, creating a free-rider predicament (Li et al., 2022). Institutional owners, prioritizing short-term objectives, can benefit from long-term goals like EID, but firms may be less inclined to disclose if costs outweigh benefits, which aligns with voluntary disclosure theory (Li et al., 2017). Furthermore, consistent with legitimacy theory, institutional owners focusing on short-term gains may be less inclined to address societal demands, thus having limited motivation to use EID as a strategy to present a favourable market image (Acar, Tunca Çalıyurt and Zengin-Karaibrahimoglu, 2021).

Third, MANGOW is significantly and positively correlated with EDS. Thus, **H3** is supported, and the finding is in line with the previous literature (e.g. Uwuigbe and Olusanmi, 2011; Khlif, Ahmed and Souissi, 2017). Uwuigbe and Olusanmi (2011) find that managerial ownership exerts a significantly positive influence on the extent of CSR disclosure in Nigeria. This suggests that firms with greater levels of managerial ownership are more inclined to prioritize environmental concerns, given the managerial owners' connection to the long-term viability of the firms (Khlif, Ahmed and Souissi, 2017). Theoretically, legitimacy theory posits that heightened attention to environmental concerns increases stakeholder demand for validation, leading to an upswing in environmental information disclosure (Li et al., 2017; Meng et al., 2013). Managers believe that robust EID enhances the firm's social image, reinforcing its commitment to environmental responsibility (Chang and Zhang, 2015), and thereby strengthening legitimacy. Additionally, higher managerial ownership can potentially align management interests with those of other shareholders, which contributes to cost reduction (Xiao and Yuan, 2007). Consequently, firms are more likely to engage in voluntary environmental information disclosure when the perceived benefits outweigh the costs, which aligns with the principles of voluntary

disclosure theory (Li et al., 2017). In the Chinese context, managers typically lack substantial ownership stakes (Jiang and Kim, 2015), which results in low managerial ownership. Unlike many developed countries, executive stock options and equity-based compensation are infrequently granted in Chinese firms, making it challenging to establish entrenched positions for managerial owners, so manager-owners hardly have the opportunity to attain empowerment and secure entrenched positions within the firm. Hence, in the absence of entrenched positions, the correlation between voluntary disclosure and managerial ownership should be positive (Donnelly and Mulcahy, 2008).

Finally, STATEOW has a significant and negative impact on EDS. Thus, **H4** is supported. This finding is in line with voluntary disclosure theory, which suggests that conflicts may arise between the priorities of state owners and other shareholders, potentially resulting in increased costs for firms, and leading to reduced voluntary EID. Moreover, social and environmental reports from such firms often undergo less scrutiny from civil society groups compared to non-SOEs (Ismail, Abdul Rahman and Hezabr, 2018). This reduces the pressure on SOEs to disclose environmental information in China, as indicated by legitimacy theory. Furthermore, SOEs rely less on capital markets for project financing and may lack the incentive to provide information to enhance their image. In contrast, firms with lower levels of state ownership are more likely to disclose environmental information and foster positive relationships with the capital market and the government (He and Loftus, 2014). In addition, non-SOEs are highly motivated to inform investors and other stakeholders through voluntary disclosure of additional environmental information (Meng et al., 2013). They aim to enhance communication with external investors regarding the firm's current or potential competitive advantages, and EID serves as a means to establish legitimacy. In summary, greater state ownership tends to result in less EID in the Chinese context, as supported by a study conducted by Argento et al. (2019), which indicates that fully government-owned enterprises in the Swedish context tend to disclose less sustainability information compared to those with partial state ownership.

Table 25 summarizes the FE regression results for the relationship between EDS and the four types of ownership structure, and their corresponding theoretical underpinning.

Table 24: Pooled OLS, RE and FE Regression

	Pooled OLS	RE	FE
Variable	EDS	EDS	EDS
OWCONCEN	-0.021*	0.013	-0.021
	(-1/964)	(0/416)	(-1.226)
INSTITOW	-0.035*	-0.056*	-0.035***
	(-2.017)	(-1.924)	(-2.610)
MANGOW	0.086***	0.041	0.086***
	(4.521)	(0.861)	(3.243)
STATEOW	-2.591***	-0.051	-2.591***
	(-5.435)	(-0.048)	(-2.639)
BIG4	2.598	6.166	2.598
	(0.752)	(1.237)	(0.514)
ROA	-0.040	-0.012	-0.040
	(-1.219)	(-0.139)	(-0.721)
MKTB	-0.173**	-0.006	-0.173
	(-3.032)	(-0.034)	(-1.206)
LEV	-0.767***	-0.310*	0.767***
	(-6.625)	(-1.761)	(-7.986)
FS	3.460***	2.112***	3.460***
	(8.207)	(3.985)	(12.415)
BS	0.294***	0.169	0.294***
	(5.163)	(0.890)	(2.724)
BM	0.269***	0.197***	0.269***
	(6.685)	(3.571)	(6.383)
DUAL	0.042	-0.188	0.042
	(0.076)	(-0.163)	(0.067)
BIND	0.041	-0.026	0.041
	(1.305)	(-0.491)	(1.124)
Constant	-33.958***	-21.621***	
	(-5.094)	(-2.790)	
F-value	.		30.470
R-squared	0.326		0.326
Industry control	Yes	Yes	Yes
Year control	Yes	Yes	Yes
Observations	1552	1552	1552

Notes: *t* statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 25: Summary of FE Regression Results

Variable	Relationship with EDS	Whether The Hypothesis Is Accepted	Whether Supported by Theories
OWCONCEN	Insignificant Negative (-)	Not accepted	Not applicable
INSTITOW	Significant at 1% Negative (-)	Accepted	Yes
MANGOW	Significant at 1% Positive (+)	Accepted	Yes
STATEOW	Significant at 1% Negative (-)	Accepted	Yes

5.6.4 Endogeneity issues and additional analyses

The issue of endogeneity has the potential to result in inconsistent estimations and erroneous inferences, potentially yielding deceptive conclusions and unsuitable theoretical interpretations (Ullah, Akhtar and Zaefarian, 2018; Ullah et al., 2021). In certain cases, this bias might even cause coefficients to exhibit an incorrect direction or sign (Ullah et al., 2021). In a FE model, firm-specific fixed effects are integrated into the econometric model either by adding a group of firm-specific indicator variables to the regression or by conducting internal transformations (differencing) to remove the time-invariant components (Ullah, Akhtar and Zaefarian, 2018). This procedure effectively eliminates unmeasured variables at the time-invariant industry and firm levels. Nevertheless, the use of FE estimation comes into play when grappling with endogeneity in situations where firm-specific attributes (time-invariant) are correlated with the explanatory variable. According to Fulgence et al. (2022), while the FE method may help alleviate the impact of unobservable firm-specific factors, it may not fully eliminate the issue of endogeneity. For instance, although ownership structure can affect EID, it is plausible that EID can also influence ownership structure. For example, shareholders increasingly consider environmental factors when making their investment decisions. The extent of EID can shape shareholder perception, influencing their decisions to either buy or sell shares, thus

impacting the ownership structure over time. Therefore, we conduct the 2SLS method with instrumental variables in our analysis (Wang et al., 2019). The results reported in Table 26 are consistent with our main findings in Table 24, and hence our findings are not sensitive to the issue of endogeneity.

Second, to address the potential simultaneous relationship between ownership structure and EID, we estimate a lagged effect model (Wang et al., 2019). According to Saini and Singhania (2019), the prerequisites for utilizing static panel models are not always adequately considered. For instance, we utilized a FE estimation approach, which has the potential to manage unobservable variations, assuming strict exogeneity. Strict exogeneity implies that a firm's current ownership structures (independent variables) are not influenced by any alterations in a firm's past EDS (dependent variable) (Ullah, Akhtar and Zaefarian, 2018). If the lagged value of EDS impacts current ownership structures, the static effect estimators become biased. Therefore, we utilized the lagged effect regression to address potential endogeneity issues. The results shown in Table 26 are comparable to our main findings, thus further confirming that our findings are robust.

Table 26: Endogeneity: 2SLS and Lagged Effect Regression

	2SLS	Lagged Effect
Variable	EDS	EDS
OWCONCEN	-.022	
	(-1.100)	
INSTITOW	-.037**	
	(-2.480)	
MANGOW	067**	
	(2.171)	
STATEOW	-5.075***	
	(-3.015)	
L.OWCONCEN		-0.020
		(-1.077)
L.INSTITOW		-0.037**
		(-2.533)
L.MANGOW		0.065**
		(2.241)
L.STATEOW		-2.992***
		(-3.079)
Control variables	Yes	Yes
Industry control	Yes	Yes
Year control	Yes	Yes
Observations	1351	1354
F-value	28.146	28.409
R-squared	0.333	0.337

Notes: *t* statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

To increase the robustness of the findings, this study employed three additional analyses. First, we divide the firms into two groups: 'high-regulated' industries, which include financials, telecommunications, industrials and energy; and 'low-regulated' industries which include real estate, consumer discretionary, technology, health care, consumer staples, basic materials, and utilities[7]. Chen et al. (2021) contend that it is

[7] In this study, high-regulated industries include financials, telecommunications, industrials and energy, and low-regulated industries include real estate, consumer discretionary, technology, health care, consumer staples, basic materials and utilities. The categorization is based on the *Regulations of Environmental Inspection on Firms Assessing to or Refinancing on the Stock Market*, which identifies certain industries, such as metals, mining, construction, electricity, petroleum and chemicals, and food and beverages, as polluting (Lu and Abeysekera, 2014). Additionally, industries such as banking and insurance, telecommunications and transportation are recognized as having high consumer awareness in China. Consequently, all polluting industries and those with high consumer awareness are considered high-regulated industries, while the remaining industries fall under the

imperative not to overlook the varied impacts when evaluating different firms or industries because industry characteristics is an essential factor impacting firms' EID. The level of firms' focus on corporate EID varies when one takes into account the characteristics of different types of firms or industries. The unique nature of corporate production and operations in different industries results in distinct environmental impacts, leading to varying stakeholder expectations and levels of media attention. Production processes in heavily polluting/high-regulated firms are recognized as of significant concern with detrimental environmental effects. These firms are obliged to manage the pollutants generated during their production operations. Failure to do so can result in adverse consequences for their reputation, stock prices, and overall firm value. Additionally, firms in the lower-polluting/low-regulated category face stricter governmental regulations, compelling them to engage in EID practices. Table 27 illustrates that the relationship between EDS and ownership structure is more significant for low-regulated industries when compared with high-regulated industries. This finding is aligned with the discussion of Chen et al. (2021), and it is also supported by legitimacy theory which suggests more pressure pushes low-regulated industries to disclose environmental information in order to gain legitimacy. Therefore, this finding is consistent with the results of the baseline model.

Second, we categorize the firms into small and large firms based on their market capitalization. Table 27 presents the results of these two groups. The findings for both groups are similar to those in the baseline model. We find a significant impact of EDS on INSTITOW for both small and large firms. However, we show that EDS has a significant impact on MANGOW for small firms but on STATEOW for large firms. The reason for this can be that managerial ownership and state ownership may play different roles for small and large firms in disclosing environmental information.

Third, we finally divide our sample into two groups: before and during 2014, and after 2014. The reason for this is that in 2014, a more stringent environmental protection law was introduced to further enhance EID in China, as discussed previously. This law places the responsibility for environmental protection on both

low-regulated category.

individuals and organizations, outlining various penalties for environmental misconduct by individuals, organizations, and local governments (Ullah et al., 2022). In light of these developments, we conducted an examination to assess the effect of the 2014 *Environmental Protection Law of the People's Republic of China* on the relationship between EID and ownership structures in the pre-and post-implementation period. The empirical results presented in Table 27 reveal a significant correlation between EID and the four types of ownership structure after the enactment of the law. This finding indicates that the implementation of this legislation has played a crucial role in affecting the nexus between ownership structures and EID in China.

Table 27: FE Regression by Industry Type, Firm Size and the Implementation of the *Environmental Protection Law*

	Industry Type		Firm Size		Implementation of the environmental protection law (2014)	
	High-regulated	Low-regulated	Small	Large	Pre	Post
Variable	EDS	EDS	EDS	EDS	EDS	EDS
OWCONCEN	0.030	0.005	-0.020	0.034	-0.013	-0.009
	(1.149)	(0.217)	(-0.833)	(1.485)	(-0.572)	(-0.408)
INSTITOW	-0.009	-0.046**	-0.053***	-0.052***	-0.001	-0.057***
	(-0.449)	(-2.208)	(-2.704)	(-2.763)	(-0.061)	(-3.249)
MANGOW	0.003	0.094***	0.135***	-0.016	0.137***	0.107***
	(0.046)	(2.922)	(4.313)	(-0.351)	(3.416)	(3.169)
STATEOW	-2.402*	-5.451***	-1.479	-3.301**	-1.421	-2.846*
	(-1.873)	(-3.060)	(-1.034)	(-2.427)	(-1.491)	(-1.765)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry control	Yes	Yes	Yes	Yes	Yes	Yes
Year control	Yes	Yes	Yes	Yes	Yes	Yes
Observations	793	759	710	844	496	1056
F-value	12.055	15.110	8.336	11.221	8.751	28.462
R-squared	0.272	0.241	0.249	0.344	0.278	0.309

Notes: *t* statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

5.7 Conclusion

In recent years, due to increasingly alarming levels of environmental degradation, EID has emerged as a practical approach to address environmental pollution. Despite China being the world's second-largest economy (Jiang and Kim, 2015) and the largest carbon emitter, the current literature on EID in the Chinese context remains limited, with most previous studies concentrating on CSR and specific ownership structures, leaving a gap in comprehensive research on EID in China.

Using a sample of 300 firms listed in the SHSZ300 index from 2009 to 2019, this study examines the relationship between firms' EID and ownership structure (i.e. ownership concentration, institutional ownership, managerial ownership and state ownership) in China. We find that despite the growth of EID in recent years, the EID level of Chinese firms is relatively low when compared to developed countries. Our findings show that some industries (such as energy) disclose more environmental information than others; however, the industry category is not a critical factor contributing to the overall low level of environmental disclosure in China, as there is little variance in EID across industries. Additionally, our results show that when firms have a lower level of institutional ownership, a higher level of managerial ownership, and a lower level of state ownership, they tend to disclose more environmental information. Furthermore, additional analyses show that the correlation between EID and ownership structure is notably more pronounced in industries with lower regulatory oversight compared with those that are highly regulated; both small and large firms exhibit a willingness to disclose environmental information, but the impact of EID on managerial ownership tends to be more substantial among small firms, while the impact of EID on state ownership has a more pronounced influence among large firms. Moreover, the enforcement of the *Environmental Protection Law of the People's Republic of China* in 2014 has played a pivotal role in increasing the influence of EID on ownership structures in China.

Our findings can contribute to a deeper understanding of the EID landscape in China. We suggest that investors who are interested in non-financial issues (such as

EID), should evaluate firms' ownership structure because these factors are correlated to the EID level. Managers also need to strengthen the quality of their environmental information. To enhance the value-generating capacity of EID, it is imperative that environmental information is reliable, pertinent, and can be clearly understood by stakeholders.

Our study also offers practical recommendations for firms. First, they should consider advancing EID standards, encouraging the creation of dedicated environmental reports, and introducing third-party assurance mechanisms. Leveraging corporate governance mechanisms can enable a timely response to external market demands and effectively enhance the quality of EID. Second, they should recognize the growing pressure from the government and the public, and incorporate environmental concerns into their strategic planning processes. Third, they should consider prioritizing and enhancing their environmental management systems, establishing dedicated environmental departments, implementing environmental performance evaluation systems, and integrating environmental behaviour assessments into employee performance evaluations by creating a system of incentives and penalties. Finally, they should consider concentrating on refining production methods to make their processes more environmentally sustainable.

Our results have significant implications for regulators. First, there exists a significant disparity, in the realm of EID, between Chinese listed firms and those listed in the United States or Europe. Given that enhanced corporate environmental information availability can enhance capital market efficiency and attract investors, regulators should investigate the reasons behind the reluctance of Chinese listed firms to engage in more comprehensive disclosure, and formulate corrective actions. Second, there is a need for a comprehensive improvement in addressing the issue of EID in all industries, rather than focusing solely on specific industry types. When formulating policies related to EID engagement, policymakers should consider the diversity in ownership types and industry characteristics, and special attention should be paid to low-regulated industries. Third, the enforcement of pertinent laws will demonstrate their effectiveness in enhancing firms' EID in China, and regulators

should further refine their regulatory processes to enact more effective regulations. Fourth, the CSRC should enhance its green finance policies to meet the capital financing requirements and also utilize market-based mechanisms to regulate and oversee the environmental management practices of listed firms, ultimately enhancing firms' EID level. Finally, policymakers should be aware that institutional ownership and state ownership do not necessarily guarantee higher levels of EID. Therefore, it is necessary to implement a more stringent set of voluntary and mandatory measures in China to lead institutional owners, such as mutual funds and state and private pension funds, to become more responsible and play a greater role in stewarding their firms towards environmental disclosure and climate action (Slager et al., 2023). Policymakers also should consider that increased levels of institutional ownership and state ownership may impede EID, so it is necessary to implement regulatory measures or ownership structure reforms that involve the distribution of some state-owned and institutional shares to the public. Overall, it is essential for all stakeholders to collaborate in the pursuit of sustainable development. By doing so, the efficiency of corporate governance mechanisms and the decision-making process can be enhanced, ultimately leading to improved EID levels within firms.

This study has several limitations. First, China has unique socialist national characteristics with a financial system and corporate governance structure different from other countries, so these findings may be limited to the Chinese context. Second, due to data constraints, this study does not include other forms of ownership structures, such as foreign ownership. This study also relies on secondary data, but scholars in the future might benefit from using qualitative data. Third, future research may benefit from theories other than voluntary disclosure theory and legitimacy theory and may investigate the role of CEOs as moderators when examining the relationship between corporate governance and EID.

Chapter 6

Board Diversity

6.1 Brief Summary

EID holds significant importance in advancing sustainable practices and fostering environmental accountability. Board diversity, varying across contexts, can profoundly impact firms' willingness and capacity to disclose environmental information. Drawing from upper echelon theory and social identity theory, this research investigates whether board diversity (i.e. age, tenure, gender, and overseas background) can influence the EID of Chinese firms. Utilizing panel data from firms listed on the Shanghai Shenzhen 300 Index spanning from 2009 to 2019, the findings reveal a marginal enhancement in environmental information disclosure in China, yet the overall level remains comparatively low compared to developed nations. Moreover, firms with older board members, lower gender diversity, and greater diversity in terms of overseas backgrounds tend to disclose more environmental information. Further analyses indicate that in industries subject to stringent regulatory oversight, board tenure negatively impacts firms' EID levels, unlike in sectors with less regulatory control, a trend observed across small firms as well. Besides, the diversity of board members' academic background positively influences EID.

6.2 Introduction

In recent times, there has been a notable increase in stakeholders' demands for EID, driven by the growing global emphasis on environmental protection (Zeng et al., 2010). The demand for EID encapsulates stakeholders' needs to ensure that organizations are held accountable for their environmental impact, promoting collective progress for all stakeholders without exploitation (Khan et al., 2021). Adhering to the latest guidelines established by the ISSB, firms are expected to regularly issue reports detailing the environmental impact of their operations. A prominent example of enhanced EID requirements is the European Union's CSRD, which mandates comprehensive sustainability reporting, including detailed environmental impact disclosures, for a wide range of firms operating within the EU

(European Commission, 2021). Similar EID initiatives in developing/emerging countries include India's Green Rating project (Powers et al., 2011), Indonesia's Performance Evaluation and Ratings program (García, Sterner and Afsah, 2007), and China's Green Watch program (Wang et al., 2004). EID programs seem to influence firm behavior (Cohen and Santhakumar, 2007). Policymakers have extensively promoted these programs for several reasons. A key advantage is that EID has been shown to lead to substantial enhancements in environmental quality. In addition, Bagherpour Velashani and Arabsalehi (2008) highlights the economic benefits of enterprise EID that businesses have the option to utilize voluntary disclosures, particularly those related to environmental matters, as a mechanism for conveying information to the market, primarily due to anticipated economic advantages, such as mitigating underpricing.

Since China's entry into the World Trade Organization, its integration with the global economy has deepened, marked by increased openness (Agyemang et al., 2020). China is currently pursuing a global expansion strategy, with environmental concerns emerging as a significant constraint on this trajectory (Yang, 2006). As the social economy rapidly develops, the demand for natural resources rises, leading some enterprises to prioritize economic goals over ecological considerations. Consequently, the discharge of pollutants during resource extraction has inflicted severe damage on the natural environment. The extent of environmental harm caused by corporate activities has exceeded the environment's natural capacity for restoration. Chinese listed firms have experienced increasing pressure to disclose their environmental impact from society, the media, and the government. An example of the latter is the progressive implementation of various regulations (e.g. the *Guidelines on Environmental Information Disclosure for Listed Firms* and the *Environmental Protection Law of the People's Republic of China*) on EID. These regulations indicate that the Chinese government perceives EID as a favorable undertaking and they servs as a tactic to assist firms in harmonizing China's considerable economic expansion with its environmental and social impacts, aligning with the concept of a "harmonious society" (Shaheen et al., 2021).

Board diversity refers to the varying compositions of a board of directors, which can be classified into directly observable aspects (such as gender, age, and ethnicity) and less visible aspects (such as education and work experience) (Katmon et al., 2019). Board diversity is increasingly regarded as a favourable attribute of board composition due to its potential to bring a wider range of expertise, knowledge, and resources to the table (Muttakin et al., 2015), allowing for a more comprehensive approach to addressing stakeholder needs and issues, thus enhancing decision-making processes (Mateos De Cabo, Gimeno and Nieto, 2012). However, the effectiveness of board diversity in the context of developing nations has faced scrutiny in recent years (Shaheen et al., 2021). Critics argue that governance structures and practices that are effective in developed countries may not necessarily be suitable for environments with nascent legal and institutional frameworks (Muttakin et al., 2015). Therefore, the question of whether board diversity significantly impacts the EID in China remains pivotal.

Although the concept of CSR originated in the West, its fundamental principles have long been evident in China (Lu et al., 2015). China's tradition of responsible business practices dates back over 2,500 years to Confucianism (Wang and Juslin, 2009). Confucian values like "righteousness - yi" and "sincerity - xin", which align with modern Western CSR concepts, significantly influenced ancient Chinese merchants to seek profits with integrity and a dedication to societal well-being (Lu et al., 2015). A significant milestone in the evolution of CSR in China is the proposed national strategic objective of "Constructing a Harmonious Society". Rooted in Confucian principles, this goal highlights the localization of CSR within the Chinese context. If certain aspects of board diversity, such as board age and gender diversity, are influenced by cultural or other unique factors specific to China, and if these factors do not influence EID, then the presence of board diversity may not always translate into increased transparency and accountability in the Chinese context. Thus, this study aims to examine whether the elements of board diversity (namely, board age, board tenure, board gender diversity, and board overseas background) have an impact on the EID in China by using a sample of firms listed on the Shanghai

Shenzhen 300 Index from 2009 to 2019.

The reasons for choosing these four elements are as follow. First, managers with different ages are anticipated to exert distinct impacts on strategic decisions owing to disparities in values, risk preferences, and socio-cultural backgrounds (Muniandy et al., 2023). This implies that, among a range of options for a specific strategic decision, board age plays a significant role in selecting the preferred alternative (Hambrick and Mason, 1984). Second, the inclusion of board tenure can positively influence stakeholder management and stimulate innovation in CSR decision-making, potentially affecting the CSR disclosures of multinational corporations (Peng et al., 2021). Tenure diversity reflects the board's awareness of potential growth opportunities and competitive advantages (Barroso, Villegas and Pérez-Calero, 2011). Third, Wood and Eagly (2009) posit that men and women hold distinct viewpoints regarding leadership positions. Within Chinese listed firms, gender diversity has been observed to contribute significantly to variations in the strategic choices made by board members (Muniandy et al., 2023). Finally, Chinese national development organizations are actively implementing the *Thousand Talents Plan* established by the government. This initiative seeks to attract Chinese individuals with overseas experience back to China, encouraging them to apply the knowledge they have gained abroad, particularly in the realm of environmentally sustainable practices (Shahab et al., 2020). With Chinese firms facing pressure to demonstrate social and environmental responsibility due to internationalization (Hung, 2011), the overseas background of board members becomes increasingly pertinent. Therefore, this study chose board age, board tenure, board gender diversity and board overseas background as the four elements within board diversity.

Our study yields three main findings. First, despite the recent rise in the level of EID, Chinese firms exhibit lower EID levels compared to those in developed economies. Notably, this lack of EID remains consistent across different industries in China, regardless of their specific sector. Second, firms with an older average board age, lower gender diversity, and greater diversity in overseas backgrounds among

board members tend to have a higher propensity for disclosing environmental information. Third, upon additional analyses, we discovered that in industries subject to rigorous regulatory scrutiny, longer board tenure has a detrimental effect on the level of EID in contrast to sectors with less regulatory oversight. This pattern holds true even among smaller firms operating within these industries. Remarkably, the diversity of board academic background has a positive correlation with the extent of EID, indicating that a more academically diverse board may contribute to enhanced environmental transparency and reporting practices.

This study significantly advances the existing literature by examining the impact of board diversity on EID in China, an area that has received limited attention despite the growing global emphasis on diversity and sustainability governance. By incorporating multiple dimensions of board diversity, applying a multitheoretical framework, and exploring industry-specific regulatory effects, this research provides novel insights into the governance–EID relationship in an emerging market context. First, although there is an increasing trend of the research in board diversity, recent studies have examined its impact on CSR rather than EID in China (e.g. Shaheen et al., 2021; Naveed, Voinea and Roijakkers, 2022; Sial et al., 2018). The existing literature overwhelmingly emphasizes board gender diversity as the primary measure of diversity (e.g., Katmon et al., 2019; Peng et al., 2022; He et al., 2021), neglecting other critical board attributes, such as age, tenure, and overseas experience. This study refines the scope of board diversity research by incorporating a broader set of diversity attributes to assess their collective and individual effects on EID. By doing so, it offers a more holistic understanding of how board composition influences environmental transparency in China.

Second, this study applies upper echelon theory and social identity theory, recognizing the distinctive socio-cultural context of China. Traditional gender norms, deeply rooted in Confucianism and patriarchal structures, have historically influenced boardroom compositions (Wang, Wilson and Li, 2021). However, as educational and workforce dynamics evolve, diversity's role in corporate decision-making is also

shifting. While upper echelon theory explains how directors' demographic characteristics shape strategic choices, social identity theory provides insight into how group affiliations influence collective board behavior. Recognizing that neither theory alone fully explains board diversity's impact on EID, this study integrates both perspectives within a multitheoretical framework, enhancing explanatory power. This approach diverges from previous research, which primarily relied on single theories such as RBV theory or upper echelon theory alone (e.g., Katmon et al., 2019; Muniandy et al., 2023).

Third, this study is the first to investigate regulatory disparities in the board diversity–EID relationship across high-regulated and low-regulated industries in China. The findings reveal contrasting effects of board diversity under different regulatory environments, highlighting an important dimension that has been overlooked in prior research. In high-regulated industries, board tenure and board gender diversity exhibit significant negative correlations with EID, likely due to entrenched board members prioritizing risk aversion over proactive disclosure, especially under strict regulatory oversight. Conversely, in low-regulated industries, all four aspects of board diversity (age, tenure, gender, and overseas background) significantly influence EID, indicating that firms operating with fewer regulatory constraints may benefit more from diverse perspectives in environmental governance. These findings contribute new empirical evidence on how regulatory stringency moderates the effectiveness of board diversity in driving environmental transparency, a dimension that has not been previously identified in board diversity research.

The remainder of this study is structured as follows. Section 2 presents the theoretical framework and hypotheses development. The data and methodology are described in Section 3. Section 4 presents the findings and discussion. Section 5 concludes the study.

6.3 Theoretical Framework and Hypotheses Development

6.3.1 Theoretical framework

According to upper echelon theory, a firm's strategic decisions and performance are influenced by the background characteristics of its top management (Muniandy et al., 2023; He et al., 2021; Shahab et al., 2020). This means that a manager's perceptions and values form the basis for their strategic decisions. While CEOs may not be directly involved in preparing financial reports, they set the overall tone, influencing the decisions of various managers (Bassyouny, Abdelfattah and Tao, 2020). Specifically, the CEO is regarded as a pivotal figure in top management, with the ability to select the most effective strategies to enhance the business's sustainable and environmental growth (Hussain et al., 2022). Therefore, CEOs, being the most influential managers in their firms, have the ability to align their strategic goals and objectives with institutionally mandated environmental and sustainability requirements. This alignment may ultimately result in increased disclosure of corporate environmental sustainability information. Hambrick and Mason (1984) propose that observable board attributes like age are crucial for understanding firm strategic decisions and performance levels. Moreover, upper echelon theory posits that personal characteristics influence human behavior, aiding firms in selecting suitable board members (He et al., 2021). This framework offers insights into the optimal selection of board members and helps firms in addressing environmental challenges, such as EID. Prior research has employed upper echelon theory to explore the influence of CEOs' attributes on environmental and social performance (Khan et al., 2020; Shahab et al., 2018; García-Sánchez, Hussain and Martínez-Ferrero, 2020; Velte, 2019). Therefore, from the viewpoint of upper echelon theory, the unique attributes of board members, encompassing both psychological traits and, can play a crucial role in shaping the execution of strategic initiatives (e.g. EID activities) in China.

Social identity theory (Tajfel and Turner, 1979) examines how individuals' interactions and behaviors are influenced by the various groups to which they belong

(Hogg, 2006; Hogg and Terry, 2000), and addresses the processes of group categorization----both self-imposed and imposed by others----and how these categorizations and identities affect interactions among individuals from different groups (Chen, Crossland and Huang, 2016). Highly salient categories, such as gender, are cognitively represented as prototypes that amplify perceptions of similarities within the category and differences between categories (Hogg and Terry, 2000). These categories thus exert a depersonalizing effect. A superordinate group that includes multiple categories, like a board of directors, can become a "crucible where inter-subgroup differences are intensified" (Chen, Crossland and Huang, 2016). Board diversity may hinder prompt strategic initiatives or cause board inefficiency (Fernández-Temprano and Tejerina-Gaite, 2020). In addition, social identity theory suggests that increasing the number of female directors can lead to uncooperative behavior from male directors (Liu, Su and Zhang, 2023), resulting in more disagreements and poor communication.

RBV theory (Barney, 1991) elucidates how corporate strategies mitigate external threats and attain a competitive edge by leveraging internal resources (Peng et al., 2021). Experience and knowledge, classified as intangible assets (Helfat and Peteraf, 2003), stem from board diversity and can bolster the environmental or CSR decision-making processes of the boards (Rao and Tilt, 2016). It is crucial to explore the connection between board diversity and EID through the lens of RBV theory. Board diversity represents a "core competence" or "dynamic capability" that enhances organizational capabilities (Katmon et al., 2019). The RBV theory acknowledges that diverse resources and capabilities are valuable assets contributing to a firm's competitive advantage (Richard, 2000). Diverse board characteristics create synergies that benefit the organization (Galbreath, 2005) and provide varied perspectives in critical decision-making, such as CSR (Rao and Tilt, 2016). The diverse capabilities of board members impact strategic decisions by establishing relationships with the external environment through networking, reputation, and social ties (Zhang and Dodgson, 2007). A diverse board brings a wide range of specialized skills and experiences, enhancing the board's ability to provide advice on CSR (Katmon et al.,

2019). According to RBV theory, board diversity represents a heterogeneous intangible asset that empowers firms to formulate more comprehensive, effective, and innovative environmental strategic decisions. Barney (1991) highlights that (1) firms consist of diverse resources such as firm assets, staff expertise, and organizational systems, and (2) these resources may not be easily transferable across firms, thus leading to enduring heterogeneity (Katmon et al., 2019). Hence, we posit that examining the impact of board diversity on the EID in the Chinese context adds to the existing literature and is of interest to responsible investors and stakeholders.

6.3.2 Board age and EID

Board age serves as an indicator of directors' overall business experience and signifies their maturity in managing the business (Hafsi and Turgut, 2013). In the context of corporate governance, age is associated with directors' behavior and their inclination towards embracing new ideas about board operations. From a theoretical standpoint, the upper echelon perspective (Hambrick, 2007; Hambrick and Mason, 1984) views the age of top executives as a significant observable attribute, essential for decision-making and the execution of firm strategies (Shahab et al., 2020). Our arguments are grounded in the upper echelon perspective, and we propose that younger board members are more inclined to pursue risky investments and ventures as a means of demonstrating their abilities to the firm. They focus more on wealth maximization and are willing to take significant risks to achieve high profits (Serfling, 2014). Consequently, unlike their older counterparts, they tend to overlook environmental and sustainable regulations, prioritizing financial outcomes instead. Ferrell, Fraedrich and Ferrell (2005) argue that older board members typically have more experience and expertise in addressing complex ethical issues, positively influencing firms' environmental and societal policies. Similarly, Elmagrhi et al. (2019) state that as directors age, their understanding of environmental issues grows, leading to older directors typically exhibiting higher levels of environmental moral reasoning compared to their younger counterparts. It is also suggested that the board age can impact the extent of disclosure concerning environmental and societal issues

(Cucari, Esposito De Falco and Orlando, 2018; Ibrahim and Hanefah, 2016).

Post, Rahman and Rubow (2011) investigated the correlation between directors' age and the environmental performance of U.S. firms, discovering a positive relationship between the two variables. Elmagrhi et al. (2019) found that the age of female directors positively influences the overall environmental performance of Chinese firms. Muniandy et al. (2023) investigated the relationship between board generational cohorts and corporate environmental and social disclosure in China, revealing that older board members are positively associated with such disclosures. Similarly, Ma et al. (2019) found that the average age of top managers has a positive impact on EID. In contrast, Katmon et al. (2019) reported a significant negative correlation between board age and the quality of CSR disclosure in Malaysia. Therefore, according to the discussions above, this study proposes the following hypothesis:

H1: Board age is positively associated with firms' EID levels.

6.3.3 Board tenure and EID

Board tenure refers to the duration during which directors hold positions on the board within an organization (Katmon et al., 2019). Grounded in the RBV theory, Barroso, Villegas and Pérez-Calero (2011) suggest that diversity in board tenure signifies the board's understanding of the firm's operations, facilitating the development of board potential and competitive advantage. Longer board tenure offers advantages as directors accumulate experience with firm policies and become proficient in monitoring the organization's reporting processes (Chan, Liu and Sun, 2013; Hafsi and Turgut, 2013; Peng et al., 2021). It is associated with reduced dissemination of misleading information and disclosures (Donoher, Reed and Storrud-Barnes, 2007) and enables the development of organization-specific expertise and relationships with stakeholders (Johnson, Schnatterly and Hill, 2013). However, longer tenure may lead to risk aversion, limited access to information, and decreased engagement in innovative activities (Peng et al., 2021). Moreover, increased tenure, familiarity with management practices, and proximity to managers might result in reluctance among

board members to address social responsibility issues (Hafsi and Turgut, 2013), thereby reducing stakeholder focus.

Consequently, existing literature presents divergent perspectives on board tenure, and its impact on the EID/CSR issues remains inconclusive. Peng et al. (2021) demonstrate a positive relationship between board tenure and CSR decision-making using data from China, Japan, the UK, and the US. In contrast, Khan et al. (2021) identify a negative association between CEO tenure and corporate social and environmental disclosures in the Chinese context. Additionally, Hafsi and Turgut (2013) illustrate an insignificant correlation between board tenure and corporate social performance. Therefore, based on the discussions above, this study proposes the following hypothesis:

H2: Board tenure is positively associated with firms' EID levels.

6.3.4 Board gender diversity and EID

The importance of having women on boards has gained increased attention and is now recognized as a global imperative (Katmon et al., 2019). Studies indicate that gender diversity elicits distinct responses to norms, attitudes, beliefs, and perspectives (Hafsi and Turgut, 2013). According to social identity theory (Tajfel and Turner, 1986), individuals categorize themselves by group characteristics such as gender, fostering in-group preference and out-group discrimination (Liu, Su and Zhang, 2023). In traditionally male-dominated Chinese boards, women are often viewed as out-group members, causing their contributions to be undervalued. The inclusion of female directors can be seen as a threat by male directors. As more women join the board, men are forced to share power, which can heighten conflicts between genders, adversely affecting corporate decision-making and performance (Pucheta-Martínez, Bel-Oms and Olcina-Sempere, 2019).

Although many studies suggest that female directors positively impact CSR reporting, EID, and corporate social performance (Katmon et al., 2019; Husted and de Sousa-Filho, 2019; Naveed, Voinea and Roijakkers, 2022), previous results are not unanimous. Agyemang et al. (2020) found a negative relationship between gender

diversity and environmental accounting information disclosure in Chinese listed mining firms. Zhuang, Chang and Lee (2018) also noted a negative effect of gender diversity on CSR performance in China. They propose that female board members may primarily represent stakeholders of the same gender, potentially affecting CSR. This perspective is shaped by the institutional context, including cultural factors like gender equality (Brieger et al., 2019; Knippen, Shen and Zhu, 2019). Wang, Wilson and Li (2021) argue that gender equality remains a global challenge due to historical, cultural, and economic factors. In China, traditional gender attitudes rooted in Confucianism and patriarchy persist, although changing educational and labor force dynamics are gradually shifting perceptions. Despite reforms in corporate governance laws, female board representation quotas in China remain minimal (Shaheen et al., 2021). Manita et al. (2018) contend that the appointment or election of one woman to a board can trigger marginalization (Konadu et al., 2022) of power, delegitimization of her role, symbolic and social diminishment of her status, suppression of her voice, and diminished capacity to effect change. As a result, her influence on EID often proves ineffective, and in certain instances, may even have a negative impact. Therefore, based on the discussions above and the Chinese context, we propose the following hypothesis:

H3: Board gender diversity is negatively associated with firms' EID levels.

6.3.5 Board overseas background and EID

Board overseas background indicates whether a member has worked or studied abroad (Zhuang, Chang and Lee, 2018). Chinese national development institutions are actively executing the *Thousand Talents Plan* initiated by the government, aiming to entice Chinese individuals with overseas experience to return to China and apply the knowledge acquired abroad, particularly concerning environmentally sustainable practices (Shahab et al., 2020). Although research on board members' overseas backgrounds is scarce, this aspect carries significant weight in board composition (Miller and Triana, 2009), particularly given the growing trend in China, where individuals frequently pursue education or employment abroad before returning to

contribute to domestic enterprises. In the context of upper echelon theory, a board member's overseas background is among the attributes that can exert influence on a firm's environmental initiatives (Shahab et al., 2020). As per the theory, managerial decisions stem from perceptions, values, and cognitive abilities, influenced by education and experience. This principle underscores that various attributes of top managers, such as their experiences, career trajectories, or age, play a role in shaping their strategic choices and organizational outcomes (Nielsen, 2010). Directors with greater overseas experience offered robust and insightful responses, aligning well with the principles of the upper echelon theory. The conclusions drawn by Thambugala and Rathwatta (2021) suggest that the experience of directors can positively influence CSR practices because experienced directors are adept at making meaningful recommendations to improve CSR and CSR reporting systems. Zhuang, Chang and Lee (2018) revealed a significant and positive association between board members' overseas background and CSR performance in China. Given the pressure on Chinese firms to be socially and environmentally responsible due to internationalization (Hung, 2011), the overseas background of board members becomes increasingly relevant. Based on the discussions above, this study proposes the following hypothesis:

H4: Diversity of board overseas background is positively associated with firms' EID levels.

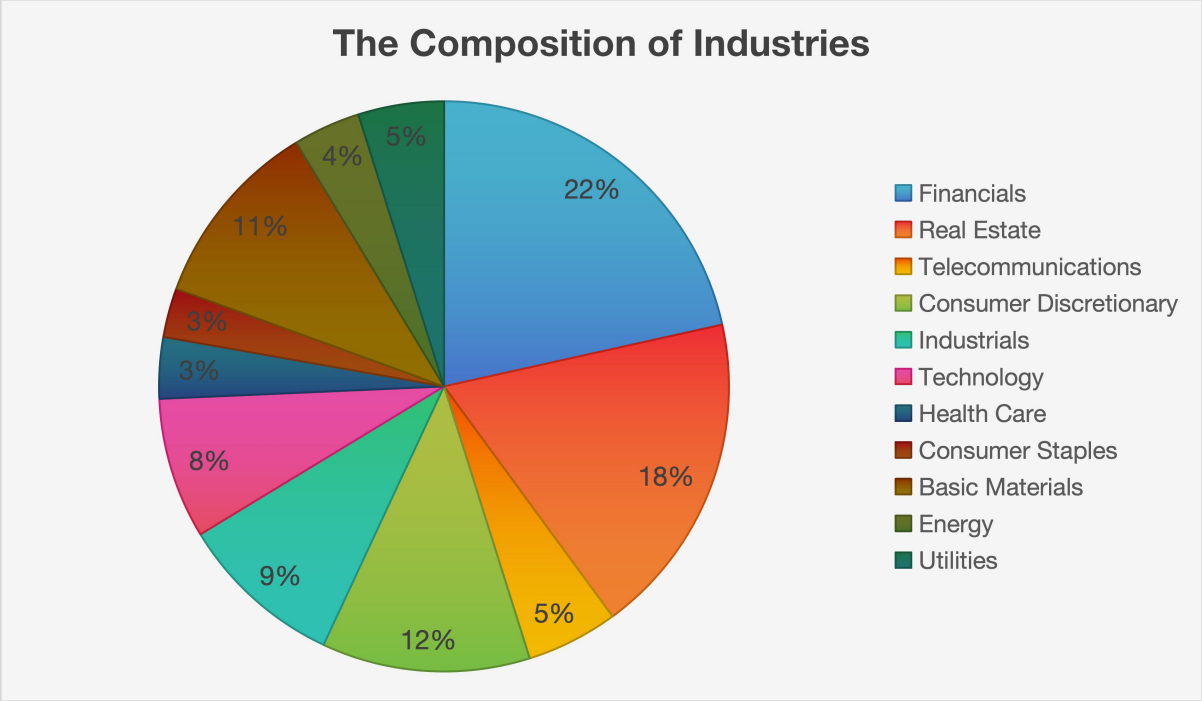
6.4 Research Methodology

6.4.1 Data and sample

This study utilizes data sourced from Bloomberg and the CSMAR spanning the period from 2009 to 2019. Information regarding EDS, TENURE, INSTITOW, CEO duality (CEODUAL), BS, BM, ROA, LEV, FS, MKTB, BIG4, and IND was acquired from Bloomberg. Data pertaining to board age (BAGE), board gender diversity (BGEN), board overseas background (OVERSEABACK), academic background (ACABACK),

and BIND was collected from CSMAR. The selection of 2009 as the starting point is due to the limited availability of EDS data prior to that year. Notably, China enacted the *Interim Measures for Public Participation in Environmental Impact Assessment* in 2006 and the *Environmental Information Disclosure Measures* in 2008 (Agyemang et al., 2020). Moreover, enterprise EID has been mandated since 2003 under the *Clean Production Promotion Law* and *Environmental Impact Assessment Law*. The study focuses on firms listed on the SHSZ300 Index, characterized by substantial market capitalization and strong liquidity. The CSI 300, comprising the CSI 100 index and the CSI 200 index, serves as the benchmark for Chinese stock exchanges, analogous to the S&P 500 Index. These 300 listed firms encompass roughly 60% of market capitalization and exhibit favorable market representation within the Chinese capital market (Muniandy et al., 2023). The sample includes firms from 11 industries: financials, real estate, telecommunications, consumer discretionary, industrials, technology, healthcare, consumer staples, basic materials, energy, and utilities. Firms lacking requisite data for analysis were excluded from the study. The final sample comprises 288 firms spanning 11 years, totaling 2,488 firm-year observations. The total observations are dominated by firms operating in the real estate (19.9%), financials (19.21%), and consumer discretionary (12.62%) sectors. Conversely, consumer staples exhibit the lowest representation at 2.13% of all observations. Figure 10 shows the composition of the industries.

Figure 10: Pie Chart of Industry Composition



Notes: Different colours indicate different industries, as shown in the labels on the right. The percentage is the number of firms in this industry divided by the total number of firms.

6.4.2 Variable definitions and measurement

When investigating the impact of four elements of board diversity on Chinese firms' EID, the level of EID is gauged through the EDS (Muniandy et al., 2023). EDS is a component of the Bloomberg ESG disclosure score. Bloomberg constructs this metric directly from firms' environmental disclosure levels, which range from 0.1 to 100. A higher EDS indicates greater transparency regarding environmental issues. Data sources for EDS compilation encompass various channels such as firm annual reports, CSR reports, press releases, sustainability reports, firm websites, Bloomberg surveys, and third-party research (Ifada and Indriastuti, 2021; Fahad and Nidheesh, 2021).

Regarding independent variables, BAGE and TENURE are measured as the average age and average tenure of board members, respectively (Sial et al., 2018; Muniandy et al., 2023). BGEN is measured using the Blau index (Sial et al., 2018), calculated as $BGEN = 1 - \sum_{i=1}^{n} p_i^2$, where p_i represents the percentage of each gender category, and n is the number of categories (2: male and female). The Blau

index is widely used because it captures gender heterogeneity rather than a simple proportion of female directors (Terjesen et al., 2016; Zhang et al., 2022). OVERSEABACK is also calculated using the Blau index (Zhuang, Chang and Lee, 2018), based on two categories: board members with and without international study or work experience. Similarly, ACABACK (Zhuang, Chang and Lee, 2018), as an additional variable, is assessed using Blau index with two categories: board members with and without academic affiliations.

Control variables selected for this study, including INSTITOW, BIND, CEODUAL, BS, BM, ROA, LEV, FS, MKTB, BIG4, IND, and YEAR, are chosen based on their potential influence on EID (Muniandy et al., 2023; Peng et al., 2021; Katmon et al., 2019). INSTITOW represents the share percentage held by institutional investors, with Saleh, Zulkifli and Muhamad (2010) reporting a positive correlation between institutional ownership and sustainability reporting. BIND, calculated as the ratio of independent non-executive directors to total board members, is associated with increased transparency in EID (Chen and Jaggi, 2000; Gul and Leung, 2004; Byard, Li and Weintrop, 2006; Cheng and Courtenay, 2006; Ahmed, Hossain and Adams, 2006). CEODUAL, a binary variable indicating CEO and chairman consolidation, inversely affects EID levels (Gerged, 2020; Alfraih, 2016; Chau and Gray, 2010; Freitas Neto and Mol, 2017). A smaller board size (BS) is preferred, according to Mak and Li (2001), Yoshikawa and Phan (2003), Yatim, Kent and Clarkson (2006), and Khanchel (2007), while board meeting (BM) frequency influences agency conflict mitigation (Vafeas, 1999). ROA, LEV, FS, and MKTB, representing financial performance and structure, impact EID positively (Tang and Luo, 2010; Brammer and Pavelin, 2006, 2008; Karim, Lacina and Rutledge, 2006; Meng et al., 2013; Andrikopoulos and Kriklani, 2013). BIG4, indicating the presence of Big Four audit firms, is positively linked to environmental reporting (Gerged, 2020; Odoemelam and Ofoegbu, 2018). IND and YEAR dummy variables are included to account for industry and year effects, respectively, as industry type and temporal changes may influence EID (Elfaitouri, 2014; Bewley and Li, 2000; Boesso and Kumar, 2007; Cormier and Gordon, 2001; Wang et al., 2004).

6.4.3 Model specification

Drawing upon prior research (Muniandy et al., 2023; Katmon et al., 2019; Sial et al., 2018; Agyemang et al., 2020), this study proposes a model to explore the relationship between four facets of board diversity and EID:

$$EDS_{it} = c + \beta_1 BAGE_{it} + \beta_2 TENURE_{it} + \beta_3 BGEN_{it} + \beta_4 OVERSEABACK_{it} + Controls_{it} + \varepsilon_{it} \quad (3)$$

In this equation, EDS represents the environmental disclosure score, sourced from Bloomberg, with higher scores indicating greater environmental disclosures. The variables BAGE, TENURE, BGEN, and OVERSEABACK represent board age, board tenure, board gender diversity, and overseas background diversity of the board, respectively. Control variables encompass INSTITOW, BIND, CEODUAL, BS, BM, ROA, LEV, FS, MKTB, and BIG4. Dummy variables are employed to control for industry and year effects. Table 28 displays the definitions and measurement of all variables.

Table 28: Variable Definitions and Measurement

	Variable Name	Abbreviation	Definition/Measurement
Dependent Variables	Environmental disclosure score	*EDS*	Compiled based on the firm's environmental disclosure level, ranging from 0.1 to 100. An indicator of environmental transparency. The higher the score, the more the transparency of environmental issues.
Independent Variables	Board age	*BAGE*	Average age of the board members.
	Board tenure	*TENURE*	Average tenure of all current directors on the firm board.
	Board gender diversity	*BGEN*	Gender diversity of the board measured using Blau index with two categories: male and female.
	Board overseas background	*OVERSEABACK*	Overseas background diversity of the board measured using Blau index with two categories: whether or not having study or work experience abroad.
	Board academic background	*ACABACK*	Academic background diversity of the board measured using Blau index with two categories: whether or not having academic affiliations. An academic affiliation is established when a board member has previously held or currently holds a position at a research institution.
Control Variables	Institutional ownership	*INSTITOW*	The percentage of shares held by institutional investors.
	Board independence	*BIND*	The number of independent non-executive directors divided by the number of board members.
	CEO duality (Dummy 0/1)	*CEODUAL*	If the same person holds the CEO and the chairman positions, the dummy variable is set to 1, otherwise it is 0.
	Board size	*BS*	The total number of directors on the board.
	Board meetings	*BM*	The total number of meetings held by the board, either regular or emergency meetings per year.
	Profitability	*ROA*	The ratio of net income to the total assets.
	Leverage	*LEV*	The ratio of total debts to total assets.
	Firm size	*FS*	The natural logarithm of total (short and long-term) assets reported by the firm.
	Market-to-book ratio	*MKTB*	The firm's market value divided by its book value.
	Audit type (Dummy 0/1)	*BIG4*	If the listed firm is audited by the big 4 auditing firms, the dummy variable is set to 1, otherwise it is 0.
	Industry (Dummy)	*IND*	1-11 for eleven industries which are financials, real estate, telecommunications, consumer discretionary, industrials, technology, health care, consumer staples, basic materials, energy and utilities.

This study conducted the Breusch and Pagan (1980) LM test and Hausman (1978) test to select the most suitable regression model for examining the relationship

between EID and board diversity elements, considering pooled OLS/linear, RE, and FE models. The LM test indicated that the RE model fits better than the pooled OLS model (p-value =0.000, < 0.05). However, the Hausman test favored the FE model over the RE model (p-value = 0, < 0.01). Hence, the FE model is deemed most appropriate for this study, although results from all three models are presented for comparison purposes.

6.5 Findings and Discussions

6.5.1 Descriptive statistics

Table 29 provides the descriptive statistics for all variables utilized in this study. The EDS ranges from 0.423 to 51.938, with mean and median values of 14.48 and 11.628, respectively. Comparatively, Giannarakis, Andronikidis and Sariannidis (2019) found that the average environmental disclosure level in the United States is around 0.56 out of 1, indicating that, on average, firms disclose 56% of their environmental information. Thus, China's EID level of 0.14 out of 1 is relatively low when compared to developed countries like the United States. Pan (2012) employed a numerical rating system to assess EID scores, focusing on heavily polluting firms in China. His findings indicate low EID levels, poor overall quality of EID, and limited environmental awareness among firms, despite an increasing number of disclosing firms. Tang and Luo (2010) reached similar conclusions after examining 169 Chinese firms across 21 different industries in 2008. Additionally, Meng et al. (2013) utilized a disclosure score to gauge EID and found that both the quantity and quality of corporate EID are relatively low, attributed to infrequent stakeholder involvement in EID activities.

Table 29: Descriptive Statistics

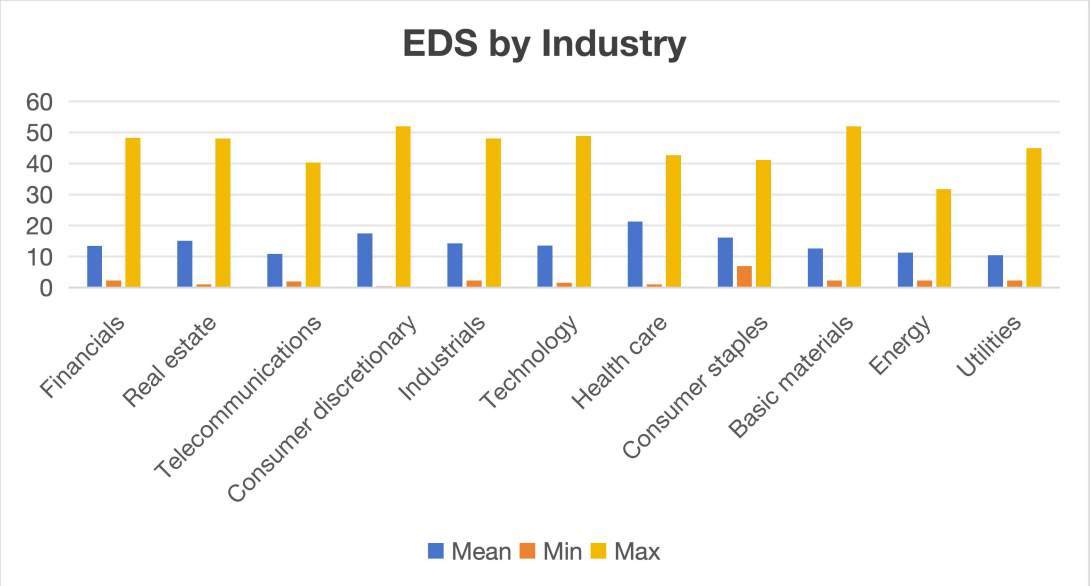
Variable	Mean	Median	Std.Dev.	Min	Max	Observations
EDS	14.480	11.628	9.956	0.423	51.938	2048
BAGE	52.797	52.889	4.055	40.800	63.25	2488
TENURE	3.719	3.596	1.413	0.425	10.25	2488
BGEN	0.136	0	0.176	0	0.5	2488
OVERSEABACK	0.176	0	0.192	0	0.5	2488
ACABACK	0.298	0.375	0.203	0	0.5	2488
INSTITOW	64.418	69.786	22.931	0	101.14	2488
BIND	38.079	36.364	6.771	0	80	2307
CEODUAL	0.192	0	0.394	0	1	2307
BS	10.026	9	2.751	4	19	2307
BM	10.674	10	5.259	2	57	2307
ROA	6.354	4.200	7.142	-18.246	128.8	2485
LEV	4.101	2.440	4.250	1.027	28.810	2484
FS	10.693	10.566	2.172	2.525	17.220	2488
MKTB	3.794	2.596	3.781	0.397	47.809	2465
BIG4	0.998	1	0.046	0	1	1849

Regarding the independent variables, the average BAGE stands at 52.797, indicating that the typical age of board members in these firms is approximately 53. This corresponds with the findings of Sial et al. (2018), Elmagrhi et al. (2019) and Khan et al. (2021), who similarly reported an average board age of around 51, 51 and 52 in China, respectively. Additionally, the minimum and maximum of BAGE are 40.8 and 63.25, so the figures suggest an overall prevalence of the elder generation on Chinese boards. The average TENURE is 3.719, indicating that board members serve for roughly 4 years on average, consistent with the findings of Muniandy et al. (2023), who found an average board tenure of around 3 years in China. Moreover, the average Blau index value for BGEN is 0.136, akin to the mean Blau index value of 0.18 reported by Sial et al. (2018), implying insufficient gender diversity on Chinese boards, given that 0 and 0.5 represent the minimum and maximum values for board gender diversity, respectively. The median for BGEN is 0, indicating that for over half of the observations, board members share the same gender. Furthermore, the data reveals that OVERSEABACK exhibits an average value of 0.176, with the median concentration at 0, echoing the findings of Zhuang, Chang and Lee (2018), who

reported an average value of 11% for OVERSEABACK, despite using a different measurement—percentage of board members with overseas background—suggesting that most Chinese firm boards lack members with overseas experience.

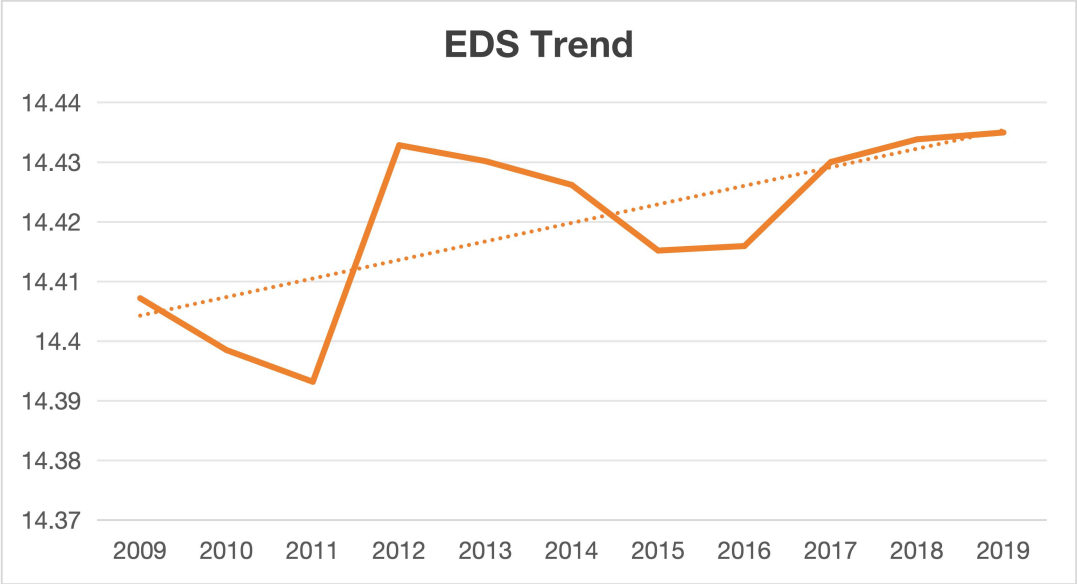
This study then assesses the EDS for each industry to examine whether industry category significantly influences low levels of environmental disclosure. Table 30 indicates that all industries exhibit relatively low levels of environmental disclosure, with the highest average EDS around 21 in the health care industry. The telecommunications and utilities sectors share similar EDS of 10/11, indicating that differences in EDS between industries are not pronounced. Figure 11 illustrates the average, minimum, and maximum values for EDS by industry category. It shows that the consumer discretionary category exhibits the widest variation, with both maximum and minimum values occurring within this industry, while the energy sector displays the narrowest variation. Figure 12 illustrates the trends in EDS from 2009 to 2019, revealing two declining cycles before 2015 and a slight upward trend thereafter. Although China has made some progress in enhancing its EID practices over these years, the improvement is not significant.

Figure 11: Histogram of EDS by Industry



Notes: The blue, purple and green bars stand for the average, minimum and maximum values of EDS, respectively. Each group of these three coloured bars belongs to one industry. The horizontal axis shows the industry categories and the vertical axis is the EDS.

Figure 12: Line Chart of Environmental Disclosure Trend from 2009 to 2019



Notes: The full line stands for the actual environmental disclosure score over the 11 years, and the dotted line shows the general trend of the environmental disclosure. The horizontal axis is the year and the vertical axis is the environmental disclosure score.

Table 30: Descriptive statistics of EDS by industry category

Industry	Obs	Mean	Median	Std.Dev.	Min	Max
Financials	440	13.402	10.714	9.401	2.326	48.214
Real estate	424	15.119	12.403	9.044	1.087	48.062
Telecommunications	115	10.853	14.729	6.872	1.933	40.310
Consumer discretionary	259	17.467	13.178	11.731	0.423	51.938
Industrials	194	14.255	9.302	11.689	2.326	48.062
Technology	158	13.539	11.628	9.143	1.550	48.837
Health care	85	21.338	17.830	11.236	1.087	42.636
Consumer staples	53	16.118	13.954	8.634	6.977	41.085
Basic materials	188	12.631	10.853	8.074	2.326	51.938
Energy	47	11.321	6.977	9.901	2.326	31.707
Utilities	85	10.479	9.302	9.640	2.326	44.961

Additionally, we analyze the industry composition in our sample based on board age, tenure, gender diversity, overseas background, and academic background. First, we found that the consumer staples industry has the oldest board members on average, around 56 years, while the energy industry has the youngest, around 50 years. This shows that the average board age does not vary widely across industries, suggesting that high-pollution industries in China tend to have younger board members compared to low-pollution industries. Second, the industrials sector has the longest tenure,

whereas the energy sector has the shortest, indicating that tenure varies significantly in high-pollution sectors in China, with more frequent board member turnover compared to low-pollution industries. Third, the energy sector also has the most gender-diverse boards, while the health care industry is predominantly composed of one gender. Finally, regarding overseas and academic backgrounds, the financial sector has the most diverse boards, meaning board members come from a variety of backgrounds. In contrast, the telecommunications sector tends to have more uniform board member backgrounds in terms of overseas and academic experience. Figure 13, 14, 15, 16, and 17 illustrate the industry compositions based on board age, tenure, gender diversity, overseas background, and academic background, respectively.

Figure 13: Bar Chart of Industry Composition by Board Age

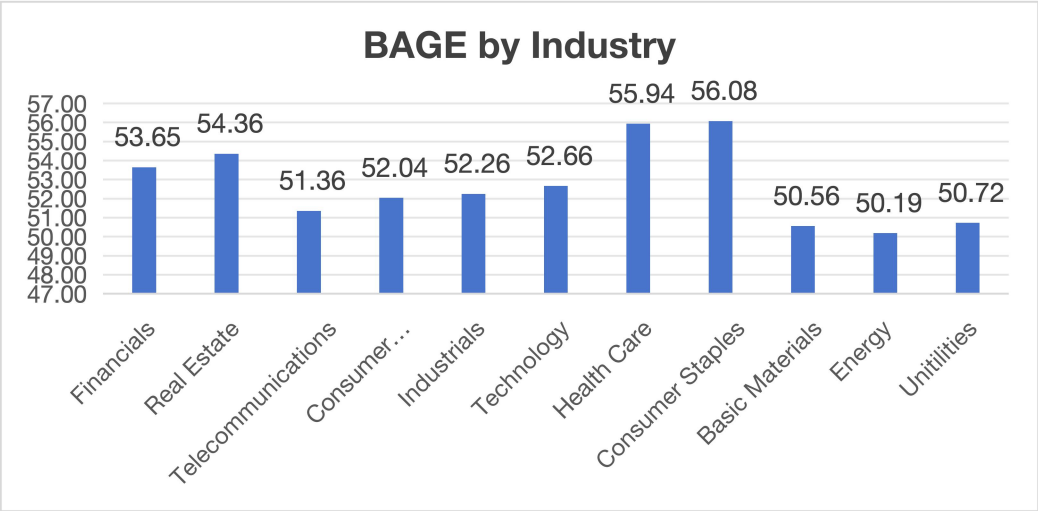


Figure 14: Bar Chart of Industry Composition by Board Tenure

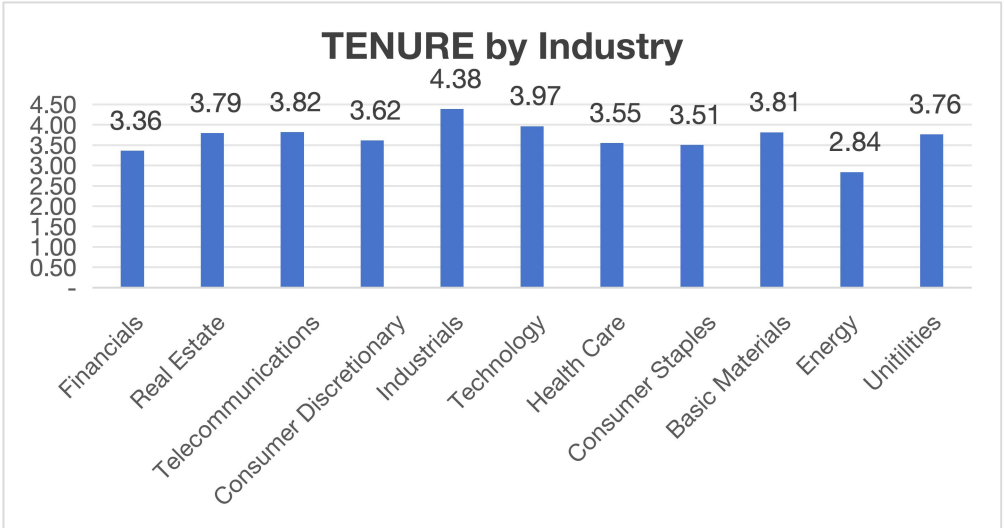


Figure 15: Bar Chart of Industry Composition by Board Gender Diversity

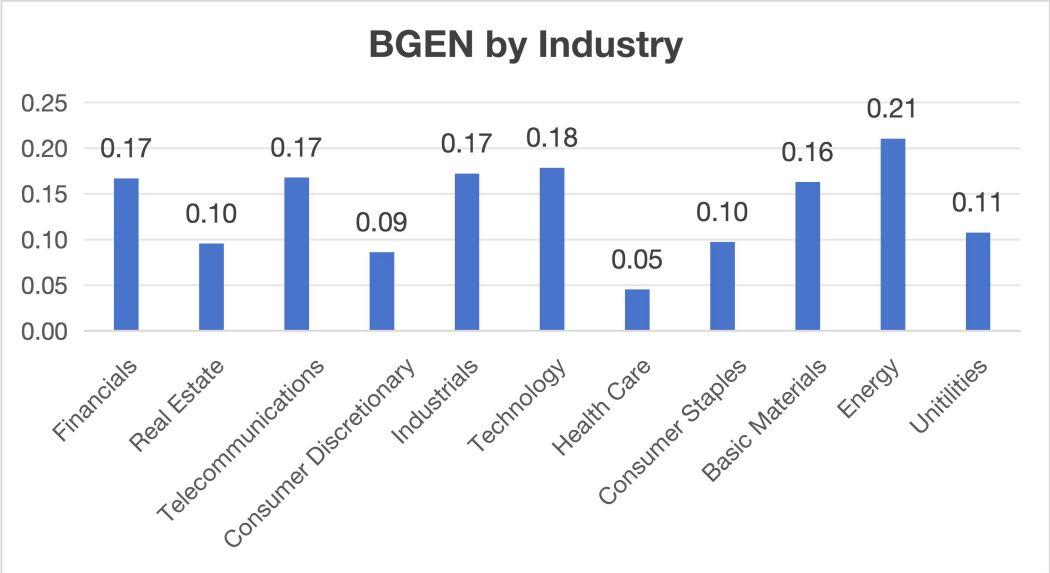


Figure 16: Bar Chart of Industry Composition by Board Overseas Background

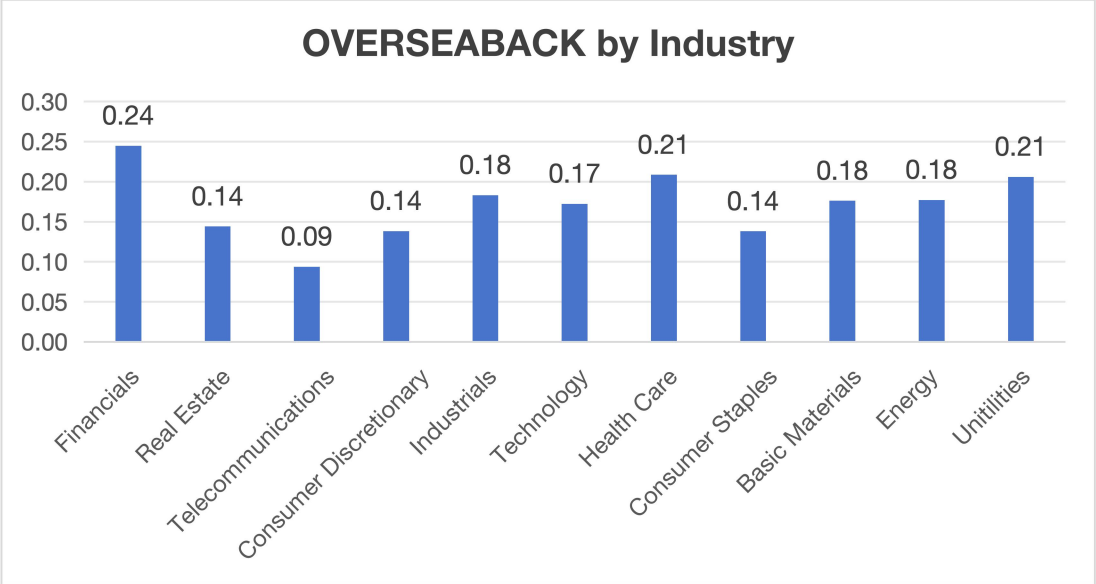
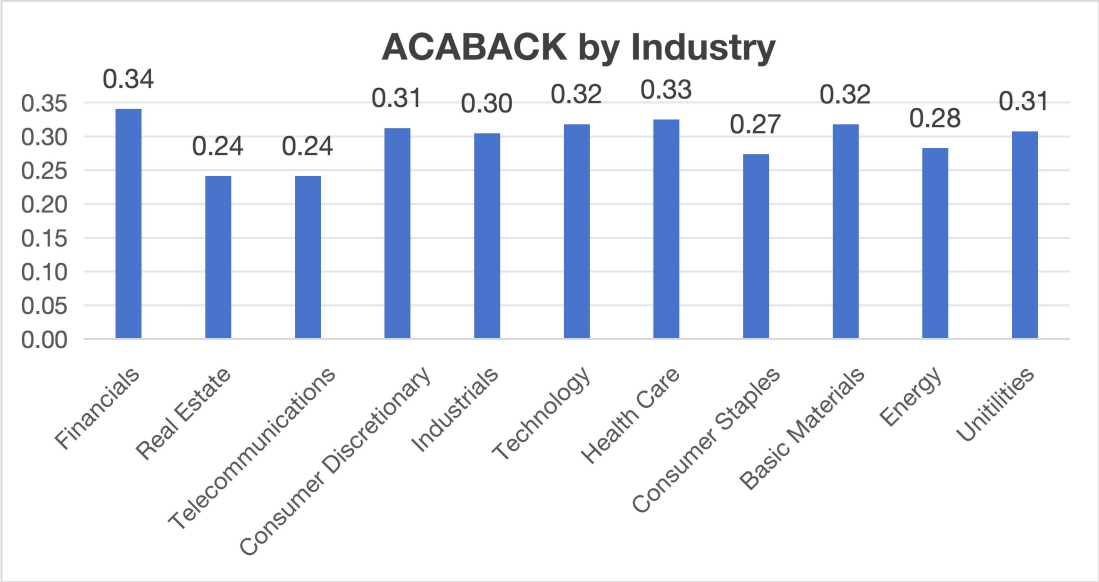


Figure 17: Bar Chart of Industry Composition by Board Academic Background



6.5.2 Correlation analysis

Tables 31 and 32 display the results of the correlation matrix and VIF analysis for all variables. Except for the negative relationship between BGEN and EDS, the remaining three independent variables (BAGE, TENURE, and OVERSEABACK) exhibit significant positive correlations with EDS. The pairwise correlations indicate no evident multicollinearity concerns in the model, as the discrepancies among these independent variables are relatively minor. Additionally, Table 32 reaffirms the absence of multicollinearity issues, as the VIF values are below 5 (Wang et al., 2019).

Table 31: Pairwise Correlations

Variable	EDS	BAGE	TENURE	BGEN	OVERSEABACK	INSTITOW	BIND	CEODUAL	BS	BM	ROA	LEV	FS	MKTB	BIG4
EDS	1														
BAGE	0.295***	1													
TENURE	0.003	0.133***	1												
BGEN	-0.076***	-0.099***	-0.036*	1											
OVERSEABACK	0.129***	0.073***	-0.078***	0.161***	1										
INSTITOW	0.153***	0.388***	-0.141***	-0.099***	0.069***	1									
BIND	0.088***	0.297***	-0.036*	-0.071***	0.02	0.122***	1								
CEODUAL	-0.055**	-0.136***	0.081***	0.086***	0.032	-0.240***	0.087***	1							
BS	0.044**	0.137***	-0.052**	-0.006	0.164***	0.150***	-0.332***	-0.135***	1						
BM	0.113***	-0.094***	-0.065***	-0.009	0.048**	-0.021	0.064***	-0.018	-0.027	1					
ROA	-0.168***	-0.196***	0.108***	0.086***	-0.050**	-0.134***	-0.017	0.135***	-0.257***	-0.149***	1				
LEV	0.050**	0.246***	-0.105***	0.023	0.182***	0.193***	-0.039*	-0.101***	0.557***	0.084***	-0.383***	1			
FS	0.319***	0.536***	-0.046**	-0.057***	0.210***	0.473***	0.093***	-0.197***	0.504***	0.115***	-0.404***	0.707***	1		
MKTB	-0.221***	-0.325***	-0.01	0.073***	-0.069***	-0.200***	-0.022	0.177***	-0.241***	-0.084***	0.438***	-0.282***	-0.501***	1	
BIG4	0.019	-0.029	0.005	0.016	0.01	0.003	-0.01	0.022	-0.003	-0.008	0.027	-0.036	-0.045*	0.027	1

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

Table 32: Variance Inflation Factor

Variable	VIF	1/VIF
FS	4.946	.202
LEV	3.144	.318
MKTB	2.117	.472
BS	1.837	.544
BAGE	1.788	.559
ROA	1.771	.565
INSTITOW	1.424	.702
BIND	1.409	.71
TENURE	1.145	.873
CEODUAL	1.122	.891
OVERSEABACK	1.119	.894
BGEN	1.092	.916
BM	1.087	.92
BIG4	1.004	.996
Mean_VIF	1.786	.996

6.5.3 Regression analysis

Table 33 presents and compares the pooled OLS, RE and FE (baseline model) estimates of the impact of the four elements of board diversity on the EDS. First, BAGE is significantly and positively correlated with EDS at the 1% significance level, which is in line with **H1**. The finding is also supported by upper echelons theory (Hambrick, 2007; Hambrick and Mason, 1984), which considers the age of top executives as a crucial observable attribute, vital for decision-making and the implementation of firm strategies (Shahab et al., 2020). According to Ferrell, Fraedrich and Ferrell (2005), older board members usually possess greater experience and expertise in handling complex ethical issues, positively affecting firms' environmental and societal policies. Elmagrhi et al. (2019) similarly suggest that as directors age, their comprehension of environmental issues enhances, resulting in higher levels of environmental moral reasoning compared to younger directors. The age of board members can also influence the extent of disclosure on environmental and societal issues (Cucari, Esposito De Falco and Orlando, 2018; Ibrahim and Hanefah, 2016). Ma et al. (2019) found that the average age of top managers

positively impacts EID. Additionally, Post, Rahman and Rubow (2011) identified a positive correlation between the age of directors and environmental performance in US firms, a trend echoed by Muniandy et al. (2023) in China, where older board members are linked to increased corporate environmental and social disclosure.

Second, TENURE is not significantly correlated with EDS, so **H2** is rejected. Our finding is consistent with that of Hafsi and Turgu (2013), who found an insignificant relationship between board tenure and corporate social performance. The reason can be that less experienced or shorter-tenured board members may feel hesitant to voice their opinions, while more experienced or longer-tenured members might be too closely aligned with managers and reluctant to introduce dissenting views into the decision-making process, especially when taking the Chinese context into consideration. This dynamic could result in board members being inclined to follow rather than take the lead in addressing social responsiveness and responsibility issues (Hafsi and Turgu, 2013).

Third, BGEN is significantly and negatively correlated with EDS at the 5% significance level. Thus, **H3** is supported, and the finding is in line with the previous literature (e.g. Agyemang et al., 2020; Zhuang, Chang and Lee, 2018). The negative effects of increased gender diversity in groups may stem from smoother communication within homogeneous groups, where members share similar backgrounds and perspectives, as suggested by social identity theory (Fernández-Temprano and Tejerina-Gaite, 2020). Greater gender diversity can reduce group cohesion and communication, leading to higher conflict levels. Agyemang et al. (2020) found a negative relationship between gender diversity and environmental accounting information disclosure in Chinese mining firms, and Zhuang, Chang and Lee (2018) reported a similar negative impact on CSR performance in China. They suggest that female board members may primarily represent same-gender stakeholders, influencing CSR outcomes. Furthermore, on traditionally male-dominated Chinese boards, women are often seen as out-group members, leading to their contributions being undervalued. Male directors may perceive female directors as a threat, and as more women join the board, power-sharing can heighten

gender conflicts, negatively impacting corporate decision-making and performance (Pucheta-Martínez, Bel-Oms and Olcina-Sempere, 2019).

Finally, OVERSEABACK has a significant and positive impact on EDS at the 1% significance level. Thus, **H4** is supported. This finding aligns with upper echelon theory, which posits that a board member's overseas background can significantly influence a firm's environmental initiatives (Shahab et al., 2020). The theory asserts that managerial decisions are shaped by the perceptions, values, and cognitive abilities derived from education and experience, indicating that various characteristics of top managers, such as their experiences, career paths, or age, affect their strategic choices and organizational performance (Nielsen, 2010). Directors with extensive overseas experience contribute valuable insights, supporting upper echelon theory. Thambugala and Rathwatta (2021) suggest that experienced directors positively impact CSR practices by making effective recommendations to improve CSR and CSR reporting systems. This is consistent with Zhuang, Chang and Lee (2018), who found a positive correlation between the overseas backgrounds of board members and CSR performance in China.

Table 34 summarizes the FE regression results for the relationship between EDS and the four elements of board diversity, and their corresponding theoretical underpinning.

Table 33: Pooled OLS, RE and FE Regression

	Pooled OLS	RE	FE
Variable	EDS	EDS	EDS
BAGE	0.219***	0.014	0.219***
	(4.198)	(0.112)	(2.811)
TENURE	0.001	-0.247	0.001
	(0.008)	(-0.800)	(0.006)
BGEN	-2.660*	-0.770	-2.660**
	(-2.215)	(-0.403)	(-2.130)
OVERSEABACK	5.434**	1.717	5.434***
	(2.492)	(0.920)	(4.796)
INSTITOW	-0.016	0.005	-0.016
	(-1.653)	(0.199)	(-1.311)
BIND	-0.050*	-0.023	-0.050
	(-1.990)	(-0.468)	(-1.355)
CEODUAL	-0.193	-0.301	-0.193
	(-0.489)	(-0.326)	(-0.329)
BS	0.050	-0.030	0.050
	(0.603)	(-0.162)	(0.488)
BM	0.257***	0.170***	0.257***
	(6.226)	(3.049)	(5.964)
ROA	-0.011	-0.002	-0.011
	(-0.266)	(-0.034)	(-0.237)
LEV	-0.560***	-0.086	-0.560***
	(-5.674)	(-0.505)	(-6.252)
FS	2.877***	1.169*	2.877***
	(4.755)	(1.749)	(10.998)
MKTB	-0.079	0.026	-0.079
	(-1.650)	(0.232)	(-0.637)
BIG4	1.891	2.307	1.891
	(0.783)	(0.880)	(0.382)
Constant	-36.577***	-11.446	
	(-4.153)	(-1.335)	
F-value	962.478		30.830
R-squared	0.355		0.355
Industry control	Yes	Yes	Yes
Year control	Yes	Yes	Yes
Observations	1692	1692	1692

t statistics in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 34: Summary of FE Regression Results

Variable	Relationship with EDS	Theoretical Underpinning
BAGE	Significant at 1% Positive (+)	Upper echelon theory
TENURE	Insignificant	Not applicable
BGEN	Significant at 5% Negative (-)	Social identity theory
OVERSEABACK	Significant at 1% Positive (-)	Upper echelon theory

6.5.4 Robustness check and additional analyses

Previous studies have emphasized that the correlation between board diversity and corporate disclosure could face an endogeneity issue (Katmon et al., 2019; Jia and Zhang, 2012; Upadhyay and Zeng, 2014; Ben-Amar et al., 2015), which may arise from omitted variables or simultaneity. According to Fulgence et al. (2022), while the FE method may help mitigate the impact of unobservable firm-specific factors, it may not completely resolve the issue of endogeneity. For example, although board diversity may influence EID, it is plausible that EID can also influence board diversity. As noted by Saini and Singhania (2019), the prerequisites for employing static panel models are not always adequately considered. In our study, we adopted an FE estimation approach, assuming strict exogeneity, which implies that a firm's current board diversity (independent variables) is not affected by any changes in a firm's past EDS (dependent variable). However, if the lagged value of EDS impacts current board diversity, the static effect estimators may become biased. To address this potential endogeneity issue, we utilized lagged effect regression. The results presented in Table 35 are consistent with our main findings, indicating that our results are not sensitive to the issue of endogeneity.

Furthermore, to address the potential simultaneous relationship between board diversity and EID, we employed the 2SLS method with IV in our analysis (Wang et al., 2019). The 2SLS method enables consistent estimation of simultaneous equations involving endogenous predictors and stands out as one of the most powerful and

adaptable tools for addressing endogeneity (Katmon et al., 2019). As per French and Popovici (2011), IV estimation is a potent technique capable of producing reliable estimates even in the presence of endogeneity, provided it is applied correctly. The results reported in Table 35 align with our main findings in Table 33, providing further confirmation of the robustness of our results.

Table 35: Lagged Effect and 2SLS Regression

	Lagged Effect	2SLS
Variable	EDS	EDS
BAGE	0.289***	0.289***
	(3.016)	(3.049)
TENURE	0.076	0.076
	(0.384)	(0.388)
BGEN	-4.113**	-4.113***
	(-2.577)	(-2.605)
OVERSEABACK	8.874***	8.874***
	(6.023)	(6.089)
Constant		-32.247***
		(-4.741)
Control variables	Yes	Yes
Industry control	Yes	Yes
Year control	Yes	Yes
Observations	1589	1589
F-value	31.594	
R-squared	0.356	0.356

t statistics in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

To enhance the robustness of our findings, we conducted three additional analyses. First, we categorize the firms into industries with high and low levels of regulation based on their regulatory environment. Chen et al. (2021) argue that it is crucial to consider the diverse impacts when assessing different industries due to the influence of industry characteristics on firms' EID. Table 36 presents different findings for high-regulated and low-regulated industries, with TENURE and BGEN showing significant correlations with EDS in the former group, while all four aspects of board diversity significantly affect EDS in the latter group. Although the results for high-regulated industries are less significant than those for low-regulated ones, this is

still within our expectations. One main reason is that financial firms constitute a significant portion of this group (around 54% of firms in high-regulated group) and they often provide limited environmental information in their annual reports (Chen et al., 2021), resulting in generally EID levels. While the results for low-regulated industries align with those of our baseline model for the whole sample (shown in Table 33) with a significant impact of TENURE on EDS. They are also supported by the theoretical underpinning and accepted by the hypotheses. However, the findings are different among high-regulated industries, particularly regarding TENURE, which exhibits a negative impact on EDS. This is inconsistent with **H2**, but it may be attributed to the potential effects of longer tenure, such as risk aversion, limited information access, and reduced engagement in innovative endeavors (Peng et al., 2021), especially under the pressure of regulations. The significant and negative impact of BGEN on EDS is in line with **H3** and our baseline model in Table 33. Regarding OVERSEABACK, there is limited existing literature, but we posit that whether board members have overseas backgrounds or not does not significantly affect these firms, given their high level of regulation. While board members with foreign experience may show greater attention to EID issues, those without such backgrounds are still bound by EID-related regulations. Hence, it is reasonable to observe an insignificant impact of OVERSEABACK on EID within high-regulated industries.

Second, we divide the sample into small and large firms using the median firm size value as a benchmark (Katmon et al., 2019). Table 36 presents the results of these two groups. The findings for both groups are again different as only TENURE shows a negative correlation with EDS for small firms, while all four variables present a significant impact on EDS for large firms. The results for the latter group are similar to those in our baseline model (shown in Table 33) with a significant impact of TENURE on EDS. The results of large firms are more significant than those of small firms and we highlight several potential reasons why the impact of board gender diversity on EID is influenced by firm size. First, larger firms have more financial resources than smaller ones (Cheng, Zhong and Cao, 2020), allowing them to invest

in projects like EID to enhance stakeholder relationships and gain credibility, whereas smaller firms often allocate resources to traditional business strategies, especially if financially constrained. Second, environmental initiatives require well-developed processes to be effective, which is challenging for smaller firms, making firm size crucial for EID effectiveness. Third, economies of scale in larger firms enhance corporate social and environmental performance by facilitating resource availability and involving more people in EID activities (Donaldson, 2001). Fourth, larger firms, due to their visibility, engage more diverse stakeholder groups (Michelon and Parbonetti, 2010). Finally, large firms have a greater capacity to implement complex environmental projects because they possess more defined goals, measures, and procedures to monitor their activities.

Finally, we add ACABACK as an additional variable due to the common practice in China of scholars from academic institutions like universities and research centers serving as independent directors on corporate boards in recent years (Zhuang, Chang and Lee, 2018). ACABACK is academic background diversity of the board, measured using Blau index with two categories: board members whether or not having academic affiliations. The results in Table 36 indicates that ACABACK is significantly and positively correlated with EDS at the 1% significance level. This finding is consistent with that of Zhuang, Chang and Lee (2018) who studied CSR performance in China. Two main reasons are provided as follow. First, board members from academic institutions often hold advanced degrees. Numerous studies have shown a positive correlation between education level and individuals' concerns about ethical issues (Post, Rahman and Rubow, 2011). People with advanced degrees are generally more concerned about CSR issues than those with less education (Elm, Kennedy and Lawton, 2001). This is because highly educated board members tend to have broader perspectives (Post, Rahman and Rubow, 2011) and a deeper understanding of environmental issues. Additionally, directors with research backgrounds in CSR, sustainability, or related fields may be particularly motivated to promote superior CSR performance, as they can more clearly see the benefits (Chang et al., 2017). Second, academic scholars in China play a significant role in the legal

system by serving on advisory boards that develop, modify, and promulgate laws and regulations (Zhuang, Chang and Lee, 2018). Scholars with legal backgrounds can provide firms with professional advice on how to comply with these regulations. Therefore, the results remain robust after adding ACABACK.

Table 36: FE Regression by Industry Type, and Firm Size and FE Regression with Academic Background

Variable	High-regulated Industries EDS	Low-regulated Industries EDS	Small Firms EDS	Large Firms EDS	FE with ACABACK EDS
BAGE	0.200	0.296***	0.113	0.328***	0.206***
	(1.374)	(3.209)	(1.099)	(2.836)	(2.644)
TENURE	-0.826***	0.535**	-0.638***	0.856***	-0.026
	(-2.996)	(2.579)	(-2.838)	(3.674)	(-0.160)
BGEN	-3.967**	-2.829*	-2.238	-3.057*	-3.220**
	(-2.020)	(-1.735)	(-1.307)	(-1.778)	(-2.551)
OVERSEABACK	0.142	8.082***	1.764	7.051***	4.692***
	(0.076)	(5.595)	(1.056)	(4.677)	(4.037)
ACABACK					3.155***
					(2.762)
Control variables	Yes	Yes	Yes	Yes	Yes
Industry control	Yes	Yes	Yes	Yes	Yes
Year control	Yes	Yes	Yes	Yes	Yes
Observations	674	1018	630	1062	1692
F-value	16.385	20.452	5.800	15.522	29.398
R-squared	0.346	0.396	0.267	0.382	0.358

t statistics in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

6.6 Conclusion

In light of escalating environmental degradation, EID has gained prominence as a practical strategy to tackle environmental pollution. Despite China's status as the world's second-largest economy (Jiang and Kim, 2015) and the largest carbon emitter, existing literature on the correlation between board diversity and EID within the

Chinese context is scant. Previous studies have primarily focused on CSR and board gender diversity, thereby creating a gap in comprehensive research on other facets of board diversity in China. Using a sample of 300 firms listed in the SHSZ300 index from 2009 to 2019, this study examines the relationship between firms' EID and board diversity (i.e. age, tenure, gender, and overseas background) in China. We find that despite the recent increase in EID, Chinese firms demonstrate lower EID levels compared to those in developed economies (Giannarakis, Andronikidis and Sariannidis, 2019). This deficiency in EID remains consistent across various industries in China, irrespective of their sector. Additionally, our study suggests that firms with older board members, lower gender diversity on the board, and a higher percentage of members with overseas backgrounds tend to disclose more environmental information. Additional analyses indicate that in high-regulated industries, board tenure has a negative impact on firms' EID levels, unlike in low-regulated industries, and this pattern persists among small firms. Notably, the diversity of board academic background positively influences EID.

Our results can enrich the comprehension of the EID scenario in China. We recommend that investors concerned with non-financial matters, such as EID, scrutinize the diversity of firms' boards, particularly in terms of board members' age, gender, overseas and academic background, as these factors are linked to EID levels. Additionally, managers should enhance the quality of firms' environmental information. To augment the value creation potential of EID, it is essential that environmental information is trustworthy, relevant, and easily comprehensible to stakeholders.

Our study also provides practical recommendations for firms. First, they should contemplate the advancement of EID standards, encouraging the development of specialized environmental reports, and implementing third-party assurance mechanisms. By leveraging corporate governance mechanisms, firms can promptly respond to external market demands and effectively improve the quality of EID. Second, they should acknowledge the mounting pressure from the government and the public and incorporate environmental considerations into their strategic planning

processes. Third, they should prioritize and enhance their environmental management systems, establish dedicated environmental departments, implement environmental performance evaluation systems, and integrate assessments of environmental behavior into employee performance evaluations through the establishment of incentive and penalty systems. Fourth, firms should hire older, more experienced board members, reduce gender diversity, and maintain diversity in terms of members' overseas and academic backgrounds, especially for firms in high-pollution sectors, such as those in the energy industry. It is important to note that for a positive impact on EID levels, board tenure should be short in small firms and highly regulated industries and long in large firms and less regulated industries. Finally, all firms should focus on refining production methods to render their processes more environmentally sustainable.

Our findings hold substantial implications for regulators. First, a notable gap exists in EID between Chinese listed firms and those in the United States (Giannarakis, Andronikidis and Sariannidis, 2019). Given the combined landscape of mandatory and voluntary disclosure of environmental information, Chinese regulators should investigate the factors contributing to the hesitance of firms towards more comprehensive voluntary disclosure and devise corrective measures accordingly. Second, there is a pressing need for comprehensive enhancement in addressing EID across all industries, rather than focusing solely on specific industry sectors. Policymakers crafting regulations related to EID engagement should take into account board diversity, regulatory levels of firms, and firm sizes. They should also acknowledge the increasing number of individuals returning to China with overseas backgrounds and implement relevant policies to encourage the repatriation of individuals after studying and working abroad. Similarly, policies promoting the entry of individuals with academic backgrounds into industries are also necessary. Overall, it is imperative for all stakeholders to collaborate in the pursuit of sustainable development. Through such collaboration, the efficiency of corporate governance mechanisms and decision-making processes can be enhanced, ultimately leading to improved EID levels within firms.

This study has several limitations. First, China possesses unique socialist

national characteristics and a traditional Confucian culture, along with corporate governance regulations (e.g. the *Guidelines for Social Responsibility*, the *Guidelines on Environmental Information Disclosure for Listed Firms*, and the *Environmental Protection Law of the People's Republic of China*) distinct from those of other countries, potentially limiting the generalizability of the findings beyond the Chinese context. Second, due to data limitations, this study does not encompass other dimensions of board diversity, such as the nationality or ethnicity of board members. Additionally, this study relies on secondary data, whereas future scholars might derive insights from employing qualitative data. Third, future research may benefit from exploring theories other than upper echelon theory, social identity theory and RBV theory when investigating the relationship between corporate governance and EID.

Chapter 7

Conclusion

7.1 Introduction

This thesis set out to explore the intricate relationship between corporate governance mechanisms and EID in Chinese firms. Utilizing a comprehensive dataset of 300 firms listed on the SHSZ300 from 2009 to 2019, the study examined how board characteristics, ownership structure, and board diversity influence EID. This final chapter synthesizes the key findings from the three individual papers, discusses their theoretical and practical implications, acknowledges limitations, and suggests areas for future research.

7.2 Summary of Findings

The research revealed that board characteristics significantly influence EID. Larger boards were positively associated with higher levels of EID, suggesting that diverse expertise and viewpoints enhance environmental transparency. Frequent board meetings correlated positively with EID, indicating that regular interactions among board members facilitate better oversight and information sharing. Independent directors were crucial for increasing EID by providing objective oversight and reducing managerial opportunism. Interestingly, board gender diversity showed no significant impact on EID, implying that gender diversity alone does not necessarily enhance environmental disclosures. CEO duality, where the CEO also serves as the board chair, did not significantly affect EID, reflecting mixed findings in the literature. Additionally, the positive relationships between EID and board characteristics were more pronounced in low-regulated industries, and the 2014 *Environmental Protection Law* significantly strengthened these connections.

Ownership structure also played a crucial role in influencing EID. Managerial ownership positively impacted EID, suggesting that managers with significant ownership stakes are more likely to prioritize environmental sustainability. Conversely, institutional ownership was negatively associated with EID, implying that a short-term focus by institutional investors may discourage comprehensive

environmental disclosures. State ownership had a negative impact on EID, possibly due to conflicts of interest arising from the state acting as both regulator and owner. High ownership concentration was found to lead to lower EID, as dominant shareholders might prioritize short-term financial gains over environmental responsibilities. The relationship between EID and ownership structure was stronger in low-regulated industries, and the effects of managerial and state ownership varied by firm size. The 2014 *Environmental Protection Law* played a crucial role in enhancing the relationship between EID and ownership structures.

The impact of board diversity on EID was also significant. Older board members were associated with higher levels of EID, potentially due to their greater experience and moral reasoning. The impact of board tenure on EID was mixed; while longer tenure could lead to a better understanding and monitoring of environmental issues, it could also result in entrenchment and resistance to change. Lower gender diversity was associated with higher EID in this context, suggesting that cultural factors might influence the effectiveness of gender diversity. Directors with international experience positively influenced EID by bringing global best practices and stricter environmental standards to the firm. The study underscored that board diversity impacts EID differently depending on industry regulation levels, with tenure diversity showing negative impacts in highly regulated industries but positive effects in less regulated ones. Academic background diversity also positively influenced EID.

These findings provide a comprehensive analysis of how various corporate governance mechanisms — board characteristics, ownership structure, and board diversity — impact EID in Chinese firms. The results underscore the importance of tailored corporate governance practices to enhance environmental transparency and accountability, considering the unique regulatory and cultural context of China. The positive role of the 2014 *Environmental Protection Law* in enhancing EID practices highlights the significance of regulatory frameworks in promoting environmental sustainability.

7.3 Theoretical Implications

This thesis integrates multiple theoretical perspectives to provide a nuanced understanding of the relationship between corporate governance and EID. Agency theory, RBV theory, voluntary disclosure theory, legitimacy theory, upper echelon theory, and social identity theory collectively offer a comprehensive framework for analyzing how governance mechanisms influence environmental transparency and accountability.

Agency theory emphasizes the importance of board oversight in mitigating managerial opportunism and ensuring that management acts in the best interests of shareholders. The positive association between independent directors and EID supports this theory, highlighting the role of independent oversight in enhancing transparency and accountability. The RBV theory is also relevant, as the diverse expertise and viewpoints brought by larger boards can be seen as valuable resources that enhance a firm's capabilities in addressing complex environmental issues and providing comprehensive disclosures. The lack of significant impact of gender diversity on EID, however, suggests that merely having a diverse board is not sufficient; the effectiveness of board diversity may depend on how well diverse perspectives are integrated into board decision-making processes. This finding calls for further exploration of the contextual factors that influence the effectiveness of board diversity in enhancing EID.

Voluntary disclosure theory posits that firms will disclose information when the perceived benefits outweigh the costs. The positive impact of managerial ownership on EID suggests that managers with significant ownership stakes are more likely to perceive the benefits of transparency, aligning their interests with those of long-term stakeholders. Conversely, the negative impact of institutional and state ownership on EID highlights potential conflicts of interest and short-termism, which can undermine the incentives for comprehensive environmental disclosure. Legitimacy theory is also pertinent, as SOEs may face unique pressures to align with government policies and maintain legitimacy. However, the dual role of the state as both regulator and owner

can create conflicts that undermine the effectiveness of EID practices. The findings underscore the need for governance structures that can balance these competing interests to enhance transparency and accountability.

Upper echelon theory suggests that the characteristics of top executives influence strategic decisions, including EID. The positive association between board members' age and EID supports this theory, as older directors may bring greater experience and moral reasoning to the boardroom, enhancing the firm's commitment to environmental transparency. Social identity theory provides a framework for understanding the mixed effects of gender diversity. While diverse boards can bring a range of perspectives and enhance decision-making, cultural factors and resistance to change may limit the effectiveness of gender diversity in improving EID. The positive impact of international experience on EID highlights the value of diverse backgrounds and global perspectives in promoting best practices and stricter environmental standards.

7.4 Practical Implications

The findings of this thesis have far-reaching implications for policymakers, corporate managers, and investors seeking to EID in China. Given the growing global emphasis on corporate environmental responsibility, well-designed policies and governance practices can play a critical role in ensuring sustainable business practices and transparent environmental reporting.

Policymakers should consider strengthening corporate governance regulations to ensure that board independence, diversity, and ownership structures support enhanced EID practices. The results indicate that independent directors play a key role in reducing managerial opportunism and enhancing transparency. Regulatory bodies should mandate or incentivize the inclusion of independent directors in firms, particularly in SOEs, where conflicts of interest between government oversight and corporate decision-making may hinder effective environmental governance. Given that high ownership concentration can lead to selective or minimal environmental

reporting, corporate governance reforms should promote better disclosure practices among firms with dominant shareholders. Encouraging minority shareholder protections and strengthening investor rights can mitigate the risks associated with concentrated ownership, ensuring that firms are held accountable for their environmental performance. The study further underscores the importance of regulatory frameworks in driving corporate environmental transparency. The positive role of the 2014 *Environmental Protection Law* in improving EID suggests that government interventions can be effective in strengthening corporate sustainability efforts. Policymakers should build on this success by expanding regulatory requirements for ESG disclosures and ensuring their effective enforcement. Introducing mandatory environmental reporting standards with clear disclosure guidelines and penalties for non-compliance could further improve EID consistency and reliability. Additionally, sector-specific policies may be needed to address variations in disclosure practices, as firms in highly regulated industries may already be subject to more stringent environmental requirements, while firms in less regulated industries might require greater regulatory incentives to enhance their EID efforts.

For corporate managers, the findings emphasize that board structure and governance mechanisms are crucial for enhancing environmental reporting practices. The presence of independent and diverse directors contributes to more transparent EID. However, simply increasing board diversity is not sufficient; managers must ensure that diverse perspectives are effectively integrated into decision-making processes. Firms should invest in training programs and workshops to enable board members to understand the value of diversity in corporate governance and leverage their expertise to improve sustainability reporting. Additionally, frequent board meetings and active participation in environmental governance discussions can help ensure that sustainability remains a priority in corporate strategy. Corporate leaders should also reassess ownership structures to ensure that governance mechanisms align with long-term sustainability goals. The study highlights the potential benefits of managerial ownership in fostering commitment to environmental responsibility. By aligning managers' interests with those of long-term stakeholders, firms can enhance

their ESG performance and improve investor confidence. However, firms must also carefully balance the influence of majority shareholders to avoid situations where controlling stakeholders suppress environmental disclosures for short-term financial gains.

Investors can use these findings to make informed investment decisions based on governance structures and EID practices. Firms with high state or institutional ownership may be less likely to engage in comprehensive environmental disclosure, necessitating additional due diligence from investors seeking sustainable investment opportunities. By prioritizing firms with strong board independence, diverse leadership, and transparent governance, investors can reduce risks associated with weak EID practices while supporting businesses that align with ESG principles. Sustainable investing strategies, such as ESG screening, shareholder activism, and impact investing, can further incentivize firms to enhance their environmental transparency and adopt robust governance mechanisms.

7.5 Limitations and Future Areas of Research

Despite its contributions, this study has several limitations that should be acknowledged. The reliance on secondary data sources means that certain aspects of corporate governance and EID may not be fully captured. Data availability and quality can vary across firms and industries, leading to potential measurement inconsistencies. While efforts were made to ensure data reliability, variations in reporting standards and disclosure transparency may introduce biases, particularly for firms that selectively report environmental information. Additionally, some aspects of corporate governance, such as board decision-making dynamics, informal governance practices, and the role of sustainability committees, are difficult to quantify using publicly available data, which may limit the depth of governance insights obtained.

A second limitation relates to the omission of other regulations that could influence EID. This study primarily focuses on the 2014 *Environmental Protection*

Law as a key moderating factor in the corporate governance – EID relationship. However, other regulatory frameworks such as the *Green Finance Guidelines*, Corporate Social Credit System, and regional environmental disclosure policies may also play a significant role in shaping firms' EID practices. The exclusion of these additional regulations means that the study may not fully capture the broader regulatory environment that influences corporate environmental transparency.

Third, the study is specific to Chinese firms, which limits the generalizability of the findings to other institutional and market settings. China's corporate governance landscape is unique, characterized by strong state influence, ownership concentration, and evolving regulatory oversight. While the findings provide valuable insights for firms operating in emerging markets, applying these conclusions to developed economies or countries with different governance structures requires careful contextual consideration. Cultural, legal, and economic differences can shape the relationship between corporate governance and EID, affecting the applicability of the results beyond China.

Additionally, the measurement of EID and corporate governance practices presents challenges. EID practices vary significantly across firms in scope, depth, and reliability, and while content analysis methods help quantify disclosure quality, they may not fully capture the strategic intent behind disclosure practices. Similarly, corporate governance is a multi-faceted construct, and the proxies used — such as board characteristics, ownership structure, and board diversity — may not reflect the full complexity of governance mechanisms that influence EID.

Future research can expand on this study by conducting comparative analyses across different economies to understand how the impact of corporate governance on EID varies in different institutional settings. While this study focuses on China, where state ownership and regulatory interventions play a significant role, governance structures in developed economies tend to rely more on market-based mechanisms. Investigating how these differences influence EID can offer a broader perspective on global best practices. Additionally, examining how governance mechanisms affect EID in other emerging markets with similar regulatory transitions, such as India or

Brazil, can provide valuable cross-country insights.

Another promising area for future research is the integration of multiple environmental regulations to provide a more holistic understanding of how governance interacts with policy frameworks. While this study focuses on the 2014 *Environmental Protection Law*, several other regulations, such as *China's Green Finance Guidelines* and Corporate Social Credit System, may also shape corporate disclosure behavior. Examining how multiple regulatory mechanisms work together or create unintended consequences for firms' EID practices would contribute to a more comprehensive policy evaluation.

Another area of interest is the role of technological advancements in transforming EID practices. The emergence of artificial intelligence (AI), big data analytics, and blockchain technology presents new opportunities for enhancing corporate transparency. AI-driven sentiment analysis can help automate and improve environmental reporting quality, while blockchain can create tamper-proof disclosure records that strengthen corporate accountability. Future research could explore how technological innovations influence firms' disclosure behaviors and whether they enhance or weaken the relationship between governance mechanisms and EID.

Cultural influences on EID also warrant further investigation, as national culture shapes corporate governance norms and disclosure expectations. In China, Confucian traditions, hierarchical management structures, and state influence play a key role in shaping corporate decision-making. In contrast, Western economies, characterized by individualism and strong shareholder activism, may prioritize market-driven environmental transparency. Exploring how cultural dimensions interact with governance structures to influence EID practices could provide valuable cross-cultural insights for both academics and policymakers.

Finally, future studies should consider alternative governance measures that go beyond board characteristics and ownership structure. While this study focuses on board diversity, independence, and CEO duality, other governance dimensions, such as the presence of sustainability committees, director networks, and executive compensation linked to ESG performance, could also play a role in driving EID

improvements. Incorporating qualitative methods, such as interviews with board members, regulators, and sustainability officers, could complement quantitative analyses and provide a more nuanced understanding of how governance mechanisms influence EID.

By addressing these areas, future research can contribute to strengthening corporate governance frameworks, refining environmental policies, and promoting transparency in business sustainability practices. This will ensure that corporate environmental disclosure not only meets regulatory standards but also aligns with stakeholder expectations for responsible and sustainable business operations.

7.6 Conclusion

In conclusion, this thesis contributes to the understanding of the complex interplay between corporate governance mechanisms and EID in Chinese firms. By examining board characteristics, ownership structure, and board diversity, it highlights the critical role of robust corporate governance in promoting sustainable business practices and enhancing environmental transparency and accountability. The findings offer valuable insights for policymakers, practitioners, and scholars interested in advancing the field of corporate governance and sustainability.

The integration of multiple theoretical perspectives provides a robust framework for future research, while the practical implications offer actionable insights for improving EID practices. Despite its limitations, this study lays a solid foundation for ongoing research and policy development in the field of corporate governance and environmental sustainability. By continuing to explore and address the factors that influence EID, scholars and practitioners can contribute to the development of more transparent, accountable, and sustainable business practices globally.

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