UNIVERSITY OF CAPE COAST

SOVEREIGN GREEN BONDS AND ENVIRONMENTAL PERFORMANCE: THE MODERATING ROLE OF FORMAL AND INFORMAL INSTITUTIONAL FRAMEWORKS FROM A GLOBAL PERSPECTIVE

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's signature…………………………….. Date………………………

Name: Foster Segbe

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast

Supervisor's Signature: ……………………………Date: ……………………

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ABSTRACT

Works on green bonds and environmental performance have gained significant attention in recent years due to the growing threat of climate change. This study looks at the connections between institutional frameworks, environmental performance, and sovereign green bonds globally. The study uses a mixed-method approach using a First Difference General Method of Moments (GMM) panel estimator to evaluate these associations using data from 71 nations from 2007 to 2022. The findings show that green bond issuance has a major positive impact on environmental performance, implying that greener bond financing might help with climate change mitigation efforts. Furthermore, the study shows that both formal and informal institutional frameworks have important roles in improving environmental performance. Significantly, the study indicates that institutional frameworks moderate the link between environmental performance and green bonds, suggesting that stronger institutions augment the positive environmental effects of green bonds. These findings highlight the need of supporting policies to develop green bond markets and institutional frameworks in order to maximise the efficiency of sustainable finance in resolving global environmental concerns. They also have important implications for investors and policymakers. The study recommends governments actively promote green bonds through supportive policies. It also recommends the need for strong institutional frameworks to ensure green bonds effectively contribute to environmental improvements and combat climate change.

KEY WORDS

Environmental Performance

General Method of Moments

Green Bonds

Institutional Frameworks

Moderating Role

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DEDICATION

To my mother: Charity Wormadey

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LIST OF ACRONYMS

EPI	Environmental Performance Index
FINSTF	Formal Institutional Framework
GB	Green Bond issuance (Billion USD)
GDPG	Gross Domestic Product Growth (%)
INFINSTF	Informal Institutional Framework
INSTF	Institutional Framework
POPG	Population Growth (%)
TRADE	Trade (% of GDP)
WDI	World Development Indicators
WGI	Worldwide Governance Indicators
ECO	Ecosystem vitality
HLT	Environmental Health
CCH	Climate change mitigation

CHAPTER ONE

INTRODUCTION

The worldwide financial landscape is undergoing a transformative shift towards sustainable and responsible investment, reflecting an increasing awareness of the urgent need for environmental conservation (Ng, Nathwani, Fu & Zhou, 2021). Amid this transition, green bonds have emerged as an innovative tool for channeling private capital to climate-aligned assets. This study looks at how institutional frameworks, both formal and informal, mitigate the effects of green bonds in addressing climate change. Through a worldwide analysis, this study adds to the body of evidence already available on green bonds and environmental performance. The study utilises a wide-ranging measure that encompasses multiple dimensions of environmental performance. Practically, the findings of this research will be valuable for policymakers as they coordinate actions to address the current global climate challenges.

Background to the Study

The textile of our planet is woven with threads of immense beauty and incomparable biodiversity (Adams, 2021). However, this vibrant canvas is now stained by the stark reality of climate change, a challenge that casts a long shadow over the future of our planet and its inhabitants (Burke, Clarke, O'Keeffe & Corrigan, 2024). Climate change poses an existential threat, with greenhouse gas (GHG) emissions being the prime cause of human activities. The intensifying climate crisis calls for urgent action across all sections of society to mitigate carbon emissions and adapt to current and expected climatic changes (Garbric, 2023).

Globally, voices are rising in reaction to this impending calamity. A historic example of governments' commitment to reducing greenhouse gas emissions and keeping global warming far below 2 degrees Celsius is the 2015 adoption of the Paris Agreement (Chvostek, 2023). Since then, countries have embarked on ambitious national climate action plans, aiming to shift towards cleaner energy sources, improve energy efficiency, and protect natural ecosystems.

On October 18, 2019, the European Union officially launched the International Platform on Sustainable Finance (IPSF). The platform acts as a multi-stakeholder forum for discussion amongst authorities tasked with implementing regulatory measures for sustainable finance, with the aim of helping investors identify and seize sustainable investment opportunities that truly contribute to climate and environmental goals. Financing the renewable energy innovation and sustainable infrastructure needed to realise these commitments requires mobilising trillions of dollars in climate-aligned investment over the next few decades (Songwe, Stern & Bhattacharya, 2022).

As a result of these combined efforts, green bonds have become a popular financial tool in the battle against climate change (Banga, 2019). Governments and companies issue these fixed-income securities to generate money especially for environmentally beneficial initiatives including renewable energy, sustainable infrastructure, and the development of green technologies (Schumacher, 2020). Green bonds offer a unique opportunity to bridge the gap between climate ambitions and financial resources, channeling private capital towards projects that drive environmental progress (Pietri, 2021). From 2013 to 2021, cumulative green bond issuances rose from $11 billion to over $1.95 trillion (Tirumala & Tiwari, 2023).

A comprehensive analysis by JI and Zhang (2023), reveals that green bonds not only provide financial resources for sustainable projects but also contribute to fostering a green economy by influencing investor behavior. Environmental, social, and governance (ESG) factors are being considered by investors more and more in their decision-making, which encourages businesses and governments to implement more sustainable policies (Khamisu, Paluri & Sonwaney, 2024). This, in turn, increases investor confidence and attracts a wider pool of capital towards sustainable investments. Moreover, green bonds can stimulate innovation in green technologies and project development, paving the way for more effective and impactful solutions to environmental challenges (Deschryver & De Mariz, 2020).

To ensure the true "greenness" of green bonds and maximise their environmental impact, a robust institutional framework is essential (Nguyen, Luu, Hoang & Nguyen, 2023). This framework involves various elements, including standardised criteria for project eligibility and transparency, independent verification mechanisms, and supportive regulatory environments. Such frameworks, like China's Green Bond Endorsement Mechanism, provide confidence to investors and encourage broader market participation (Lin & Hong, 2022). Ellingsen and Aune (2022), emphasise the global nature of green bond markets, highlighting the need for an understanding of regional differences in regulatory environments.

Countries with robust institutional frameworks exhibit higher green bond issuance and attract a more diverse investor base. On the other hand, countries without well-defined regulations have difficulty establishing investor trust and guaranteeing the legitimacy of green financial products. Moreover, the study by Popescu, Hitaj and Benetto (2021), stresses the importance of standardised reporting mechanisms within institutional frameworks to enhance the comparability and reliability of environmental performance metrics associated with green bonds.

The signaling theory and the Ecological Economic Theory, on which this study is based, suggests that financial products such as sovereign green bonds might help a nation's environmental performance by coordinating economic growth with environmental sustainability (Costanza et al., 2014). Additionally, this study recognises that the impact of these financial instruments is shaped by the larger institutional and cultural context in which they operate (Hofstede et al., 2010; Scott, 2014). Drawing on Institutional Theory and Hofstede's Cultural Dimensions Theory, it examines how formal institutional structures and cultural norms may influence the effectiveness of green bonds in promoting environmental improvements.

Statement of the Problem

Even though there has been an increasing recognition of green bonds globally, there is still an inconclusive empirical research on their actual effects on environmental sustainability. According to Tuhkanen and Vulturius (2022) and Gilchrist, Yu and Zhong (2021) many studies on developed economies have been carried out, analysing investor preferences or project-level objectives financed by green bonds. Additionally, Mertzanis (2023), Naeem, Conlon and Cotter (2022) and Sun, Fang, Iqbal and Bilal (2022) point out that there is a dearth of data regarding the macroeconomic effects of green bond issuance in aggregate, particularly for emerging markets that contribute significantly to emissions but have high climate vulnerabilities.

Prior research on green bonds has largely concentrated regarding their characteristics and the financial impact on issuers. Comparing the credit ratings, yields, premiums, and liquidity of green bonds to conventional bonds has been the subject of some research (e.g. Fatica, Panzica & Rancan, 2021; Löffler, Petreski & Stephan, 2021; MacAskill, Roca, Liu, Stewart & Sahin, 2021;). A different body of research looks at how issuers' financial performance is impacted by green bonds and finds that it has a positive effect on stock price reactions, firm values and profitability (Jin & Zhang, 2023; Nylén, 2021; Vitalii & Elettra, 2020; Yeow & Ng, 2021; Zhou & Cui, 2019).

Green bonds, by channeling capital towards environmentally beneficial projects, offer a potent tool in the global climate store. The ability of green bonds to attract private investment, drive innovation, and enhance transparency are undeniable (Rouhelo & Kepsu, 2022). However, concerns linger about the "greenness" of some projects and the potential for greenwashing, where environmental claims outweigh actual impact (Brustad & Sæther, 2021). Moreover, it is still difficult to measure how successful green bonds are in accomplishing particular environmental objectives like lowering greenhouse gas emissions or preserving biodiversity. This lack of clarity hinders the full potential of green bonds and limits their ability to truly catalyze transformative change.

Critics argue that in many cases, proceeds end up funding business-as-usual projects aligned with an issuer's existing climate strategy rather than driving additional emissions mitigation (Bingler & Colesanti, 2020; Christophers, Bigger & Johnson, 2020). For example, about three-quarters of Chinese green bond proceeds have refinanced mature wind farms and solar plants built in the past rather than financing new assets (Negre, 2023). Analysts hence call for greater clarity regarding project selection criteria and disclosure of sustainability impacts by issuers (Lebelle, Jarjir & Sassi, 2022). The credibility hence substantially depends on accompanying institutional architectures regarding definitions, reporting requirements, verification, and accountability that shape market transparency and environmental safeguards (Dimitrov, Hovi, Sprinz, Sælen & Underdal, 2019; Hachenberg & Schiereck, 2022).

One major problem that still exists is defining and quantifying the environmental impact of green bonds. While frameworks like the Climate Bonds Initiative's Green Bond Taxonomy provide a starting point, they often lack the granularity and specificity needed to accurately assess project outcomes (de Lucena Barreiro, 2023). Moreover, attributing environmental improvements solely to green bonds is difficult due to the complex interplay of factors influencing environmental change (Alamgir & Cheng, 2023). This inadequate robust impact measurement hinders our ability to understand the true effectiveness of green bonds and adjust strategies for greater environmental benefit.

While prior scholars analysed drivers and challenges of green bond market growth alongside investor perspectives, limited research examines the relationship between regulatory frameworks and environmental performance. However, a critical research gap persists in understanding the exact interactions between institutional frameworks, regulatory variations, and the actual ecological impact of green bonds globally. The absence of comprehensive analyses that bridge these dimensions hinders a holistic understanding of how the financial sector can more effectively contribute to tackling the pressing issues brought on by climate change.

Institutional frameworks are of the form formal and informal. Formal institutional frameworks such as regulatory policies, standards, and enforcement mechanisms, provide the structural foundation for green bond markets by dictating eligibility criteria, reporting requirements, and verification processes, which shape transparency and accountability (Dimitrov et al., 2019; Hachenberg & Schiereck, 2022). Robust regulatory environments can alleviate concerns about greenwashing, ensuring that proceeds are directed toward genuinely sustainable projects rather than merely refinancing existing assets (Lebelle et al., 2022).

Simultaneously, informal institutional frameworks, including cultural norms and societal values, significantly influence stakeholder engagement and public perception, impacting investor confidence and community support, which are crucial for the success of green initiatives. A strong alignment between formal regulations and informal societal expectations can enhance the effectiveness of green bonds in achieving environmental goals; conversely, misalignment may result in inadequate environmental outcomes, as many projects funded by green bonds often fail to significantly contribute to emissions reduction or biodiversity preservation (Bingler & Colesanti, 2020; Christophers et al., 2020).

This study addresses the aforementioned research gaps by examining the relationship between green bonds, both formal and informal institutional frameworks, and overall environmental performance. To measure environmental performance, this study uses the Environmental Performance Index (EPI). The EPI is a comprehensive and widely used tool for assessing countries' environmental performance across a broad range of indicators. It comprises forty performance indicators grouped into eleven issue categories, including climate change mitigation, ecosystem vitality, and environmental health, encompassing aspects like air quality, biodiversity, and greenhouse gas emissions.

This broad measure is essential because focusing solely on metrics like CO_2 emissions may overlook other critical environmental dimensions impacted by green bond-financed projects, such as water quality, waste management, or biodiversity preservation. The EPI provides a more holistic assessment, capturing the multifaceted nature of environmental sustainability and offering a more complete picture of the potential environmental benefits associated with green bonds which are in line with the Sustainable Development Goals (SDG) 7, 9, 11, 13 and 15.

This study further fills the gap by including an interaction term to analyse how formal and informal institutional frameworks interact to influence environmental performance in the context of green bonds. This approach offers insights that can inform policy decisions, guide investment choices, and contribute to the ongoing dialogue surrounding sustainable finance.

Purpose of the Study

The purpose of this study is to examine the relationship between Sovereign Green Bonds, Institutional Frameworks, and Environmental Performance on a global scale.

Research Objectives

1. To assess the relationship between green bonds and environmental performance.
2. To evaluate the relationship between institutional frameworks and environmental performance of green bond issuing countries.
3. To examine how formal and informal institutional frameworks moderate the relationship between green bonds and environmental performance.

Research Hypothesis

H1: The issuance of green bonds contributes positively to environmental performance.

H2: The institutional frameworks of issuing countries exerts a positive influence on the environmental impact of green bonds.

H3: Formal and informal institutional frameworks moderate the positive relationship between green bonds and environmental performance.

Significance of the Study

In the perspective of tackling the urgent issues raised by climate change, this work is highly significant. The research adds significant knowledge to the domains of sustainable finance, environmental economics, and policymaking by carefully analysing the connection between green bonds, institutional frameworks, and environmental performance. Understanding how institutional setups influence the issuance, credibility, and actual impact of green bonds is crucial for shaping effective strategies to mobilize private capital towards environmentally sustainable projects. The findings of this study can guide policymakers in enhancing regulatory frameworks, assist investors in making informed decisions, and foster a more transparent and impactful green finance landscape.

This research has the potential to contribute directly to several specific SDGs while also offering broader relevance to the overall 2030 Agenda. This connection to the SDGs provides a strong rationale for the study, highlighting its potential real-world impact and policy relevance. It explains how green bonds contribute to SDG 7 (Affordable and Clean Energy) by financing renewable energy and energy efficiency projects. It also connects the study to SDG 9 (Industry, Innovation, and Infrastructure) through green bonds' support of sustainable infrastructure and clean technology. Further connections are made to SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 15 (Life on Land), demonstrating the wide-ranging relevance of the research. Ultimately, the study's significance lies in its potential to inform and influence practices that contribute meaningfully to global efforts aimed at mitigating climate change and achieving sustainability goals.

Scope of the Study

This study examines Green Bond dynamics in a variety of institutional contexts from a global standpoint. The study made use of sizable datasets on green bonds and other metrics that were available from 71 different nations. Formal and informal rules were employed as proxies for the institutional frameworks, the volume of green bonds issued served as a proxy for green bonds, and the Environmental Performance Index served as a proxy for environmental performance. The measurement of the informal institutional framework involved creating a composite index by PCA of the six national cultural norms or factors: power distance, individualism, drive for success and accomplishment, avoiding ambiguity, long-term orientation, and indulgence.

Formal institutional framework was also measured using a composite index of the six governance. These measures were used as they relate to the variables in the study in contrast to alternative measurements employed in certain empirical studies.

Limitations to the Study

It is important to note the limitations of this study. Data on the issuing of Green Bonds, environmental performance criteria, and institutional quality that are currently accessible are used in the study. The analysis's robustness may be impacted by restrictions on the availability of data and possible regional differences in data quality. The global nature of the study involves diverse regulatory environments and market conditions. Regional heterogeneity may introduce complexities, making it challenging to generalize findings to all jurisdictions uniformly. Also, Quantifying the environmental impact of green bonds involves various dimensions beyond carbon emissions reduction. The complexity of assessing broader sustainability outcomes may introduce challenges and limitations in providing a comprehensive evaluation. Additionally, although the study's objective is to examine the impact of institutional frameworks, it could not adequately reflect the specifics of every nation's regulatory environment. In-depth case studies or country-specific analyses could provide more nuanced insights.

Definition of Terms

Sovereign Green Bonds

Lopez-Claros (2021) defined green bonds as fixed income debt instruments where the proceeds are earmarked exclusively for projects and assets that have positive environmental benefits. Green bonds provide an avenue to direct private capital flows towards climate change mitigation and adaptation activities. Sovereign green bonds are debt securities issued by national governments to finance projects that yield environmental benefits.

Environmental Performance

Environmental performance refers to the measurable outcomes and impacts related to ecological sustainability. In the context of this study, it specifically pertains to the quantitative assessment of climate change, ecosystem viability, and environmental health.

Institutional Frameworks:

The set of regulatory, legal, and governance structures that define the rules and parameters within which financial markets, including green bond markets, operate.

Formal Institutional Frameworks:

The structured systems of laws, regulations, and policies that govern behavior within a society. This includes the governance indicators that facilitate or hinder the issuance and effectiveness of green bonds.

Informal Institutional Frameworks:

These are the unwritten rules, norms, and cultural practices that influence behavior in a society or a nation.

Moderating Role

The influence that a third variable exerts on the relationship between two other variables, affecting the strength or direction of that relationship.

Organisation of the Study

The study is organised into five distinct chapters to give a comprehensive analysis in resolving the research gaps and to methodically approach the research goals. The first chapter serves as an introduction, providing background data, summarizing the research question, and establishing the study's objectives.

In chapter two, research gaps are identified and the body of knowledge on green bonds, institutional framework and environmental performance is explored through a thorough review of related literature. The third chapter provides a description of the study strategy, which includes the quantitative methodology, data gathering methods, and analytic procedures. In Chapter 4, the empirical findings are discussed. Chapter 5, which concludes the study, offers a comprehensive overview of the findings, examines their consequences, and suggests avenues for further investigation.

CHAPTER TWO

LITERATURE REVIEW

Introduction

The literature review is a central part of the study since it offers a comprehensive analysis of the body of research on the effects of green bond issuance on environmental performance. This chapter offers theoretical and empirical support for the study. The study used five theories: signaling theory, ecological economic theory, environmental Kuznet curve, institutional theory and Hofstede's cultural dimensions. This chapter also dives deeper into the techniques and findings of empirical research on green bond issuance, critically analyzing them. Furthermore, the chapter gives theoretical and empirical reasons for the control variables chosen. By incorporating an extensive amount of literature, the review seeks to identify research gaps that will provide the basis for additional empirical investigation and the development of conceptual frameworks.

Theoretical Review

This section examines the theoretical foundations in relation to the research objectives.

Signaling theory

Signaling theory, originating from Spence's (1973) seminal work on labour markets, posits that actors possessing private information can utilise signals to credibly convey that information to others. Within the realm of corporate finance and sustainability, signaling theory suggests that companies issue green bonds as a mechanism to signal their genuine dedication to environmental protection

(Flammer, 2021). This signal aims to distinguish them from entities engaging in "greenwashing", a practice characterised by exaggerated or misleading environmental claims. The issuance of a green bond, defined by specific use-of-proceeds criteria and often subject to external verification, functions as a costly signal demonstrating a tangible commitment exceeding mere rhetoric (Zerbib, 2019). This costliness, manifested in reporting obligations, potential scrutiny, and the imperative to allocate capital to designated green projects, is precisely what imbues the signal with credibility.

The relevance of Signaling Theory to the study of green bonds lies in its ability to explain how these financial instruments can influence investor behaviour and corporate practices. When companies issue green bonds, they not only attract capital from environmentally conscious investors but also enhance their reputation in the market. This positive signaling can lead to increased investment in sustainable projects, thereby promoting better environmental practices and outcomes (Fatica & Panzica, 2021). Furthermore, the transparency associated with green bonds—often requiring third-party verification of the environmental benefits of funded projects—serves to bolster the credibility of the signal being sent. This transparency helps to mitigate concerns about "greenwashing," where companies might otherwise misrepresent their environmental efforts (Zhou & Cui, 2019).

Green bonds achieve environmental protections through several mechanisms facilitated by the signaling effect. First, the capital raised from green bonds is specifically allocated to projects designed to deliver environmental benefits, such as energy efficiency improvements and renewable energy developments. This targeted funding ensures that resources are directed towards initiatives that contribute to sustainability goals (Zhang, Xiong, & Huang, 2023). Second, the commitment to transparency and accountability in the use of proceeds from green bonds encourages companies to adhere to high environmental standards, as they are held accountable by investors and regulatory bodies (Fatica & Panzica, 2021). Lastly, the positive market response to green bond issuance can incentivise more companies to adopt sustainable practices, creating a ripple effect that enhances overall environmental performance across industries (Chen et al., 2023).

Ecological Economic Theory

Ecological economics offers a critical perspective on the conventional neoclassical economic model by explicitly acknowledging the interconnectedness between human economies and natural ecosystems (Daly, 1991). In contrast to traditional economics, which often treats the environment as an externality, ecological economics regards natural capital as a fundamental constraint on economic activity. Several core tenets of ecological economics are particularly relevant to the study of green bonds: Firstly, the principle of *sustainable scale* advocates for economic activity operating within the planet's biophysical limits. Green bonds, by financing projects that mitigate environmental impact (e.g., renewable energy, energy efficiency), contribute to achieving a more sustainable scale of economic activity (Daly, 1991). They direct investment towards activities that minimise resource depletion and pollution, aligning with the central principle of operating within planetary boundaries.

Secondly, the principle of *just distribution* emphasises the equitable distribution of resources and environmental burdens across generations and within current societies. Green bonds can support projects that address environmental justice concerns, such as providing access to clean energy in disadvantaged communities or mitigating the impacts of climate change on vulnerable populations. Thirdly, the principle of *efficient allocation*, whilst acknowledging the role of markets, promotes mechanisms that internalise environmental costs. Green bonds, through their focus on environmentally beneficial projects, can help correct market failures by directing capital towards sustainable investments that might otherwise be undervalued by traditional financial markets. They encourage efficient allocation of capital towards projects that minimise environmental damage.

Ecological economics provides a normative framework for assessing the environmental impact of economic activities. By linking green bonds to the principles of sustainable scale, just distribution, and efficient allocation, we can understand how these financial instruments can contribute to a more sustainable and equitable economy. They offer a financial mechanism to operationalise ecological economics principles.

Environmental Kuznets Curve (EKC) Hypothesis

The EKC hypothesis proposes an inverted U-shaped relationship between economic growth and environmental degradation (Grossman & Krueger, 1995). It suggests that as an economy develops, environmental degradation initially increases but subsequently declines after a certain income threshold is reached. Several factors are suggested to explain this relationship: the scale effect, where early stages of economic growth are often associated with increased resource consumption and pollution due to increased production and consumption; the technique effect, whereas economies develop, technological advancements and stricter environmental regulations lead to cleaner production processes and reduced pollution; and the composition effect, whereas economies shift from manufacturing to service-based industries, the overall environmental impact may decrease (Grossman & Krueger, 1995).

Whilst the EKC hypothesis has been subject to debate and empirical scrutiny, it is relevant to the study of green bonds because it suggests that economic development can be compatible with environmental improvement, especially when coupled with appropriate policies and technologies. Green bonds can play a crucial role in facilitating the "technique effect" by financing the development and deployment of clean technologies and sustainable infrastructure. They can help accelerate the transition to a cleaner economy, potentially shifting the EKC downwards or shortening the period of increasing environmental degradation. They provide a financial mechanism to support the transition from the upward to the downward sloping part of the EKC.

Integrating signaling theory with ecological economics and the EKC hypothesis offers a more comprehensive understanding of the function of green bonds. Signaling theory explains *why* companies issue green bonds (to signal their commitment to environmental sustainability) (Flammer, 2021; Zerbib, 2019), while ecological economics provides the normative framework for *what* constitutes environmental sustainability (sustainable scale, just distribution, efficient allocation) (Daly, 1991). The EKC hypothesis provides a macro-level perspective on the relationship between economic development and environmental quality, suggesting that green bonds can be a key instrument in achieving sustainable development pathways (Grossman & Krueger, 1995). By incentivising investment in cleaner technologies and sustainable projects, green bonds can contribute to a decoupling of economic growth from environmental degradation, supporting the transition towards a more sustainable economy as envisioned by ecological economics and potentially influencing the trajectory of the EKC. On the basis of prior studies and this theoretical framework, the study hypothesised that;

H1: There is a positive relationship between the issuance of sovereign green bonds and a country's environmental performance.

Institutional Theory

Institutional theory examines how formal and informal rules, norms, and beliefs shape organisational behaviour and societal outcomes (North, 1990). In the context of green bonds and environmental performance, institutional theory suggests that the effectiveness of green bond markets and their impact on environmental outcomes are influenced by the institutional environment in which they operate. Key aspects of institutional theory relevant to this objective include:
—Formal institutions**:** these encompass laws, regulations, policies, and government agencies. Strong environmental regulations, clear green bond standards, and effective enforcement mechanisms can create a supportive environment for green bond issuance and ensure that proceeds are used for genuinely green projects (Ehlers & Packer, 2017). Conversely, weak or inconsistent regulations can lead to

greenwashing and undermine the credibility of the green bond market (Zerbib, 2019). For example, a country with stringent environmental impact assessment procedures for projects financed by green bonds is more likely to see tangible environmental improvements.

Informal institutions include cultural norms, social values, and shared beliefs. Societal awareness of environmental issues, public support for sustainable development, and a strong sense of environmental responsibility can create a demand for green investments and encourage companies to adopt environmentally friendly practices (Marquis & Tilcsik, 2013). For instance, a culture that values long-term sustainability over short-term profits may be more conducive to green bond issuance and investment.

Another factor is Isomorphism**,** this refers to the tendency of organisations to adopt similar structures and practices in response to institutional pressures. In the context of green bonds, coercive isomorphism (pressure from regulations), mimetic isomorphism (imitating successful organisations), and normative isomorphism (adopting industry best practices) can influence the development and adoption of green bond standards and practices across countries (DiMaggio & Powell, 1983). For instance, countries may adopt similar green bond taxonomies to align with international standards and attract foreign investment.

Institutional theory provides a framework for understanding how the institutional context—both formal and informal—influences the development and effectiveness of green bond issuance and their impact on environmental performance. By examining the interplay of regulations, norms, and beliefs, we can identify factors that promote or hinder the contribution of green bonds to environmental protection.

Hofstede's Cultural Dimensions Theory

Hofstede's Cultural Dimensions Theory provides a framework for understanding cultural differences across nations (Hofstede, 2001). It identifies several dimensions of national culture that can influence attitudes towards environmental issues and the adoption of sustainable practices, including: Power distance: This dimension reflects the extent to which less powerful members of a society accept and expect that power is distributed unequally. In high power distance cultures, environmental regulations may be less effectively enforced due to a lack of public pressure and accountability (Hofstede, 2001).

Individualism vs. collectivism: this dimension reflects the degree to which individuals are integrated into groups. In collectivist cultures, there may be a stronger emphasis on collective responsibility for environmental protection, which could translate into greater support for green initiatives (Hofstede, 2001). Uncertainty avoidance: this dimension reflects the extent to which members of a society feel uncomfortable with uncertainty and ambiguity. In high uncertainty avoidance cultures, there may be a greater preference for clear environmental regulations and standards, which can facilitate the development of green bond markets (Hofstede, 2001). Long-term vs. short-term orientation: this dimension reflects the extent to which a society prioritises future rewards over immediate gratification. Cultures with a long-term orientation are more likely to invest in sustainable practices and support long-term environmental goals, which can be conducive to green bond investment (Hofstede, 2001).

Hofstede's Cultural Dimensions Theory provides a framework for understanding how cultural values and beliefs influence environmental attitudes and behaviours across different countries. These cultural factors can interact with formal institutions to shape the effectiveness of green bond markets and their impact on environmental performance. For example, a country with high uncertainty avoidance and a long-term orientation may be more likely to develop strong green bond standards and attract long-term green investments.

By combining institutional theory with Hofstede's Cultural Dimensions Theory, we gain a more nuanced understanding of the relationship between institutional frameworks and the environmental performance of green bond-issuing countries. Formal institutions provide the legal and regulatory framework for green bond markets, while informal institutions, including cultural values and beliefs, shape societal attitudes towards environmental issues and the adoption of sustainable practices. Hofstede's dimensions help to explain the variations in informal institutions across countries, providing a crucial cultural lens through which to examine the effectiveness of formal institutions in promoting green finance and environmental protection.

For example, even with strong environmental regulations (formal institutions), a country with a short-term orientation and high-power distance (cultural dimensions) may experience challenges in effectively implementing and enforcing those regulations, thus hindering the environmental performance of green bonds. This integrated approach allows for a more comprehensive analysis of the complex interplay of institutional factors that influence the success of green bond markets in achieving environmental objectives. From this, the following hypothesis were formulated:

H2: *Institutional framework exert positive influence on environmental performance. And*

H3: *Institutional frameworks moderate the positive relationship between green bonds and environmental performance.*

Conceptual Review

This section reviewed relevant concepts supporting the study. The major concepts of Green bonds, environmental performance and institutional frameworks are discussed.

Green bonds

"Green bonds" are a type of fixed income financial instrument that is used to raise capital from investors for both new and ongoing projects that have a positive environmental impact and are in line with goals for broader sustainability, climate change adaptation, and mitigation, according to Chygryn, Pimonenko, Luylyov, and Goncharova (2019). Green bonds can be used to fund a variety of projects, including waste management, energy-efficient green buildings, pollution prevention efforts, biodiversity conservation activities, waste management, and low-carbon transportation infrastructure like electric vehicles and trains. Renewable energy systems like solar, wind, small hydro, and biomass power assets that expand clean energy access are also eligible (Infield & Freris, 2020).

Approved global issuers of green bonds include development banks, governments, municipalities, public sector initiatives, and private companies from a variety of industries looking to raise money for investments with a sustainability focus. According to Sangiorgi and Schopohl (2021), issuers can demonstrate their credibility by voluntarily adopting the Green Bond Principles, which provide standardized protocols for the use of proceeds, process management, and transparency. Frameworks that adhere to principles include comprehensive information on project selection standards, anticipated eligibility expenses, and unallocated cash management throughout the bond's duration (de Lucena Barreiro, 2023).

These data are in line with reputational guarantees that avoid overt "greenwashing." Project-level allocations, however, show that there is concentration in a few industries, mainly in transportation, low-carbon buildings, and renewable energy (Bonds, 2021). Concerns are raised about the funding of green bonds' additionality and diversification (Jones, Baker, Huet, Murphy & Lewis, 2020). Furthermore, despite greater climate vulnerabilities, emerging markets lag behind developed countries in terms of issuances and proceeds (Arndt, Loewald & Makrelov, 2020). Green bonds can realise their full potential for accelerating sustainable development by addressing such structural constraints.

Institutional frameworks

In the green bonds context, institutional frameworks represent the prevailing amalgamation of statutory regulations, policy guidelines, industry reporting standards, verification mechanisms and disclosure requirements enforcing varying oversight, transparency and accountability conditions over entities issuing sustainability-themed bonds within a specific jurisdiction (Kila, 2022). These include regulations governing precise definitional boundaries applied towards aligning assets with green eligibility taxonomies, mandatory levels of disclosure and reporting detail required from issuers regarding use of proceeds and quantitative environmental impact metrics, intensities of external auditing and credentialing through approved verifiers, and accountability structures like sanctions against misconduct or greenwashing by issuers regarding actual capital utilization (Zhang, 2020).

Jurisdictional variances across such institutional criteria determine overall strengths and limitations around integrity, credibility and governance over local green bond markets (Perkins, 2021). Policy factors also shape issuer motivations and investor perceptions besides directing on-ground implementation for funded assets and infrastructure delivered by intermediaries that influence measurable sustainability outcomes (Jarvis, 2020).

Environmental performance

The concept encompasses metrics analysing the ecological outcomes delivered by initiatives and assets funded through green bonds, thereby allowing assessments into their climate financing credibility. This includes ex-ante projections and ex-post quantifications regarding key indicators like emissions reduction, renewable energy capacity added, area of forests conserved, or populations provided climate-resilient public infrastructure access (Cobourn, 2023).

The effectiveness of green bonds is contingent on the dynamic interplay between these core concepts. A well-designed institutional framework provides the foundation for identifying and selecting truly green projects, ensuring their environmental integrity through verification processes (Nguyen et al., 2023). This, in turn, maximises the potential for demonstrably positive environmental performance, attracting responsible investors and contributing to greening the financial system.

Despite the promising potential of green bonds, several challenges remain. Greenwashing practices can undermine market integrity, while limitations in impact measurement hinder accurate assessment of environmental outcomes (Yang, Nguyen, Nguyen, Nguyen & Cao, 2020). Ongoing research and innovation are crucial to address these challenges. Further refinement of standardization criteria, strengthening verification procedures, and developing robust and standardized impact measurement frameworks are essential for strengthening the green bond market's effectiveness in tackling environmental challenges (Bhutta, Tariq, Farrukh, Raza & Iqbal, 2022)

Empirical Review

The empirical literature on the nexus between green bonds, environmental performance and institutional frameworks is reviewed in this section.

Green bonds and the environment

After their initial issuance in 2007, green bonds have grown rapidly, becoming a significant debt instrument with a sustainability focus that directs global capital flows toward projects addressing climate change adaptation and mitigation, including renewable energy, low-carbon transportation, green buildings, biodiversity preservation, and growth paths that are resilient to climate change (Licastro & Sergi, 2021)). As a result, assessing the environmental effects and additionality credentials of the growing green bond market has drawn the attention of researchers. Early research concentrated on concepts, typologies, and drivers, such as the rapidly expanding Chinese issuances, and was based on aggregate market data that suggested a sizable potential for decarbonization if employed strategically (Asian, 2021).

Later research examined investor viewpoints and risk profiles, recording a desire for more robust external certification systems to confirm climate credentials and legitimacy (Büber, 2022). This led to worries about the dangers of "greenwashing" in the absence of strict governance structures.

One of the most significant concerns surrounding green bonds is the pervasive issue of greenwashing. Studies by Gilchrist et al. (2021) and Banga (2019), highlight how firms may exploit the growing demand for green investments by labeling projects with limited environmental benefits as "green" to attract environmentally conscious investors. This greenwashing dilutes the market's integrity and undermines its potential to deliver genuine environmental progress.

Furthermore, existing standardisation criteria and verification procedures often lack sufficient precision, enabling projects with questionable environmental credentials to slip through the cracks (Kimura & Kinchy, 2019). Kalmenovitz, Lowry and Volkova (2021) point to regulatory fragmentation and the influence of powerful actors like rating agencies as factors contributing to these deficiencies.

This lack of stringent oversight further amplifies the greenwashing problem and hinders the ability of green bonds to truly contribute to environmental goals.

Notwithstanding, studies increasingly demonstrate a possible link between green bond issuance and positive environmental changes, including the potential to accelerate the adoption of low-carbon and climate-resilient infrastructure and energy projects (Nguyen et al., 2023). Studies that have used meta-analytical techniques, green buildings funded by designated green bonds have significantly lower lifecycle emissions, energy consumption, and overall sustainability credentials than conventional assets (Shrivastava & Bhusan, 2023; Tingle, 2023). An analysis conducted by Cielo and Subiantoro (2021) on certified low-carbon commercial buildings in Europe revealed that bond funds was allocated to energy-saving features, onsite renewable power sources, and water reuse systems, which resulted in a 20–30% decrease in operational effect. Investing in low-carbon infrastructure through green bonds delivers substantial environmental benefits for climate change mitigation, thanks to their affordability for issuers (Hongo & Anbumozhi, 2020) and investor attraction due to low risk and appealing returns (Nykvist & Maltais 2022).

The modelling centred on European utilities, wind capacity expansions funded by green bonds between 2019 and 2021 are expected to offset 42 million tons of CO_2 emissions over the course of the following 25 years (Mertzanis, 2023). In order to highlight the socio-environmental potential of grid stability models, a 500 MW hybrid renewable energy project in Oman that was funded by green bonds was used to illustrate accumulating sustainability benefits in terms of water conservation, job creation, and air pollution reductions (East & Initiative, 2022).

Another significant benefit of green bonds is to fund green technology. Several techno-economic evaluations, focusing mostly on China's electric vehicle production, associate large potential lifetime emission reductions with capacity improvement expenditures financed by corporate green bonds as the electronic vehicle market expands (Li, Ye, Liao, Ji & Ma, 2020). An increased assembly line owned by a single automaker is estimated to reduce emissions by approximately 550,000 tonnes annually (Ou et al., 2022).

Green train transport bond evaluations show the significant carbon difference compared to comparable fossil fuel systems; 5 million tonnes CO_2 are expected to be offset in Germany over a 30-year period by a €500 million bond issue (Osman et al., 2022). The amount of green technology patents and the issuing of green bonds have been found to positively correlate in recent studies (Zhang et al., 2020). Thus, the issuance of green bonds can contribute to environmental improvement by promoting the development of green technology.

Institutional frameworks and environmental performance

Research on the connection between environmental performance and institutions has grown in importance. Institutional frameworks can be broadly divided into formal and informal categories. Official laws, rules, policies, and government agencies that have an impact on environmental decision-making are referred to as formal institutional frameworks. Unwritten social norms, practices, traditions, and beliefs that influence environmental actions and priorities are known as informal institutional frameworks (Dedoulis, & Leventis, 2023). Although formal vs informal institutional frameworks have different advantages and disadvantages, both types of institutional frameworks have an impact on how nations, corporations, and people respond to environmental challenges.

Environmental regulations, protected area policies, pollution control agencies, environmental impact assessment procedures, and other formal institutional frameworks are directly related to the environment. In order to mitigate negative externalities connected to pollution and resource extraction, as well as address market failures pertaining to public commodities like air and water, these organisations provide explicit rules and recommendations for environmental management (Chen, Li, Yuan, & Zhang, 2022).

There is extensive research demonstrating how strong formal institutional frameworks can enhance environmental performance and sustainability across sectors. Strict air and water pollution regulations have been shown to reduce industrial emissions in multiple country-cases (Hettige, Mani & Wheeler, 2019). Biodiversity preservation policies like the establishment of protected wetlands lead to improved species protection outcomes (Hermoso, Abell, Linke & Boon, 2016). Government facilitated assessment tools like Environmental Impact Assessments (EIAs) support more sustainable planning and development decisions (Benson, 2003).

In addition to strengthening formal institutional frameworks, efficient enforcement and monitoring systems also improve environmental compliance and results. The literature, for instance, demonstrates how genuine regulatory threats, such as penalties or revoked permits, force firms to absorb environmental costs and encourage the use of cleaner manufacturing methods (Niu, Wang & Yang, 2022). In a same vein, environmental authorities may now more effectively identify illicit deforestation and take preventative action thanks to remote sensing technologies (Perazzoni, Bacelar-Nicolau & Painho, 2020). The primary advantages that formal institutional frameworks bestow are associated with their dependability and effectiveness in tackling environmental concerns. Clear environmental norms and duties for public and commercial actors are codified by formal institutions (Thompson & Harris, 2021). Additionally, they support consistency and accountability across cases when combined with sufficient oversight and enforcement.

On the other hand, unwritten social norms, beliefs, conventions, and traditions that also affect environmental decisions and behaviors are included in the category of informal institutional frameworks. Examples include customs related to the use of resources and actions related to conservation (Murphy, 2021). The ways that local communities engage with their surroundings are shaped by these deeply rooted social patterns. Research shows that informal rules can enable sustainable behaviors where formal institutions are lacking. For instance, customary tribal institutions have better conserved community forest resources in some Indian states compared to state policies (Kashwan, MacLean & García-López, 2019). Local norms that limit grazing and firewood collection have proven effective for self-monitoring ecosystems in rural communities (Jode & Flintan, 2020).

Informal institutional structures can also support official environmental policy. Municipal waste management laws are reinforced in certain Western cities by social norms that promote recycling and garbage reduction (Knickmeyer, 2020). In Brazil, several customary tenure arrangements promote rainforest conservation efforts alongside protected areas (Maretti et al., 2023). Therefore, where traditional practices coincide with conservation and emissions mitigation activities, informal institutions can support bottom-up collaboration for sustainability (Donegan, Gold, Dyson & Bartle, 2023). Compared to opposition to official policy directives, community-based informal regulations may garner more local buy-in (Kashwan et al., 2019). Regulations must take internal value systems into consideration if environmental projects are to succeed (Litvinenko, Bowbrick, Naumo, & Zaitseva, 2022).

However, informal institutional frameworks can also pose barriers to sustainability outcomes in cases of norms that promote overexploitation of resources or excessive pollution. Deeply embedded social customs like wood heating norms in rural China exacerbate air pollution despite national emissions regulations (Monks & Williams, 2020). And customary privileges held by cattle ranchers propelling Amazon deforestation present ongoing impediments to Brazilian rainforest conservation efforts (Hanusch, 2023).

Adopting new official regulations is not as difficult as realigning deeply embedded informal institutional structures. Changing cultural practices, community preferences and long-held value systems around environmental concerns needs patience and exact policy approaches accounting for particular social dynamics (MacMurray & Futrell, 2021). Therefore, informal institutional structures offer a two-pronged benefit that can either bolster or impede formal policy endeavors aimed at achieving sustainability. Overall the literature emphasizes accounting for formal-informal institutional structures to diagnose levers or obstacles tied to social responses and environmental outcomes.

Green bonds, institutional frameworks and environmental performance.

The idea that strong institutional frameworks and green connections are essential for achieving high levels of environmental performance is supported by a number of empirical studies. Stated differently, unless they are paired with a strong institutional framework, green bonds alone might not be sufficient to achieve the appropriate levels of environmental performance. This may help to explain the contradictory results between green bonds and environmental performance.

The legislative and governance frameworks that green bonds function inside have a substantial impact on how well they accomplish environmental goals, according to research by Dikau and Volz (2021). Transparent reporting, the issue of green bonds with credibility, and efficient monitoring of environmental outcomes are all made possible by a strong institutional structure. Defined rules and expectations for the issue of green bonds are provided by a well-defined institutional framework, which also offers regulatory stability. de Chanrond (2023), have noted that issuers are encouraged to engage in ecologically sustainable projects with confidence due to this stability. A greater number of green bonds financing projects with favorable environmental effects can be achieved through regulatory certainty, which also serves to minimise uncertainty and draw in additional issuers.

Arguably, establishing and enforcing transparent reporting criteria is made possible by institutional structures, which guarantee accurate and comparable data regarding the environmental performance of green bonds (Steuer & Tröger, 2022). As transparent reporting fosters investor trust, Velte (2020) stress the significance of explicit reporting procedures in regulatory contexts. Investor confidence in the beneficial environmental impact of projects supported by green bonds is increased when they have access to accurate information, which helps them make well-informed decisions.

Companies that issue green bonds could incorrectly depict themselves as environmentally conscientious without implementing actual actions, resulting to greenwashing tendencies (Yeow & Ng, 2021). Greenwashing can lead to information gaps among stakeholders in a corporation (Torelli, Balluchi & Lazzini, (2020), make it more difficult to allocate high-quality resources effectively (Nguyen et al., 2023) and ultimately reduce the effectiveness of green bonds. Thus, encouraging open reporting procedures among bond issuers may be a way for organizations to stop engaging in greenwashing, protecting the real environmental advantages of green bonds.

Strong institutional frameworks enable nations to promote favorable environmental outcomes through green bonds by coordinating their regulatory frameworks with their national environmental goals. Lin and Hong (2022) emphasise the importance of regulatory structures that serve more general policy goals related to the environment. The commitment to generating positive environmental outcomes is reinforced by the way that well-aligned institutional frameworks guarantee that green bond issuances make a real contribution to national sustainability goals. These facilitate the conversion of more general environmental policy goals into practical rules and incentives.

According to Falcone (2020) research, nations with clearly defined regulatory frameworks are more advantageous in allocating the revenues of green bonds towards projects that are in line with their respective national sustainability agendas. This alignment guarantees that the issuance and application of green bonds are directed toward the accomplishment of particular environmental benchmarks and targets.

The linkage with national environmental goals permits the targeted distribution of green bond financing. Nations that include green finance legislation into their environmental policy frameworks —by, for example, establishing aggressive targets for reducing emissions—direct the issuance of green bonds toward initiatives that make a significant contribution to these objectives. According to Wang, Wang, Wang and Yang (2020) analysis of the relationship between regulatory frameworks and environmental performance, this focused strategy increases the probability of a positive environmental impact. The aims of the environment can change over time with the support of a flexible institutional framework. Given that environmental concerns and priorities are subject to change, flexibility is crucial. Green bonds are additional expected to continue to be in line with the most urgent environmental issues in nations where regulatory frameworks are flexible enough to address new sustainability concerns (Deschryver & De Mariz, 2020)

Also, a strong institutional structure boosts investor trust in green bonds, drawing in a more confident and varied pool of investors. Nations with clear regulatory frameworks have an easier time drawing in foreign capital (Ulrich, Trench & Hagemann, 2022). Since the environmental performance criteria linked to these instruments are reputable and trustworthy, investors are further likely to fund green bonds issued in transparent and stable regulatory environments. A greater amount of money is invested in ecologically friendly initiatives when investor confidence is higher.

Positive environmental results can be promoted comprehensively by institutional frameworks that integrate environmental criteria into larger financial policies. Flejterski (2019) contend that including environmental factors into financial legislation guarantees the sustainable operation of the entire financial system. Through this integration, green finance methods can be more widely adopted and impact a variety of financial operations in addition to green bonds. A more sustainable financial ecosystem is created when environmental factors are methodically included into decision-making processes, which is ensured by a holistic approach.

There are no denying advantages of institutional frameworks in fostering favorable environmental outcomes through green ties. These standards serve as the cornerstone of a strong and significant green bond market, promoting environmental integrity, increasing impact, and boosting investor trust. We can fully realise the promise of green bonds as effective instruments for advancing a sustainable future and addressing the pressing environmental issues of our day by consistently enhancing and improving these frameworks.

Control Variables

The study considers macroeconomic measures related to trade, population growth, and economic growth in order to account for country-specific factors that could have an influence on the environment.

GDP is used in the study as a key control variable to separate out the impacts of sovereign green bonds on environmental performance. GDP is a measure of economic growth. By taking into consideration the larger economic backdrop that affects environmental outcomes researchers may consider the GDP, which represents the total value of goods and services generated in a nation. Based on Ecological Economic Theory, which highlights the relationship between ecological and economic systems, accounting for GDP allows for a more detailed examination of how green bonds function in various economic contexts. In the end, this method helps differentiate between the effects of economic growth and the particular contributions of green finance, leading to a better understanding of how sovereign green bonds might improve environmental performance.

Another macroeconomic indicator that impact environmental performance is population size. This is because higher populations often result in increased resource consumption and waste generation, aggravating environmental degradation (Ehrlich & Holdren, 1971). According to studies, population growth increases strains on natural resources, leading to deforestation, biodiversity loss, and greater greenhouse gas emissions (Dietz & Rosa, 1997). Therefore, it is essential to account for population in studies of environmental performance in order to isolate the influence of other factors, such economic growth or technological improvements and ensuring more accurate assessments of sustainability interventions and policy outcomes (York, Rosa, & Dietz, 2003).

In addition, trade has a considerable impact on environmental performance through multiple pathways, demanding regulation in environmental research. The pollution haven theory proposes that polluting firms move to nations with low environmental restrictions (Cole, 2004). In contrast, the Porter hypothesis contends that trade may stimulate innovation and efficiency, possibly enhancing environmental results (Porter & Van der Linde, 1995). Trade can also have an environmental impact due to scale, content, and method impacts (Grossman & Krueger, 1991). The scale impact normally increases environmental deterioration as production grows, but composition and method effects can enhance or degrade environmental quality depending on the context (Antweiler, Copeland & Taylor, 2001). Controlling for trade in environmental studies separates the impacts of other factors and offers a more accurate evaluation of factors influencing environmental performance (Frankel & Rose, 2005).

Gaps in existing studies

Green bonds and institutional frameworks both appear to be important factors in determining environmental performance, according to the theoretical and empirical review. Furthermore, the literature review illustrates that institutional framework serves as a moderating factor in the connection between green bonds and environmental performance. This is explained by the theory that the effectiveness of institutional frameworks determines whether green bonds would yield the most benefits (Egli, 2020). Furthermore, there exists a limited research indicating that green bonds improve environmental performance provided that institutional frameworks are improved (Nguyen et al., 2023). This signal comes from the finding that nations with higher institutional frameworks incline to have greater positive coefficients for environmental performance than countries with less or weak institutional frameworks.

The studies conducted by Chang et al. (2022) and Nguyen et al. (2023) bear resemblance to the present research. Nevertheless, it's worth noting that Chang et al. (2022) did not incorporate interaction terms involving institutional frameworks and environmental performance, while the model employed by Nguyen et al. (2023) did not include informal institutional structures. In contrast, this study utilises a comprehensive measure to comprehend both informal and formal institutional frameworks.

Additionally, this study makes use of the Environmental Performance Index (EPI), a comprehensive proxy for assessing environmental performance. The EPI, which consists of forty performance indicators, covers eleven issue categories: fisheries, acid rain, agriculture, water resources, heavy metals, air quality, sanitation and drinking water, heavy metals, waste management, ecosystem services, biodiversity and habitat, and climate change mitigation. These indicators monitor three primary policy objectives: ecosystem vitality, climate change mitigation, and environmental health. An extensively used instrument for evaluating a nation's environmental performance is the EPI.

Contribution to existing studies

By adding interaction terms involving institutional framework and environmental performance, this study adds to the body of current research. Specifically, it builds upon the work of Chang et al. (2022) and Nguyen et al. (2023). A more thorough comprehension of the interactions between various variables is made possible by this intricate approach. Also, the research area of this study is expanded beyond what was previously examined by including both formal and informal institutional frameworks into the model. This wider viewpoint offers a more comprehensive understanding of the institutional frameworks and how they affect the phenomena under study. Additionally, the usage of a comprehensive measure for environmental performance helps to methodological breakthroughs in the sector. The findings are more reliable and applicable as a result of this inclusive approach.

Chapter Summary

The chapter began with an explanation of the theories that were used in the research. It specifically used the signaling theory, ecological economic theory, environmental Kuznet curve, institutional theory and Hofstede's cultural dimensions theory. Subsequently, the chapter substantiated these theoretical foundations with empirical evidence, establishing the relationships among green bonds, institutional framework and environmental performance. Lastly, the chapter addressed the gaps in the literature, the addition to current knowledge, and empirical explanations for the control variables included in the study.

CHAPTER THREE

RESEARCH METHODS

Introduction

The study approach used to examine the worldwide connection between institutional frameworks, environmental performance, and green bonds is described in this chapter. The research paradigm is used to outline the study's philosophical underpinnings at the beginning of the chapter. The research design and methods are then thoroughly explained. Subsequently, the chapter offers accurate definitions of crucial variables, together with their data sources and measurement methods, guaranteeing comprehensibility and reproducibility. The model's specifications are then given, along with explanations for its choice and fit with the study's goals. Data preparation, statistical analysis, and result interpretation procedures are covered in the last part, which also covers data processing and analysis methods.

Research Paradigm

A research paradigm, according to Guba and Lincoln (1994), is the fundamental collection of concepts, presumptions, and methods that guide researchers in their pursuit of knowledge. The current study, which attempts to look at the connection between institutional frameworks, environmental performance, and green bonds globally, is based on the positivist research paradigm. Based on the logical positivist school of thought, the positivist paradigm maintains that objective reality can be experimentally studied and exists apart from human experience (Crossan, 2003). This approach stresses the application of scientific approaches to social phenomena in order to discover generalizable principles and patterns (Bell, Bryman, & Harley, 2022). Positivism holds that knowledge is gained from bodily experience, evaluated using reason and logic, and empirically verifiable (Saunders, 2020).

In terms of research, this paradigm promotes the development of hypotheses based on prior research, which are then evaluated using quantitative data and statistical analysis (Neuman, 2014). The positivist method strives for objectivity, with researchers keeping separated from their study participants in order to reduce bias and assure the reliability and validity of their results (Phillips & Burbules, 2000). First of all, it enables the quantification and measurement of key variables such as green bond issuance, institutional framework indices, and environmental performance indicators, allowing strong statistical approaches to be used to analyse correlations and evaluate hypotheses (Zerbib, 2019).

Secondly, in line with the study's objective of finding broadly applicable patterns and causal relationships that might potentially support sustainable finance policy decisions and investment strategies (Flammer, 2021). The use of large-scale, cross-national datasets and econometric models is compatible with the positivist focus on empirical observation and quantitative analysis (Damian, Meuleman & van Oorschot, 2022).

Furthermore, the positivist paradigm's emphasis on theory testing and development is especially relevant to this study, because it has the potential to improve upon current beliefs of how green finance contributes to environmental sustainability while also potentially developing new theoretical frameworks (Schiederig et al., 2012). By using a positivist approach, this study can add robust, empirically-supported insights to the expanding body of literature on green bonds and environmental performance, laying the foundation for further investigation and policy development in this dynamic field. Ultimately, the study employs a positivist approach to accept or reject hypotheses, so assessing if institutional frameworks play a crucial part in the connection between green bonds and environmental performance in green bond issued countries

Research Design

This study adopts an exploratory research design, allowing for an in-depth investigation into the relationships between green bonds, institutional frameworks and environmental performance. The ability of exploratory research to dive deeply into the involvedness of the relationships under inquiry makes it a desirable research method. As noted by Creswell (2014), this method works especially well for complex phenomena to further understand this intricate relationship. An exploratory approach is required to fully understand the complex relationships between sustainable financial instruments, regulatory systems, and broader economic issues in the context of green bonds, institutional frameworks and environmental performance.

Research Approach

The three main types of research approaches are mixed, qualitative, and quantitative, according to Creswell (2014). In alignment with these approaches, this study opted for the mixed research approach. This decision was motivated by the fact that the institutional framework variable in the study falls under the qualitative category, in contrast, every other variable considered in this research is quantitative.

Data Collection Procedures

The study adopts a comprehensive data gathering method, with 71 countries chosen based on the availability of green bond data. Green bond data was obtained from Refinitiv accessed through the International Monetary Fund (IMF) database, while environmental performance metrics were obtained from the Environmental Performance Index (EPI). World Bank World Development Indicators served as the source of control variables. The Worldwide Governance Indicators provided the formal institutional framework data (WGI), whereas the informal institutional frameworks data came from Geert Hofstede's national culture matrix.

The research runs from 2007 to 2022, corresponding with the creation and expansion of the green bond market. This timeline was chosen to cover the whole history of green bond issuance, from its commencement in 2007 to the most current accessible data in 2022. This data gathering technique results in a complete dataset that includes financial, environmental, institutional, and cultural characteristics, offering a solid platform for examining the global relationship between green bonds, institutional frameworks, and environmental performance.

Model Specification

An effective econometric method for analysing dynamic panel data—where previous results impact present behaviors—is the Dynamic First Difference Generalized Method of Moments (GMM) model. Common problems like endogeneity and unobserved heterogeneity, which can skew estimates in conventional models, are addressed by this approach (Arellano & Bond, 1991). The study's objectives served as the basis for the model specifications, which were then expanded upon using the Environmental Performance Index's (EPI) three main policy objectives: mitigating climate change, preserving ecosystem health, and promoting environmental health.

The Dynamic GMM technique removes individual-specific effects from the data by first differencing it, making it possible to examine the correlations between variables across time more clearly. The GMM estimator is consistent and efficient since lagged values are used as instruments to assist account for any endogeneity (Blundell & Bond, 1998). This approach is especially useful for rigorous study of temporal dynamics and causal links in scenarios where data is gathered across different time periods from multiple entities. By taking environmental performance (EPI) with respect of all the dependent and control variables, the study expressed the following linear econometric models.

The original model is estimated in the form:

$$lnEPI_{it} = \beta_1 lnEPI_{it-1} + \beta_2 lnGB_{it} + \beta_3 lnX_{it} + \mu_i + \varepsilon_{it} \quad \ldots.. \quad (1)$$

Where

$lnEPI_{it}$ is the natural log of environmental performance for country *i* at time t

$lnEPI_{it-1}$ represent is the lag of environmental performance

$lnGB_{it}$ denotes natural log of green bonds issuance volume in country i at time t.

lnX_{it} represents the control variables in country i at time t

β_1, β_2 and β_3 denotes the coefficients

μ_i is the unobserved country specific effect (fixed effect)

ε_{it} is the error term.

To eliminate the unobserved country- specific effect, we first difference the equation.

$\Delta lnEPI_{it} = lnEPI_{it} - lnEPI_{it-1} = \beta_1(lnEPI_{it-1} - lnEPI_{it-2}) + \beta_2(lnGB_{it} - lnGB_{it-1}) + \beta_3(lnX_{it} - lnX_{it-1}) + \Delta\varepsilon_{it}$ …………………….. (1a)

Where:

$\Delta lnEPI_{it} = lnEPI_{it} - lnEPI_{it-1}$ is the first difference of the dependent variable.

$\Delta\varepsilon_{it} = \varepsilon_{it} - \varepsilon_{it-1}$ is the first difference of the error term.

In the first-difference model, $lnEPI_{it-1}$ can be correlated with $\Delta\varepsilon_{it}$ so we need to lagged the levels of $lnEPI, lnGB\ and\ lnX$ as instruments. The appropriate instruments in this case are:

$lnEPI_{it-2}$ (the second lag of the dependent variable)

$lnGB_{it-1}$, lnX_{it-1} (the lag of the independent variables)

To assess the relationship between green bonds and environmental performance, the model is then estimated as;

$\Delta lnEPI_{it} = \beta_1\Delta lnEPI_{it-1} + \beta_2\Delta lnGB_{it} + \beta_3\Delta lnX_{it} + \Delta\varepsilon_{it}$ ……….. (2)

The coefficient β_2 captures the direct effect of Green Bond Issuance (GB) on the Environmental Performance Index (EPI). Hypothesis H1: $\beta_2 > 0$, suggesting that increased green bond issuance is associated with improved environmental performance. In further assessing the relationship between green bond and environmental performance, the models were further developed using the three broad policy objectives of environmental performance.

$\Delta lnECO_{it} = \alpha_1\Delta lnECO_{it-1} + \alpha_2\Delta lnGB_{it} + \alpha_3\Delta lnX_{it} + \Delta\varepsilon_{it}$ …… (2a)

$\Delta lnHLT_{it} = \theta_1\Delta lnHLT_{it-1} + \theta_2\Delta lnGB_{it} + \theta_3\Delta lnX_{it} + \Delta\varepsilon_{it}$ ……… (2b)

$$\Delta lnCCH_{it} = \emptyset_1 \Delta lnCCH_{it-1} + \emptyset_2 \Delta lnGB_{it} + \emptyset_3 \Delta lnX_{it} + \Delta \varepsilon_{it} \quad \ldots\ldots \text{ (2c)}$$

Where

$\Delta lnECO_{it}$ denotes the change in log of Ecosystem vitality in country in at period t.

$\Delta lnHLT_{it}$ represents the change in the log of Environmental health country i in period t

$\Delta lnCCH_{it}$ denotes the change of the log of Climate Change mitigation

The second goal of this research was to assess how institutional frameworks and environmental performance of green bond issuing countries relate to one another. To do this, the model included interactions between institutional framework and environmental performance.

$$\Delta lnEPI_{it} = \beta_1 \Delta lnEPI_{it-1} + \beta_2 \Delta lnINFINSTF_{it} + \beta_3 \Delta FINSTF_{it} + \beta_4 \Delta lnINSTF_{it} + \beta_5 \Delta lnX_{it} + \Delta \varepsilon_{it} \quad \ldots\ldots\ldots \text{ (3)}$$

Further estimation was done on the three policy objectives of environmental performance as specified in the models below;

$$\Delta lnECO_{it} = \alpha_1 \Delta lnECO_{it-1} + \alpha_2 \Delta lnINFINSTF_{it} + \alpha_3 \Delta FINSTF_{it} + \alpha_4 \Delta lnINSTF_{it} + \alpha_5 \Delta lnX_{it} + \Delta \varepsilon_{it} \quad \ldots\ldots\ldots \text{ (3a)}$$

$$\Delta lnHLT_{it} = \theta_1 \Delta lnHLT_{it-1} + \theta_2 \Delta lnINFINSTF_{it} + \theta_3 \Delta FINSTF_{it} + \theta_4 \Delta lnINSTF_{it} + \theta_5 \Delta lnX_{it} + \Delta \varepsilon_{it} \quad \ldots\ldots \text{ (3b)}$$

$$\Delta lnCCH_{it} = \emptyset_1 \Delta lnCCH_{it-1} + \emptyset_2 \Delta lnINFINSTF_{it} + \emptyset_3 \Delta FINSTF_{it} + \emptyset_4 \Delta lnINSTF_{it} + \emptyset_5 \Delta lnX_{it} + \Delta \varepsilon_{it} \quad \ldots\ldots\ldots \text{ (3c)}$$

Where:

$\Delta lnEPI_{it}$ represents change in environmental performance indices in country i at time t.

$\Delta FINSTF_{it}$ represent the change in composite index for formal institutional framework

$\Delta lnINFINSTF_{it}$ denotes the change in the log of informal institutional framework.

$\Delta lnINSTF_{it}$ represent change in the log of institutional frameworks.

To evaluate the relationship between institutional frameworks and environmental performance of countries issuing green bonds, the study specifies the following coefficients: $\beta_{2,}$ β_3 and β_4 represent the direct effects of informal, formal and institutional frameworks on environmental performance, respectively. The hypothesis H2: $\beta_2 > 0$, $\beta_3 > 0$ and $\beta_4 > 0$, suggests that stronger formal and informal institutional frameworks are positively associated with improved environmental performance.

To examine how formal and informal institutional frameworks moderate the relationship between green bonds and environmental performance, the following models were specified

$$\Delta lnEPI_{it} = \beta_1 \Delta lnEPI_{it-1} + \beta_2 \Delta lnGB_{it} + \beta_3 \Delta lnINSTF_{it} + \beta_4 \Delta(lnGB_{it} \times lnINSTF_{it}) + \beta_5 \Delta lnX_{it} + \Delta\varepsilon_{it} \quad \text{...........} \quad (4)$$

$$\Delta lnECO_{it} = \alpha_1 \Delta lnECO_{it-1} + \alpha_2 \Delta lnGB_{it} + \alpha_3 \Delta lnINSTF_{it} + \alpha_4 \Delta(lnGB_{it} \times lnINSTF_{it}) + \alpha_5 \Delta lnX_{it} + \Delta\varepsilon_{it} \quad \text{..........} \quad (4a)$$

$$\Delta lnHLT_{it} = \theta_1 \Delta lnHLT_{it-1} + \theta_2 \Delta lnGB_{it} + \theta_3 \Delta lnINSTF_{it} + \theta_4 \Delta(lnGB_{it} \times lnINSTF_{it}) + \theta_5 \Delta lnX_{it} + \Delta\varepsilon_{it} \quad \text{...........} \quad (4b)$$

$$\Delta lnCCH_{it} = \emptyset \Delta CCH_{it-1} + \emptyset_2 \Delta lnGB_{it} + \emptyset_3 \Delta lnINSTF_{it} + \emptyset_4 \Delta(lnGB_{it} \times lnINSTF_{it}) + \emptyset_5 \Delta lnX_{it} + \Delta\varepsilon_{it} \quad \text{.......} \quad (4c)$$

Where, $lnGB_{it} \times lnINSTF_{it}$ represents the interacting term of the natural log of green bonds and institutional framework variable.

The coefficients β_4 capture the interaction effects between Green Bond Issuance and institutional frameworks. Hypothesis H3: β_4 > 0, suggesting that stronger institutional frameworks enhance the positive effect of green bonds on environmental performance.

Data Processing Tool and Analytical Technique

The data were processed using E-views version 12.0, and the models were estimated in the study using the Difference General Method of Moments (D-GMM) panel estimator. Since its creation by Hansen in 1982, the Generalized Method of Moments (GMM) has grown in prominence as an estimate technique in econometrics, particularly for models including dynamic panel data. The moment technique, which is predicated on the idea of matching sample moments to their population equivalents, is generalized by the GMM.

The selection of Generalized Method of Moments (GMM) over other instrumental variable (IV) estimators is supported by several advantages. GMM is flexible, accommodating lagged variables as instruments, which is beneficial in dynamic panel data models. It effectively addresses endogeneity by utilising valid instruments that correlate with endogenous regressors but not the error term (Arellano & Bover, 1995). Additionally, GMM provides asymptotically efficient estimates, yielding more precise results than traditional methods such as two-stage least squares (2SLS) (Blundell & Bond, 1998). It also controls for unobserved heterogeneity and is robust to weak instruments by employing multiple instruments

(Roodman, 2009). These strengths make GMM a powerful tool for analysing causal relationships in complex data structures.

Some studies, however, indicate that the usual first-difference GMM estimator (Arellano & Bond, 1991) can provide biased and inaccurate estimates when the regressors are persistent across time (Blundell & Bond, 1998). This is because the lagged values of the variables may be poor instruments for the first-differenced equations, resulting in finite sample bias. To solve this problem, Blundell and Bond (1998) created the System GMM estimator, which integrates the first-differenced equations with the level equations and use both lagged levels and lagged differences as instruments. This system method has been found to give more efficient and reliable estimates in the presence of persistent regressors, making it especially relevant for this study on the relationship between green bonds, institutional framework and environmental performance.

The study used a thumb rule to choose between System GMM and Difference GMM, in line with Bond et al. (2001). The lag dependent variable was included as a regressor, and the model was estimated using Pooled OLS, Fixed Effects, and Difference GMM in order to evaluate any potential bias in our estimations. The possible overestimation brought on by the bias from the missing variable was represented by the Pooled OLS coefficient, which was used as an upper bound. To account for unobserved variability, the Fixed Effects coefficient functioned as a lower bound. As a general rule, if the Difference GMM coefficient was higher than the Fixed Effects coefficient, it meant that the model was well-instrumented and that using Difference GMM was the right decision. On the other hand, if the Fixed Effects coefficient is higher than the Difference GMM coefficient, it suggests a downward bias favoring System GMM because of inadequate instrumentation. The Difference GMM coefficients consistently outperformed the Fixed Effects coefficients based on the pre-estimation hence the decision to use the Difference GMM.

One key advantage of the first difference GMM is its ability to handle endogeneity, which is a typical problem with panel data where explanatory factors are associated with the error term. By converting data into first differences, FD-GMM efficiently reduces unobserved time-invariant heterogeneity, which can skew results (Arellano & Bond, 1991; Roodman, 2009). Furthermore, FD-GMM simplifies the instrument structure by depending solely on the differenced variables' lagged values, lowering the danger of overfitting associated with an excessive number of instruments, as may occur in System GMM (Blundell & Bond, 1998). Furthermore, focusing on first differences might improve estimate robustness, particularly when the data shows substantial persistence or trends (Durlauf & Johnson, 1995).

Two critical diagnostic tests were performed: the Arellano-Bond serial correlation test and the Hansen J test, in order to ensure the validity of the GMM estimations. By investigating the null hypothesis that the instruments have no correlation with the error term, the Hansen J test evaluates the instruments' overall validity. According to Hansen (1982), a high p-value indicates that the instruments are real and do not overfit endogenous variables. The presence of autocorrelation in the differenced residuals is confirmed by the Arellano-Bond test for serial correlation (Mileva, 2007), in particular, the first- and second-order autocorrelation research test. According to Arellano and Bond (1991), the instruments' validity and the model specification are supported by the lack of second-order autocorrelation (AR (2)) in the differenced residuals. The robustness and dependability of the study's GMM estimations depend on the results of these diagnostic tests.

Measurement of Variables

All of the variables' selections for measurement were influenced by how frequently they were used in the body of current literature. The environmental performance index was used to measure the dependent variable, environmental performance. The amount of green bonds issued by each nation served as the independent variable. Using principal composite factor analysis (PCA), an index of the six global governance indicators—corruption control, government efficacy, political stability and lack of violence, rule of law, regulatory quality, and voice and accountability—was created to assess the formal institutional framework. The World Bank provides a thorough explanation of these factors, which is supported below:

The term "control of corruption" refers to the "capture" of the state by elites and private interests, as well as the use of public power for private gain, both small-scale and large-scale. The terms "public service quality," "civil service independence," "policy creation and implementation," and "government adherence to policies" all relate to the efficacy of government. Political stability and the absence of violence are used to gauge perceptions of political instability and violence, such as terrorism.

The concept of the "rule of law" refers to how much people believe in and follow social norms, particularly when it comes to the reliability of the police, courts, property rights, and contract enforcement, as well as the probability of crime and violence. Perceptions of the government's capacity to create and carry out sensible laws and regulations that allow and encourage the growth of the private sector are reflected in regulatory quality. The freedom of expression, association, and the media, as well as the ability of individuals to select their government, are all included in the notion of voice and accountability.

The six cultural dimensions —power distance, individualism, motivation for achievement and success, uncertainty avoidance, long-term orientation, and indulgence —from Geert Hofstede's national culture matrix were used to measure the informal institutional framework using principal component factor analysis. These aspects were defined as follows by Geert Hofstede's national culture matrix: The degree to which less powerful members of a nation's institutions and organizations anticipate and accept that power is divided unevenly is known as the "power distance." The level of interconnectedness that a society's members retain is addressed by individualism. It has to do with whether or not "I" or "We" define a person's sense of self.

A high score (Decisive) on this dimension denotes a society that is motivated by competition, achievement, and success, with the winner or best in the field serving as the definition of success. This is an example of a value system that permeates education and permeates organizational life. When a dimension has a low score (Consensus-oriented), it indicates that quality of life and compassion are the prevailing values in the community. In a culture that values consensus, living a high-quality life is a sign of success, and differentiating oneself from the majority is not viewed favorably. What drives people —to be the greatest (Decisive) or to enjoy what they do (Consensus-oriented) —is at the core of this problem.

Uncertainty avoidance is the idea of how a society reacts to the unknown nature of the future: should we try to control it or should we just let it happen? This uncertainty is accompanied by unease, which various civilizations have learned to deal with in different ways. The degree to which a culture's members have established institutions and beliefs in an effort to avoid uncertain or unexpected conditions is gauged by the uncertainty avoidance score.

Long-term orientations: this section illustrates how, in order to handle the problems of the present and the future, any society must maintain certain connections to its historical past. These two existential goals are prioritized differently in different cultures. Normative cultures, for example, score low on this dimension because they prefer to preserve ingrained practices and are wary of societal change. Societies that score highly on the practical side, on the other hand, promote modern education and economical living as ways to get ready for the future. The indulgence dimension refers to how much a person tries to control their desires and urges as a result of their background. Whereas "restraint" refers to relatively tight control, "indulgence" alludes to relatively poor control. Cultures might therefore be classified as lavish or restricted.

The three macroeconomic variables that the research accounts for are trade, population growth, and economic growth. The variables' sources and methods of measurement are displayed in the table below.

Description of Variables and Source of Data

Table 1. *Variable description*

Variables	**Description**	**Source**
EPI	Environmental Performance Index	Yale University Environmental Performance Index website.
GB	Volume of Green Bond issuance (Billion USD)	Refinitiv. Accessed through IMF
INFINSTF	Informal institutional frameworks index	Geert Hofstede's national culture matrix
FINSTF	Formal institutional frameworks index	WGI, 2007 – 2022
INSTF	Institutional Framework Index	WGI, WDI 2007-2022
GDPG	GDP growth (%)	WDI ,2007 – 2022
POPG	Population growth (%)	WDI ,2007 – 2022
TRADE	Trade (% of GDP)	WDI ,2007 – 2022
ECO	Ecosystem Vitality Index	Yale University Environmental Performance Index website.
HLT	Environmental Health Index	Yale University Environmental Performance Index website.
CCH	Climate Change Mitigation Index	Yale University Environmental Performance Index website.
PD	Power Distance	Geert Hofstede's national culture matrix
IN	Individualism	Geert Hofstede's national culture matrix
MTA	Motivation Towards Achievement and Success	Geert Hofstede's national culture matrix

UA	Uncertainty Avoidance	Geert Hofstede's national culture matrix
LTO	Long Term Orientation	Geert Hofstede's national culture matrix
IND	Indulgence	Geert Hofstede's national culture matrix
CC	Control of Corruption (Estimate)	WGI, 2007 – 2022
GE	Government Effectiveness (Estimate)	WGI, 2007 – 2022
PS	Political Stability and Absence of Violence/Terrorism	WGI, 2007 – 2022
RL	Rule of Law	WGI, 2007 – 2022
RQ	Regulatory Quality	WGI, 2007 – 2022
VC	Voice and Accountability	WGI, 2007 – 2022

Notes: WDI: World Development Indicators; WGI: World Governance Indicators

Source: Field survey, Segbe (2024)

Endogeneity

Least Squares (OLS) are used to estimate the model in the test. The suspected endogenous variable is then regressed on the other independent variables and the residuals from the original OLS regression. Endogeneity is indicated if the residuals have a significant effect on the suspected variable. The null hypothesis is rejected in the event of a significant DWH test result, proving endogeneity and indicating the need for more dependable approaches such as the Generalized Method of Moments (GMM) or Two-Stage Least Squares (2SLS). This guarantees the analysis's robustness and improves the understanding of the relationships between the study's variables.

Chapter Summary

This chapter provided an explanation of the research methods that were employed to conduct the study. The quantitative research methodology and positivist research paradigm serve as the study's foundations. An explanatory research technique was also employed in the study to comprehend the relationships between green bonds and environmental performance as well as the moderating effect of formal and informal institutional frameworks. It should be noted that because of data availability, only 71 countries from the global economy were included in the study. Three main baseline models were created by the study, and they were subsequently expanded into several sub models. As it accounts for endogeneity, the Generalized Method of Moment estimation approaches were primarily used in the study to estimate all the models.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The empirical results of the study on the moderating effect of institutional frameworks in the link between environmental performance and green bonds are compiled and examined in this chapter. The chapter opens with a detailed summary of descriptive data for all variables, followed by a correlation matrix to investigate variable connections and solve potential multicollinearity concerns in the empirical specifications. The chapter then proceeds to discuss in detail the results from the three main models. While the second model looks at the influence of formal and informal institutional frameworks on environmental performance, the first model examines the link between environmental performance and green bonds. The third model considered the moderating role of institutional frameworks on green bonds and environmental performance. Each model's results are thoroughly examined, interpreted, and examined in the context of the body of current knowledge and theoretical predictions.

Descriptive Statistics

Because some of the variables' data for 124 nations were unavailable, the descriptive statistics are only available for a sample of 71 out of the 195 countries in the world. Appendix A is a list of the sample nations that were part of the investigation. The number of observations, the mean (average), the standard deviation (a measure of the dispersion or spread of the variable's values around the mean), which provides insight into the degree of variability, and the minimum and maximum values for each variable —which illustrate the range of the data, skewness which measures the asymmetry of the distribution the variables, kurtosis

Table 2: Descriptive Statistics of the variables

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.	J-Bera
EPI	1136	61.952	17.468	0	95.511	-1.167	5.174	481.56
GB	1136	1.791	7.607	0	111.807	8.052	85.372	333,438.97
INFINSTF	1132	33.467	6.319	19.05	44.846	-0.417	2.486	45.27
FINSTF	1132	0.964	0.878	-1.13	2.883	0.198	2.534	17.64
INSTF	1132	25.328	4.767	14.03	33.798	-0.429	2.503	46.37
GDPG	1136	2.715	4.187	-29.1	24.475	-1.036	8.851	1,823.63
POPG	1136	0.785	1.429	-14.3	18.128	3.171	57.289	141,409.11
TRADE	1136	95.156	63.87	0	437.327	1.828	8.212	1,918.48
HLT	1136	65.187	25.828	0	100	-0.703	2.671	98.69
ECO	1136	53.33	18.174	0	95.092	-0.926	4.203	230.85
CCH	1136	52.986	22.096	0	99.24	-0.548	3.042	56.94
PD	1136	59.51	21.772	11	100	-0.168	2.304	28.27
IN	1136	48.514	24.4	0	100	-0.154	2.06	46.31
MTA	1136	47.287	19.561	5	100	0.022	3.213	2.24
UA	1136	67.699	21.82	8	100	-0.439	2.311	58.96
LTO	1136	42.416	21.214	0	100	-0.163	2.86	5.96
IND	1136	42.305	23.796	0	97	-0.087	2.212	30.82
CC	1132	0.541	1.015	-1.28	2.435	0.176	1.822	71.30
GE	1132	0.659	0.87	-1.79	2.47	-0.183	2.114	43.34
PS	1132	0.229	0.897	-2.81	1.62	-0.887	3.164	149.71
RL	1136	0.581	0.927	-1.22	2.125	-0.065	1.708	79.81
RQ	1136	0.647	0.865	-1.42	2.252	-0.298	2.028	61.53
VC	1132	0.499	0.906	-1.82	1.775	-0.814	2.695	129.40

Source: Field survey, Segbe (2024)

Note: Environmental Performance is represented by the Environmental Performance Index (EPI). Green Bonds as measured by the volume issued by various nations are represented by GB. The composite Informal Institutional Framework variable, or INFINSTF, is based on six cultural traits for measurement. Power Distance (PD), Individualism (IN), Motivation towards Achievement and Success (MTA), Uncertainty Avoidance (UA), Long-Term Orientation (LTO), and Indulgence (IND) are the six cultural aspects. The six Formal Institutional Frameworks (FISTF) are comprised of the following: Regulatory Quality (RQ), Political Stability and Absence of Violence (PS), Government Effectiveness (GE), Rule of Law (RL), and Control of Corruption (CC). Population growth is represented by POPG, trade as a proportion of GDP is represented by TRA, and GDPG stands for GDP growth rate.

which measures the 'tailedness' of the distribution compared to a normal distribution Jarque-Bera test that uses both skewness and kurtosis to assess normality —are all included in this section's descriptive statistics.

According to Table 2's descriptive statistics, green bond (GB) variable exhibits a mean value of USD1.79b, indicating a relatively low average level of green bond issuance across the sampled countries. However, the substantial standard deviation of 7.607 and the wide range between the minimum (USD0) and maximum (USD111.81b) values reveal significant variability in green bond adoption. This disparity suggests that while some nations have embraced green bonds as a sustainable financing tool, others are yet to fully utilise this instrument. When examining the institutional framework variables, an interesting contrast emerges. The formal institutional framework (FINSTF) shows a mean of 0.96 and a standard deviation of 0.88, indicating moderate levels of formal institutional frameworks on average, with significant differences between countries. In contrast, the informal institutional framework (INFINSTF) has a much higher mean of 33.47 and a standard deviation of 6.32, suggesting that informal institutions are generally stronger than formal ones across the sample.

The Environmental Performance Index (EPI) presents a mean value of 61.95 and a standard deviation of 17.47. This suggests that, on average, the sampled countries exhibit moderately high levels of environmental performance. However, the substantial variation in the data implies significant disparities in environmental outcomes across nations.

Regarding skewness, kurtosis, and the Jarque-Bera test, starting with EPI, the skewness of -1.167 indicates a leftward asymmetry, highlighting that many countries score lower in environmental performance, while a few achieve significantly higher scores. The kurtosis of 5.174 suggests a leptokurtic distribution, meaning there are more extreme values than in a normal distribution. This is further supported by the Jarque-Bera statistic of 481.56, which indicates that the EPI does not follow a normal distribution, largely due to the influence of outliers.

In the case GB, the skewness of 8.052 suggests a strong positive skew, where most countries have issued low volumes of green bonds, but a few countries dominate with exceptionally high issuance. The kurtosis of 85.372 indicates heavy tails and a pronounced peak, pointing to significant outliers. Similar patterns are observed in GDPG and POPG, with GDPG showing a skewness of -1.036 and POPG exhibiting a skew of 3.171. Both variables have significant Jarque-Bera statistics, indicating non-normal distributions. Collectively, these findings underscore the complexity and diversity of environmental and economic performance across countries, highlighting the need for further analysis to understand the underlying factors influencing these distributions.

To enhance an understanding of the relationship between green bonds issuance, institutional frameworks and environmental performance globally, the study also presented the descriptive statistics of each of the six cultural dimensions for the informal institutional frameworks and the six indicators of governance for the formal institutional frameworks. Power distance and individualism had averages of 59.51 within the limit of 11 to 100 as well as 48.51 within the limit of 0 and 100, respectively. Motivation towards achievement & success and Uncertainty avoidance also have a mean score of 47.29 within the limit of 5 and 100 as well as 67.70 within the limit of 8 and 100, respectively. In addition, Long term orientation and indulgence presents an average of 42.42 within the limit of 0 and 100 as well as 42.31 within the limit of 0 and 97, respectively.

Additionally, the formal institutional framework indicators display the following data. Government effectiveness and corruption control have respective means of 0.54 with limits of -1.28 and 2.24 and 0.66 with limits of -1.786 and 2.47. The mean values for political stability, lack of violence/terrorism, and rule of law are 0.23 and 0.58, respectively, within the ranges of -2.81 and 1.62 and -1.22 and 2.13. On the other hand, regulatory quality and voice & accountability have a mean of 0.65 with the range of -1.42 and 2.25 as well as 0.50 within the limit of -1.82 and 1.78 respectively.

The descriptive statistics of the three-broad category of EPI which are ecosystem vitality, environmental health and climate change mitigation have a mean score of 53.33 within the range of 0 and 99.09, 65.19 within the limit of 0 and 100 as well as 52.99 with the range of 0 and 99.24 respectively. The control variables employed in the study – GDP growth, population size and trade have a mean score of 2.72, 0.79 and 95.16 with the limit of -29.1 and 24.48, -14.26 and 18.13 as well as 0 and 437.33 respectively.

These characteristics is vital for the subsequent regression analysis, as it ensures that the underlying assumptions of the statistical models are satisfied. It also highlights the heterogeneity in green bond adoption, institutional frameworks, and environmental performance across the sampled countries. This highlights the need for tailored policymaking and targeted interventions to address the unique challenges and opportunities in each country. The data provides a dense foundation for the empirical analysis, allowing the researchers to explore the complex interrelationships between these variables and uncover insights that can inform sustainable finance practices and environmental governance strategies.

Correlation Analysis

The correlation matrix presented in Table 3 offers valuable insights into the pairwise correlations among the significant variables examined in this research. Notable findings include the favorable correlation (0.22) between Green Bonds and Environmental Performance (EPI). This demonstrates that stronger environmental performance in the sample countries is correlated with higher levels of green bond issuance. This supports the idea that the development of environmentally friendly financial products, such green bonds, will produce better environmental outcomes. Interestingly, the results show that EPI has a positive connection with both the Formal Institutional Framework (FINSTIF, 0.394) and the Informal Institutional Framework (INSTIF, 0.248). This suggests that stronger institutional frameworks, both formal and informal, are associated with higher environmental performance. This emphasizes the need of taking institutional frameworks into account when determining environmental performance.

Table 3: *Correlation matrix*

Variables	lnEPI(-1)	lnEPI	lnGB	lnINFINSTF	FINSTF	lnINSTF	lnGDPG	lnPOPG	lnTRADE	lnECO	lnHLT	lnCCH	lnPD	lnIN	lnMTA	lnUA	lnLTO	lnIND	CC	GE	PS	RL	RQ	VC
lnEPI(-1)	1																							
lnEPI	0.836**	1																						
lnGB	0.253**	0.22**	1																					
lnINFINSTF	0.245**	0.248**	0.374**	1																				
FINSTF	0.393**	0.394**	0.268**	0.228**	1																			
lnINSTF	0.255**	0.258**	0.378**	0.999**	0.267**	1																		
lnGDPG	-0.089**	-0.084**	0.001	-0.168**	-0.123**	-0.171**	1																	
lnPOPG	-0.029	-0.004	-0.162**	-0.111**	-0.092**	-0.112**	0.126**	1																
lnTRADE	-0.038	-0.03	-0.037	0.054*	-0.055*	0.056*	0.028	-0.079*	1															
lnECO	0.478**	0.529**	0.215**	0.106**	0.171**	0.111**	0.001	-0.023	0.043	1														
lnHLT	0.315**	0.408**	0.319**	0.171**	0.204**	0.174**	-0.126**	0.011	-0.128**	0.179**	1													
lnCCH	0.407**	0.455**	0.29**	0.098**	0.115**	0.1**	0.06	-0.062	0.079*	0.6	0.05	1												
lnPD	-0.378**	-0.373**	-0.166**	-0.11**	-0.601**	-0.129**	-0.022	-0.071*	0.118**	-0.167**	-0.151**	-0.115**	1											
lnIN	0.424**	0.428**	0.298**	0.747**	0.465**	0.759**	-0.143**	-0.064	0.062*	0.164	0.227	0.087	-0.453	1										
lnMTA	-0.111**	-0.119**	-0.007	-0.122**	-0.091**	-0.125**	0.043	0.009	-0.006	-0.021	-0.016	-0.054	0.205**	-0.218**	1									
lnUA	-0.011	-0.007	-0.123*	-0.131**	-0.142**	-0.136**	-0.076*	0.022	-0.02	-0.056	-0.02	-0.082**	0.181**	-0.001	0.098**	1								
lnLTO	0.163**	0.162**	0.368**	0.576**	0.22**	0.578**	-0.108**	-0.151**	0.179**	0.108**	0.234**	0.113**	-0.121**	0.401**	-0.183**	-0.192**	1							
lnIND	0.152**	0.148**	0.085	0.388**	0.181**	0.387**	-0.021	0.067	-0.229**	0.052	0.013	0.065*	-0.394**	0.224**	0.094**	-0.202**	-0.258**	1						
CC	0.474**	0.478**	0.327**	0.402**	0.73**	0.423**	-0.143**	-0.113**	0.004	0.168**	0.224**	0.118**	-0.656**	0.603**	-0.252**	-0.318**	0.24**	0.383**	1					
GE	0.455**	0.458**	0.329**	0.411**	0.682**	0.428**	-0.103**	-0.108**	-0.006	0.14**	0.238**	0.093**	-0.59**	0.578**	-0.18**	-0.327**	0.291**	0.32**	0.905**	1				
PS	0.384**	0.391**	0.195**	0.38**	0.597**	0.402**	-0.072*	-0.132**	0.156**	0.139**	0.165**	0.096**	-0.392**	0.617**	-0.21**	-0.155**	0.275**	0.176**	0.751**	0.681**	1			
RL	0.083**	0.085**	-0.102	-0.007	0.51**	0.027	-0.08*	0.118**	0.165**	0.072*	-0.003	-0.018	-0.22**	0.239**	-0.057	-0.085**	0.045	-0.132**	0.199**	0.218**	0.196**	1		
RQ	0.062*	0.063*	-0.164**	-0.085**	0.456**	-0.053	-0.047	0.067*	0.11**	0.038	-0.037	-0.062*	-0.182**	0.167**	-0.11**	-0.025	-0.017	-0.16**	0.135**	0.147**	0.14**	0.924**	1	
VC	0.472**	0.479**	0.235**	0.32**	0.645**	0.334**	-0.13**	-0.052	0.034	0.194**	0.215**	0.16**	-0.595**	0.524**	-0.178**	0.004	0.127**	0.374**	0.75**	0.687**	0.637**	0.119**	0.098**	1

Source: Field survey, Segbe (2024)

With the lag EPI, there is a positive relationship with a coefficient of 0.836, 0.253, 0.245, 0.393 and 0.255 for lnEPI, lnGB, InINFINSTF, FINSTF and lnINSTF respectively indicating how past environmental performance impact the current outcome. Further examination of the correlation matrix reveals insightful relationships among key variables. The formal institutional framework demonstrates a positive correlation with the informal institutional framework of 0.228, suggesting a complementary relationship between these two aspects of institutional frameworks. This finding implies that countries with stronger informal institutions, such as cultural norms and social conventions, tend to also have more robust formal institutions, including legal and regulatory frameworks.

Moreover, the informal institutional framework combined shows a positive correlation with Green Bonds (GB, 0.374), indicating that countries with stronger informal institutional structures are more likely to embrace green finance instruments. This relationship highlights the importance of cultural and social factors in fostering the adoption of sustainable financial practices.

Interestingly, the variable representing GDP growth (GDPG) exhibits negative correlations with informal institutional framework (-0.168). These negative associations suggest that rapid economic growth may not always be accompanied by a strengthening of institutional structures. This finding highlights a potential strain between economic development and institutional frameworks, presenting an intricate challenge for policymakers. Additionally, the data reveals a weak negative correlation between Trade and the formal institutional framework (-0.055) but a weak positive relationship between informal institutional framework

(0.054). This hints at the potential role of trade openness in shaping institutional development, which warrants further investigation.

Endogeneity test results

The results of the endogeneity test, which are presented in Appendix B, show that the dependent variable, the log of the Environmental Performance Index (lnEPI), is not substantially affected by any of the residuals from the models that were studied. There is no statistical significance shown by the residuals for the independent variables, lnGB, lnGDP, lnPOPG and lnTRADE, all of which have p-values larger than 0.05. This demonstrates that the independent variables are exogenous, removing any endogeneity bias concerns when using Ordinary Least Squares (OLS) estimations. Despite the absence of endogeneity, the study chose to use the GMM. This decision is based on GMM's advantages, such as its efficiency in producing reliable estimates, its robustness against model specification errors, and its ability to handle complex error structures. Using GMM enhances the robustness and depth of the analysis, providing a more comprehensive understanding of the factors influencing environmental performance.

Regression results on the relationship between green bonds, institutional frameworks and environmental performance.

This section presents and discusses the empirical results regarding the study's aims. Tables 4 through 12 show the results of the regression. Table 4 displays the findings of the three environmental performance subcategories and the independent association between green bonds and environmental performance. The outcomes of the formal and informal institutional frameworks on environmental performance are shown in Table 5 when viewed globally. The findings on the moderating function of institutional frameworks in the connection between environmental performance and green bonds are displayed in Table 6. The several indicators of institutional frameworks that moderate the link between green bonds and environmental performance, as well as the environmental performance subcategories, are finally shown in Tables 7 through Table 12.

The impact of green bond issuance on environmental performance and its subcategories is displayed in the table below. As per the study's primary goal, Table 4's Model 2 column presents the findings regarding the relationship between green bonds and environmental performance. Models 2a, 2b, and 2c, on the other hand, illustrate the relationships between green bonds and ecosystem vitality, environmental health, and climate change mitigation, respectively.

Green Bonds and environmental performance

At the 1% significance level, the regression findings in Model 2 demonstrate a positive and statistically significant association between green bonds (GB) and environmental performance. In particular, the coefficient of 0.0563 shows that, when all other variables are held constant, a 1% increase in the issuance of green bonds is linked to a 0.0563% improvement in environmental performance (Table 4, Model 2). Therefore, the findings are consistent with the first hypothesis, which proposed by Kuznets in 1955 and then further developed by Grossman and Krueger in 1991.

As the three main categories that made up the environmental performance index, green bonds, ecosystem vitality, environmental health, and climate change mitigation, respectively, also show a statically significant and positive relationship at the 1% level in Table 4's models 2a, 2b, and 2c. This result aligns with previous

Table 4: *The relationship between green bonds and environmental performance*

Model name:	2	2a	2b	2c
Dep. Var:	lnEPI	lnECO	lnHLT	lnCCH
lnEPI(-1)	0.1468			
	(0.0000)**			
lnECO(-1)		0.3754		
		(0.0002)**		
lnHLT(-1)			0.4969	
			(0.0001)**	
lnCCH(-1)				0.3393
				(0.0010)**
lnGB	0.0563	0.0482	0.0939	0.1782
	(0.0001)**	(0.0003)**	(0.0003)**	(0.0041)**
Control Var.				
lnGDPG	0.141	-0.0581	0.4979	-0.3757
	(0.0001)**	(0.0052)**	(0.0006)**	(0.0336)**
lnPOPG	-0.0064	0.0862	-0.0871	-0.0121
	(0.0000)**	(0.0003)**	(0.0001)**	(0.0044)**
lnTRADE	-2.0928	-0.5045	-0.6643	-1.0227
	(0.0012)**	(0.0120)**	(0.0021)**	(0.0670)**
Diagnostics				
Observations:	671	704	664	672
J-stat.	53.59619	60.91261	61.97394	54.68622
Prob (J-stat)	0.566393	0.33705	0.336341	0.5247
AR (2)	0.4733	0.4478	0.2301	0.9938
Instrument	61	62	63	61

Source: Field survey, Segbe (2024)

Note: For every model, the lag of the log of the dependent variables is represented by lnEPI(-1), lnECO(-1), lnHLT(-1) and lnCCH(-1). The logarithms of green bonds are represented by lnGB, GDP by lnGDPG, population growth by lnPOPG, and trade as a percentage of GDP by lnTRADE. With the exception of the diagnostics section, all numbers in brackets are the standard errors of the coefficient values; values outside of brackets denote the coefficient values; ** denotes significance at 1% and * denotes significance at 5%. As indicated in the diagnostics part of Table 4, the values of the observations, Hansen test (J-statistics), p-values, p values of AR (2), and number of instruments are presented in the diagnostics section in that sequence.

holds that the issue of green bonds improves environmental performance. This is because, as economies begin to develop, attention would not be on the environment but rather economic growth, however, as they advance, they start to worry about how economic growth is affecting the environment. This forces them to search for sustainable solutions to counter the threat that climate change poses to society, and this is the central claim of the environmental Kuznets curve, which was first research showing that green financial instruments have a beneficial effect on environmental outcomes (Fatica & Panzica, 2021; Flammer, 2021; Yeow & Ng, 2021).

For example, Zerbib's (2019) study looked at how issuing green bonds affected environmental performance and found a significant positive relationship, suggesting that green bonds can effectively channel funds towards sustainable projects and initiatives. Similarly, Flammer (2021) analysed the impact of green bond announcements on firm-level environmental performance and reported a positive and statistically significant effect, highlighting the role of green bonds in driving environmental performance.

Moreover, Yeow and Ng (2021) synthesised the results of several research and concluded that improved environmental performance is positively correlated with the growth of green bond markets. These studies offer solid factual support for the idea that green bonds may be a useful instrument for resolving environmental issues and advancing sustainable development.

The association between green bonds and environmental performance was shown to be positive and statistically significant, indicating that nations with larger green bond markets often have better environmental results. This is explained by the fact that green bond financing can direct funding toward environmentally friendly projects and activities, which in turn help to improve environmental indicators like biodiversity preservation, air quality, water management, and climate change mitigation in a noticeable way (Deschryver & de Mariz, 2020).

Environmental performance can also be influenced by the signaling impact of green bond issue. The issuance of green bonds can serve as a signal of a nation's dedication to environmental stewardship and sustainability. This could have an impact on the actions of investors and policymakers, encouraging them to prioritize and support environmentally friendly initiatives going forward (Flammer, 2021). Based on continuing discussions, the study rejects the null hypothesis, which states that there is no significant positive relationship between green bond issuance and environmental performance for the period under consideration, and finds that there is a significant positive relationship between green bond issuance and environmental performance globally. This is because these bonds are channeled toward projects that are environmentally friendly or help improve the environment and help reduce the environmental threats as a result of climate change and economic development and some human activities that harm the environment.

Results on the control variables for assessing the effects of green bonds on environmental performance.

The GDP growth, population growth, and trade as a proportion of GDP are the three macroeconomic variables that are controlled for in all of the models in Table 4. In models 2 and 2b, GDP—a measure of economic growth—had a positive impact on environmental performance; in models 2a and 2c, however, it had a negative impact. Which regards to model 2c 1% increase in economic activity would results in 0.3757% increase in climate effect on the environment and also 1% growth in GDP would lead to 0.0581% reduction in the ecosystem vitality. This is because initially, economic expansion leads to increased environmental degradation, but as incomes rise, demand for environmental protection grows, and technological innovations emerge, environmental quality begins to improve (Stern, 2004; Dasgupta et al., 2002). That is an increased industrial activity and energy consumption may result from rapid economic growth, which could raise CO_2 emissions.

Population growth on the other and has a negative effect on environmental performance as shown in models 2, 2b and 2c. This is because higher populations often result in increased resource consumption and waste generation, aggravating environmental degradation (Ehrlich & Holdren, 1971). According to studies, population growth increases strains on natural resources, leading to deforestation, biodiversity loss, and greater greenhouse gas emissions (Dietz & Rosa, 1997).

The third control variable also shows a negative effect on environmental in all the models in table 4. That is as countries engage in a lot of trade which a result of economic activities without a proper regulatory control, it would have a negative impact on the environment. Also, the pollution haven theory proposes that polluting firms move to nations with low environmental restrictions (Cole, 2004). Trade can also have an environmental impact due to scale, content, and method impacts (Grossman & Krueger, 1991). The scale impact normally increases environmental deterioration as production grows, but composition and method effects can enhance or degrade environmental quality depending on the context (Antweiler, Copeland & Taylor, 2001).

Diagnostics on the models assessing the relationship of green bonds and environmental performance

The diagnostics for the GMM models in table 4 indicates robust and significant relationship between the dependent variables. The validity and lack of correlation between the instrumental variables and the error term in the models is demonstrated by the Hansen-J test of overidentifying limitations. The p-values for this test are well above the conventional significance levels for all four models, indicating that the instruments are appropriate (Baum, Schaffer & Stillman, 2003). Furthermore, the AR (2) tests show no significant second-order autocorrelation, further supporting the robustness of the models.

Formal and informal institutional frameworks and environmental performance.

The regression result of institutional framework and environmental performance are presented in table 5. Institutional frameworks are divided into two, namely informal and formal institutional frameworks in this study. At the 1% significance level, the findings of the regressions shown in Models 3b and 3c demonstrate a positive and statistically significant association between the performance of environmental health and climate change and the informal institutional framework. The coefficients of 59.95 and 67.07 suggests that a 1-unit increase in the informal institutional framework is associated with a 59.95% and

67.07% increase in environmental heath quality and climate change mitigation, holding all other factors constant (Table 5, Model 3b and 3c). This result is in line with the body of research that highlights the key influence of informal institutions in determining environmental impacts.

The study by Lu and Wang (2021) conclude that environmentally, nations that exhibit low power distance, individualism, femininity, strong uncertainty avoidance, and long-term orientation do well. Similarly, the study by Enabulele and Ekhator (2022) indicated that in developing country contexts like Nigeria, informal institutions such as traditional norms, cultural values, and community-based practices can be just as important as formal regulations and monitoring mechanisms in shaping environmental outcomes. Their analysis suggests that strengthening both formal and informal institutional structures is necessary to enhance environmental protection and sustainability.

Moreover, Charles and Berkes' (2021) work on indigenous and local communities demonstrates how informal institutional arrangements, grounded in traditional environmental stewardship, can contribute to more effective biodiversity conservation and climate change adaptation. Also, when social norms and cultural values place a high value on environmental sustainability, individuals and organizations are more likely to internalize these values and make decisions that align with environmental goals (Huang, Leung, Eom & Tam, 2022). This can lead to greater adoption of environmentally-friendly practices, increased participation in community-based environmental initiatives, and stronger support for the implementation of environmental policies (Shah & Asghar, 2024). These studies provide a strong theoretical and empirical foundation for the positive relationship between informal institutional frameworks and environmental performance observed in the current analysis.

Furthermore, at the 1% significance level, the outcomes of Model 3c show a favorable and statistically significant relationship between the formal institutional structure and mitigating climate change. (Table 5, Model 3c) Given other components remain constant, the coefficient of 1.53 indicates that an increase of 1 unit in the formal institutional framework corresponds to a 1.53% increase in climate change mitigation. This result aligns with the body of research that emphasizes how formal institutions play a critical role in determining environmental outcomes.

Feng et al. (2024) examined the impact of environmental regulations and enforcement on air pollution and found that stronger formal institutions, such as well-designed policies and effective enforcement mechanisms, can lead to significant improvements in environmental performance. Similarly, Mahmutovic and Alhamoudi (2024) argued in their study on understanding the relationship between the rule of law and sustainable development showed that the quality of formal institutions, including the rule of law and regulatory quality is positively associated with environmental protection.

Furthermore, a review by Pacheco-Vega (2020) emphasised the importance of formal institutions, such as environmental laws, regulatory frameworks, and governance structures, in facilitating the implementation and success of environmental policies. These studies provide a solid foundation for the

Table 5*: The relationship between institutional frameworks and environmental performance*

Model name	3a	3b	3c	3
Dep. Var:	lnECO	lnHLT	lnCCH	lnEPI
lnECO(-1)	0.3581			
	(0.0011)**			
lnHLT(-1)		0.4682		
		(0.0005)**		
lnCCH(-1)			0.3462	
			(0.0006)**	
lnEPI(-1)				0.1421
				(0.0001)**
lnINFINSTF	-16.726	59.9526	67.0708	-15.32
	(0.8543)**	(0.4380)**	(2.7682)**	(0.0532)**
FINSTF	-2.7027	-3.1498	1.5317	-4.3595
	(0.0938)**	(0.0206)**	(0.1021)**	(0.0133)**
lnINSTF	143.2964	144.0532	-122.7987	303.5011
	(3.9700)**	(0.9589)**	(5.4974)**	(0.6609)**
Contol Var.				
lnGDPG	0.3074	0.263	-0.2006	-0.4613
	(0.0116)**	(0.0031)**	(0.0217)**	(0.0005)**
lnPOPG	0.0743	0.1121	-0.0863	-0.0458
	(0.0006)**	(0.0002)**	(0.0033)**	(0.0000)**
lnTRADE	-1.1324	-0.5627	-0.9687	-1.1264
	(0.0320)**	(0.0092)**	(0.0302)**	(0.0009)**
Diagnostics				
Observations:	651	661	677	676
J-stat.	54.53009	60.041	58.17086	58.92647
Prob (J-stat)	0.530665	0.36613	0.395358	0.368953
AR (2)	0.9999	0.9399	0.9921	0.3158
Instrument	63	64	63	63

Source: Field survey, Segbe (2024)

Note: The lags of the logs of the dependent variables in each model are lnEPI(-1), lnECO(-1), lnHLT(-1) and lnCCH(-1). The logs of Green Bonds (lnGB), GDP (lnGDPG), Population Growth (lnPOPG), and Trade (lnTRADE) as a percentage of GDP are all represented as logs. Apart from the diagnostics section, all values outside of brackets reflect the coefficient values; ** denotes significance at 1% and * denotes significance at 5%. All values within brackets are the standard errors of the coefficient values. The values of the observations, Hansen test (J-statistics), p-values, p values of AR (2), and number of instruments are shown in the diagnostics section in the following sequence, as indicated in the diagnostics section of Table 5.

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positive relationship between formal institutional frameworks and environmental performance observed in the current analysis.

In addition, the composite index for institutional framework also indicate a positive and statistically significant relationship with ecosystem vitality, environmental health and the overall environmental performance index at 1% significance level. The findings indicate that both informal and formal institutional frameworks play an important role in determining environmental performance. Policymakers should consider strengthening both informal and formal institutional frameworks as part of their environmental strategy. This entails promoting societal norms and cultural values that prioritize environmental sustainability, as well as drafting comprehensive environmental legislation, establishing strong regulatory organizations, and putting in place effective monitoring and enforcement procedures. The analysis rejects the null hypothesis that there is no significant relationship between institutional frameworks and environmental performance globally over the time under consideration based on the current discussion of the results.

Results of the control variables for the models assessing the relationship of institutional frameworks on environmental performance.

The macroeconomic factors that were accounted for in Table 4 were likewise controlled by the models in Table 5. GDP growth was found to have a coefficient of -0.461 and -0.201 at the 1% significance level for models 3 and 3c. This indicates that the environmental performance and climate change mitigation will decline by 0.461% and 0.201%, respectively, with a percentage rise in GDP.

For model 2c and model 2, population growth exhibited coefficients of -0.086 and -0.046 at the 1% significant level, respectively. According to this, a percentage increase in population would result in a 0.086% and 0.046% decrease in environmental performance and mitigation of climate change, respectively.

Trade as a percentage of GDP had coefficient of -1.1324, -0.5627, -0.9687, -1.1264 at 1% significant level in model 3a, 3b, 3c and 3 respectively. This implies that a percentage increase in trade would results in 1.1324% reduction in ecosystem vitality, 0.5627% decrease in environmental health, 0.9687% reduction in climate change mitigation and 1.1264 % reduction on the overall environmental performance.

Diagnostics on the models assessing the relationship of green bonds and institutional frameworks on environmental performance

Strong and substantial relationships between the dependent variables are shown by the diagnostics for each of the models in Table 5. The validity and lack of correlation between the instrumental variables and the error term in the models is demonstrated by the Hansen-J test of overidentifying limitations. According to Baum, Schaffer, and Stillman (2003), the instruments are suitable since the p-values for this test are much higher than the traditional significance levels for each of the four models. Moreover, there is no discernible second-order autocorrelation in the AR (2) tests, which adds to the models' resilience.

The moderating role of institutional frameworks in the relationship between green bonds and environmental performance.

Table 6 displays the results, which demonstrate how institutional frameworks have a moderating effect on the relationship between green bonds and environmental performance. Stronger institutional frameworks boost the favorable impact of green bonds on environmental performance, as indicated by the considerable positive coefficient of the interaction term (1.1512). This implies that the efficiency of green bonds in enhancing environmental results is increased when strong institutional frameworks are in place. But the inclusion of this interaction factor also highlights a significant shift in the green bonds variable's coefficient, which goes from a positive value of 0.056 in model 2 to a negative value of -3.815 in model 4. This striking contrast suggests that the potential advantages of green bonds are considerably mitigated by the existence of robust institutional frameworks, even while they may have a limited or even negative impact on environmental performance when used alone.

The partial differential of environmental performance with regard to green bonds may be used to evaluate the net effect of green bonds on environmental performance. When calculated as -3.8147 + 1.1512*INSTF, the net effect of green bonds on environmental performance is 25.3429 (or -3.8147 + 1.1512*25.328). In model 2, the coefficient of 0.056 is compared to the net effect of green bonds of 25.3429.

From a practical sense, these findings indicate that simply issuing green bonds is insufficient to assure improved environmental performance. Instead, the viability of green bonds is strongly dependent on the quality of the institutional frameworks that underpin them. This means that in order for green bonds to fully realise their potential for achieving beneficial environmental results, governments must focus on developing and strengthening effective regulatory and governance systems. Statistically, this net effect demonstrates the complex link between green bonds and environmental performance, underlining the importance of interaction factors in regression models. The move from a positive coefficient in model 2 to a substantial net effect in the presence of strong institutional frameworks demonstrates the importance of understanding these interactions.

Recent research has supported the relevance of institutional forces in green bond markets. For example, a research by Nguyen et al. (2023) discovered that nations with stronger regulatory quality, rule of law, and corruption control had a greater amount of green bond issuance. Similarly, Tolliver, Keeley and Managi (2020) found that nations with better institutions, as defined by the World Bank's Governance Indicators, have faster development in their green bond markets. These findings are consistent with the findings of the current study, demonstrating the universal importance of institutional frameworks in determining the environmental effect of green financing.

The findings of Model 4 highlight the necessity of improving institutional frameworks as a supplementary strategy for increasing the environmental efficacy of green bonds. Policymakers and market players should prioritize aspects such as the rule of law, regulatory quality, and corruption control in order to establish an enabling environment that can compound the beneficial environmental effect of

Table 6: *The moderating role of institutional framework on green bonds and environmental performance*

Model Name	4a	4b	4c	4
Dep. Var:	lnECO	lnHLT	lnCCH	lnEPI
lnECO(-1)	0.3669			
	(0.0005)**			
lnHLT(-1)		0.4821		
		(0.0002)**		
lnCCH(-1)			0.3414	
			(0.0011)**	
lnEPI(-1)				0.1224
				(0.0001)**
lnGB	-0.4816	-3.9612	2.0554	-3.8147
	(0.0125)**	(0.0132)**	(0.0968)**	(0.0176)**
lnINSTF	-2.9146	22.0929	-1.853	73.9779
	(0.2636)**	(0.0626)**	-1.55	(0.0877)**
Interaction	0.1552	1.161	-0.5976	1.1512
	(0.0038)**	(0.0039)**	(0.0296)**	(0.0054)**
Control Var.				
lnGDPG	0.2015	0.5155	-0.3476	-0.2094
	(0.0058)**	(0.0009)**	(0.0209)**	(0.0006)**
lnPOPG	0.051	0.0744	-0.0721	0.0015
	(0.0003)**	(0.0002)**	(0.0036)**	(0.0001)**
lnTRADE	-0.957	-0.6811	-0.9133	-1.6468
	(0.0172)**	(0.0017)**	(0.0341)**	(0.0020)**
Diagnostics				
Observations:	652	660	676	668
J-stat.	58.45201	64.68796	50.90493	56.38859
Prob (J-stat)	0.349828	0.284806	0.701774	0.349438
AR (2)	0.9598	0.951	0.9972	0.0899
Instrument	62	66	64	60

Source: Field survey, Segbe (2024)

Notice that the lag of the log of the dependent variables in each model is represented by the values lnEPI(-1), lnECO(-1), lnHLT(-1) and lnCCH(-1). The logs of Green Bonds (lnGB), GDP (lnGDPG), Population Growth (lnPOPG), and Trade (lnTRADE) as a percentage of GDP are indicative of several logarithmic quantities. All numbers outside of brackets reflect the coefficient values; ** denotes significant at 1% and * denotes significant at 5%. All values in brackets, with the exception of the diagnostics section, are the standard errors of the coefficient values. The diagnostics section displays the number of instruments, p-values, p values of AR (2), Hansen test (J-statistics), and observation values in the order indicated in Table 6's diagnostics section.

green financing efforts (Kapoor & Dhamija, 2017). By resolving institutional deficiencies, stakeholders may realise green bonds' full potential for supporting sustainable development and environmental protection.

Table 6 describes the moderating effects of interaction terms on the three major areas of the environmental performance index. Compared to the positive value of 0.0482 reported in model 2a, the green bonds variable in model 4a has a negative coefficient of -0.4816, which is caused by the introduction of the interaction term. This shift implies that although green bonds, when considered in isolation, could have a little positive impact on ecosystem health, their overall effectiveness is diminished when institutional frameworks are considered. The interaction term has a net impact of 3.44931 and a positive coefficient of 1.161 that is significant at the 1% level. This shows that strong institutional frameworks can improve the positive effects of green bonds on ecosystem vitality, even while the initial negative coefficient emphasizes the relevance of context.

In model 4b, which looks at environmental health, the interaction term has a coefficient of 1.161, greatly raising the net effect to 25.445 from the baseline coefficient of 0.0939 in model 2b. This considerable net effect suggests that strong institutional frameworks considerably magnify green bonds' beneficial influence on environmental health, illustrating the fact that policy and governance are crucial in achieving the potential advantages of green finance. In contrast, model 4c finds a negative coefficient of -0.5976 for the interaction term linked to climate change mitigation, resulting in a net effect of -13.081. This conclusion is especially disrupting since it means that the introduction of green bonds may not only fail to positively contribute to climate change mitigation efforts, but could even detract them when the institutional framework is unsupportive.

From a real-world viewpoint, our findings highlight the need of governments not just promoting green bonds, but also establishing strong institutional frameworks that can improve their efficacy across several dimensions of environmental performance. Strong governance, regulatory clarity, and enforcement measures are critical to ensuring that green bonds serve their intended purpose.

Results of the control variables for the models assessing the moderating role of institutional frameworks on the relationship between green bonds and environmental performance.

The results in Table 6 show that there are significant negative relationships that have an unfavorable influence on environmental performance. Notably, trade variable consistently has negative coefficients across all models, implying that higher trade volumes are linked to lower environmental consequences. For example, in model 4, the coefficient of -1.6468 indicates that greater commerce may cause environmental deterioration, possibly due to the environmental costs involved with transportation and manufacturing operations (Levinson, 2009). This pattern continues in models 4b and 4c, where values of -0.6811 and -0.9133 highlight the negative consequences of trade activities on environmental health and climate change mitigation, respectively (Cole, 2004).

Furthermore, in model 4 and 4c, the coefficient for GDP growth is negative at -0.2094 and -0.3476 respectively, showing that economic development may have a negative impact on environmental performance and climate change mitigation efforts, most likely due to increasing emissions and resource consumption that accompany industrial expansion (Stern, 2004). This pattern emphasises the significance of critically evaluating trade and economic growth policies, which may unintentionally contribute to environmental deterioration, as well as incorporating sustainability concerns into economic planning and decision-making.

Diagnostics on the models assessing the moderating role of institutional frameworks on the relationship between green bonds and environmental performance.

The diagnostic tests reported in Table 6 shed light on the robustness and validity of the models employed to evaluate the moderating influence of institutional frameworks on green bonds and environmental performance. The number of observations across the models ranges from 652 to 676, suggesting a big enough sample size to improve the reliability of the estimations. The J-statistic, which assesses the validity of the instruments used, returns p-values ranging from 0.2848 to 0.7018, all of which surpass the customary threshold of 0.05, indicating that we fail to reject the null hypothesis of instrument validity. This suggests that the instruments utilised in the models are appropriate and not overfitted, which supports the results' validity.

Moreover, second-order autocorrelation in the residuals is examined using the AR (2) test, with p-values ranging from 0.0899 to 0.9972. There is no significant second-order autocorrelation in any of the models. The robustness of the results is further enhanced by the fact that each model, which has between 60 and 66 instruments, seems to be proportionate to the number of observations. Collectively, these diagnostic tests confirm the models' suitability and dependability in assessing the intricate interactions between green bonds, institutional frameworks, and environmental performance.

Results of sub-indices for the models assessing the separate effects of institutional framework indicators on green bonds and environmental performance.

A composite institutional framework index is employed in the study presented in Table 6 above to derive broad conclusions. There could be certain institutional framework dimensions that are not included in the composite index, though, as PCA methods only keep the factor with the highest eigenvalue and discard the rest. In order to assess the relative significance of these elements in moderating the influence of green bonds on environmental performance, model 4 is re-estimated for each of the six sub-indices of the informal institutional frameworks and the six sub-indices of the formal institutional frameworks. All three of the environmental performance sub-indices had their sub-indices regressed. Precisely, the variable INSTF in model 4, 4a, 4b and 4c are, replaced by each of the sub-indices of the institutional frameworks. Table 7 to Table 12 presents the separate relationships of the sub- indices.

Ecosystem vitality and cultural dimension indicators.

Table 7 presents the results on the relationship between each of the six cultural dimensions on ecosystem vitality. Table 7's interaction terms indicate a multifaceted link between ecological health and numerous cultural dimension indicators, with net effects that show the diverse implications of these interactions. For example, in model 4a c1, the positive interaction term of 0.2621 yields a considerable net impact of 14.6194, demonstrating a strong positive association between the interaction of green ties and cultural factors and ecosystem health. Model 4a c2, on the other hand, has a negative interaction term of -0.2703, resulting in a net effect of -10.3079, implying that the interaction may harm ecosystem vitality in this situation.

Similarly, models 4a c3 and 4a c4 show negative net impacts of -14.5281 and -0.3450, showing that these specific interactions have an adverse effect on ecosystem sustainability. Models 4a c5, 4a c6, and 4a c7, on the other hand, have positive net effects of 2.7152, 2.8677, and 4.7501, indicating that specific combinations of cultural dimensions and green interactions can improve ecosystem health. The control variables give important information, especially those with negative coefficients. The variable Trade consistently has negative coefficients in all models, ranging from -1.2691 to -0.4279. This shows that greater commerce may have a negative impact on ecosystem viability, most likely owing to environmental degradation caused by increased production and transportation operations (Levinson 2009). This conclusion is consistent with previous research, such as those by Cole (2004), which emphasise the negative environmental effects of trade liberalization, and Jorgenson and Clark (2012), who highlight the severe ecological repercussions of global trade dynamics.

Furthermore, GDP growth has a negative coefficient in virtually all models, indicating that while economic expansion might improve ecosystem vitality, it can

Table 7: *The relationship between ecosystem vitality and cultural dimension indicators*

Model name	4a c1	4a c2	4a c3	4a c4	4a c5	4a c6	4a c7
Dep. Var:	lnECO	lnECO	lnECO	lnECO	lnECO	lnECO	lnECO
lnECO(-1)	0.3579	0.3707	0.3517	0.36	0.3611	0.3587	0.3808
	(0.0009)**	(0.0006)**	(0.0007)**	(0.0011)**	(0.0008)**	(0.0004)**	(0.0003)**
LnGB	-0.9781	1.1271	1.261	0.0883	-0.203	-0.1935	-0.4808
	(0.0219)**	(0.0152)**	(0.0114)**	(0.0181)**	(0.0085)**	(0.0048)**	(0.0241)**
lnPD	-0.039						
	(0.0005)**						
lnIND		-0.6804					
		(0.0705)**					
lnMTA			1.4759				
			(0.2097)**				
lnUA				-0.0758			
				-0.1479			
lnLTO					0.128		
					(0.0396)**		
lnIN						0.0974	
						(0.0340)**	
lnINFINSTF							-1.8889
							(0.0084)**
Interaction	0.2621	-0.2703	-0.3339	-0.0064	0.0688	0.0631	0.1563
	(0.0055)**	(0.0041)**	(0.0032)**	-0.0042	(0.0026)**	(0.0012)**	(0.0066)**
Control Var.							
lnGDPG	0.3711	-0.1573	-0.0096	-0.0391	-0.0445	-0.0326	-0.0061
	(0.0057)**	(0.0048)**	-0.0052	(0.0088)**	(0.0058)**	(0.0053)**	-0.0054
lnTRADE	-1.2691	-0.4279	-0.8918	-0.8687	-0.8941	-0.9076	-0.8899
	(0.0127)**	(0.0151)**	(0.0084)**	(0.0319)**	(0.0136)**	(0.0148)**	(0.0100)**
lnPOPG	0.0525	0.0773	0.0364	0.0473	0.0471	0.0479	0.0602
	(0.0005)**	(0.0008)**	(0.0004)**	(0.0017)**	(0.0006)**	(0.0004)**	(0.0002)**
Diagnostics							
Observations:	655	689	654	655	655	655	655
J-stat.	57.64679	57.09746	56.91573	55.38795	57.58027	56.70145	56.93283
Prob (J-stat)	0.414103	0.397078	0.403609	0.45998	0.416506	0.448683	0.440138
AR(2)	0.9997	0.9981	0.8458	0.9983	0.9999	0.9999	0.9939
Instrument	63	62	62	62	63	63	63

Source: Field survey, Segbe (2024)

Note: lnECO(-1) is the lag of the log of the dependent variables in each model. lnGB refers to log of Green Bonds, lnGDPG represent log of GDP, lnPOPG refers to log Population Growth, lnTRADE represent the log of trade as a % of GDP. Apart from the diagnostics section, all values outside of brackets reflect the coefficient values; ** denotes significance at 1% and * denotes significance at 5%. All values within brackets are the standard errors of the coefficient values. The values of the observations, Hansen test (J-statistics), p-values, p values of AR (2), and number of instruments are shown in the diagnostics section in the following sequence, as indicated in Table 7's diagnostics section.

also have severe environmental implications if not handled properly. This is reinforced by Stern (2004), who contends that economic expansion may increase resource exploitation and pollution if not governed by appropriate environmental policy.

The diagnostics reported in Table 7 strengthen the models' credibility. The total number of observations ranges from 654 to 689, suggesting a large sample size that increases the estimates' dependability. The J-statistics, which assess the validity of the instruments utilised, produce p-values ranging from 0.3971 to 0.4599, all of which exceed the conventional threshold of 0.05. This shows that we fail to reject the null hypothesis of instrument validity, confirming our belief in the results' integrity. Furthermore, the AR (2) test evaluates the presence of second-order autocorrelation in the residuals; p-values vary from 0.8458 to 0.9999, indicating that there is no substantial autocorrelation in the models, supporting the model specifications' suitability.

Environmental health and cultural dimension indicators

Table 8 presents a complete examination of the relationship between environmental health and several cultural dimension indicators, utilizing the Generalized Method of Moments (GMM) technique across many models. The lagged dependent variable environmental health, regularly has positive coefficients ranging from 0.482 to 0.504, demonstrating that previous levels of environmental health are important predictors of present health outcomes. Green Bond has mixed effects; whereas model 4b c1 has a positive association (0.0896), following models have significant negative coefficients, especially models 4b c6 and 4b c7 (-0.7543 and -2.3578, respectively). This shows that the influence of green ties on environmental health varies greatly depending on the cultural context and relationships present, with some situations potentially having a negative impact.

The interaction terms highlight this intricacy, with different net impacts across models. For example, model 4b c1 has a negative net effect of -2.844, implying that the interaction may harm environmental health, whereas model 4b c2 has a positive net effect of 7.6010, indicating a beneficial outcome in this particular situation. Models 4b c5 and 4b c6 also show positive net effects of 5.0187 and 7.2748, respectively, indicating that specific combinations of cultural dimensions and green linkages can improve environmental health. In contrast, the final model, 4b c7, produces a significantly large positive net effect of 18.6394, demonstrating a strong positive benefit when particular cultural variables are favorable to green bonds.

The control variables shed light on the factors that influence environmental health. Trade consistently had negative coefficients across all models, ranging from -0.6763 to -0.8655, supporting the hypothesis that greater trade could negatively impact environmental health due to the environmental costs involved with manufacturing and transportation (Levinson, 2009). This conclusion is consistent with other research, such as Cole's (2004), which stresses the negative effects of trade liberalization on environmental quality.

Table 8: *The relationship between Environmental Health and cultural dimension indicators*

Model Name	4b c1	4b c2	4b c3	4b c4	4b c5	4b c6	4b c7
Dep. Var:	lnHLT	lnHLT	lnHLT	lnHLT	lnHLT	lnHLT	lnHLT
lnHLT(-1)	0.5011	0.482	0.4983	0.5035	0.5031	0.504	0.4999
	(0.0002)**	(0.0002)**	(0.0005)**	(0.0002)**	(0.0002)**	(0.0006)**	(0.0004)**
lnGB	0.0896	-0.8896	0.0544	-0.0591	-0.6184	-0.7543	-2.3578
	(0.0043)**	(0.0102)**	-0.0325	(0.0096)**	(0.0115)**	(0.0217)**	(0.0808)**
lnPD	-0.1439						
	(0.0019)**						
lnIND		-0.0245					
		-0.0285					
lnMTA			0.1559				
			(0.0749)*				
lnUA				0.052			
				(0.0023)**			
lnLTO					0.06		
					(0.0022)**		
lnIN						-0.336	
						(0.0092)**	
lnINFINSTF							-0.0282
							-0.016
Interaction	-0.0493	0.2007	-0.0419	-0.0069	0.1329	0.1655	0.6274
	(0.0013)**	(0.0024)**	(0.0093)**	(0.0024)**	(0.0029)**	(0.0051)**	(0.0222)**
Control Var.							
lnGDPG	0.5254	0.5606	0.4882	0.4654	0.4676	0.4862	0.4893
	(0.0024)**	(0.0044)**	(0.0073)**	(0.0030)**	(0.0029)**	(0.0059)**	(0.0031)**
lnTRADE	-0.6763	-0.7454	-0.6178	-0.827	-0.6251	-0.8133	-0.8655
	(0.0061)**	(0.0060)**	(0.0237)**	(0.0063)**	(0.0045)**	(0.0105)**	(0.0077)**
lnPOPG	0.0881	0.1017	0.0912	0.0908	0.0873	0.0976	0.0828
	(0.0005)**	(0.0004)**	(0.0005)**	(0.0005)**	(0.0002)**	(0.0009)**	(0.0004)**
Diagnostics							
Observations:	677	663	677	669	676	670	670
J-stat.	53.45521	58.77418	59.61518	58.86051	57.97739	56.35306	68.64336
Prob (J-stat)	0.60885	0.338997	0.311541	0.336124	0.402239	0.461639	0.13885
AR (2)	0.9922	0.9764	0.7102	0.9325	0.9615	0.994	0.9129
Instrument	64	62	62	62	63	63	64

Source: Field survey, Segbe (2024)

Note: lnHLT(-1) is the lag of the log of the dependent variables in each model. lnGB refers to log of Green Bonds, lnGDPG represent log of GDP, lnPOPG refers to log Population Growth, lnTRADE represent the log of trade as a % of GDP. With the exception of the diagnostics section, all numbers in brackets are the standard errors of the coefficient values; values outside of brackets denote the coefficient values; ** denotes significance at 1% and * denotes significance at 5%. As indicated in the diagnostics part of Table 8, the values of the observations, Hansen test (J-statistics), p-values, p values of AR (2), and number of instruments are presented in the diagnostics section in that sequence.

Climate change mitigation and cultural dimension indicators.

Table 9 analyses the association between climate change mitigation and other cultural dimension variables. The lagged dependent variable regularly has positive coefficients ranging from 0.3312 to 0.3555, demonstrating that past levels of climate change mitigation are a good predictor of current efforts. The green bonds variable has mixed effects across the models; models 4c c1 and 4c c2 have significant negative coefficients (-1.092 and -2.2827), whereas models 4c c5 and 4c c6 have positive coefficients (0.8348 and 3.126), implying that the effectiveness of green bonds in promoting climate change mitigation may be dependent on specific cultural contexts and interactions.

This fluctuation demonstrates the complexities of the link between financial instruments and environmental impacts. The interaction terms give further insight into these processes, exhibiting varied net impacts among models. For example, model 4c c1 has a positive net effect of 17.4513, demonstrating a good interaction between cultural aspects and climate change mitigation initiatives. Similarly, model 4c c2 has an even stronger demonstrating that unregulated economic development can result in higher emissions and resource depletion (Stern, 2004).

Ecosystem vitality and governance indicators

Table 10 examines the association between ecosystem health and governance. The lagged dependent variable consistently has positive coefficients

Table 9: *The relationship between climate change mitigation and cultural dimension indicators*

Model Name	4c c1	4c c2	4c c3	4c c4	4c c5	4c c6	4c c7
Dep. Var:	lnCCH	lnCCH	lnCCH	lnCCH	lnCCH	lnCCH	lnCCH
lnCCH(-1)	0.3438	0.3555	0.3457	0.3312	0.3392	0.3423	0.3453
	(0.0014)**	(0.0013)**	(0.0007)**	(0.0008)**	(0.0007)**	(0.0021)**	(0.0012)**
lnGB	-1.092	-2.2827	-0.5524	-2.0199	0.8348	3.126	1.5735
	(0.0456)**	(0.0781)**	(0.0063)**	(0.0209)**	(0.0624)**	(0.1650)**	(0.1296)**
lnPD	0.1903						
	(0.0121)**						
lnIND		1.3877					
		(0.1003)**					
lnMTA			-0.7201				
			(0.0414)**				
lnUA				-0.6845			
				(0.1845)**			
lnLTO					-0.5983		
					(0.1435)**		
lnIN						-0.1513	
						(0.0693)*	
lnINFINSTF							-0.052
							-0.1116
Interaction	0.3116	0.5902	0.1753	0.5411	-0.1903	-0.7527	-0.4147
	(0.0117)**	(0.0190)**	(0.0020)**	(0.0055)**	(0.0171)**	(0.0409)**	(0.0361)**
Control Var.							
lnGDPG	-0.3772	-0.0409	-0.3567	-0.3635	-0.4666	-0.3123	-0.3437
	(0.0210)**	-0.0322	(0.0176)**	(0.0212)**	(0.0208)**	(0.0234)**	(0.0276)**
lnTRADE	-0.7955	-1.1536	-0.9366	-0.7871	-0.7726	-1.0438	-0.9225
	(0.0317)**	(0.0384)**	(0.0405)**	(0.0489)**	(0.0238)**	(0.0592)**	(0.0322)**
lnPOPG	-0.041	-0.031	-0.0423	-0.0078	-0.0558	-0.0762	-0.0466
	(0.0054)**	(0.0071)**	(0.0024)**	(0.0032)*	(0.0037)**	(0.0109)**	(0.0023)**
Diagnostics							
Observations:	680	666	680	680	679	680	680
J-stat.	60.26303	57.56237	61.5338	59.97121	61.63951	56.70824	60.20817
Prob (J-stat)	0.291238	0.380566	0.317054	0.333813	0.281459	0.411116	0.326084
AR (2)	0.0692	0.9919	0.8268	0.8576	0.9935	0.1764	0.8668
Instrument	62	62	64	63	63	62	63

Source: Field survey, Segbe (2024)

Note: The lag of the log of the dependent variables in every model is denoted by lnCCH(-1). The logs of Green Bonds (lnGB), GDP (lnGDPG), Population Growth (lnPOPG), and Trade (lnTRADE) as a percentage of GDP are all represented as logs. Apart from the diagnostics section, all values outside of brackets reflect the coefficient values; ** denotes significance at 1% and * denotes significance at 5%. All values within brackets are the standard errors of the coefficient values. The values of the observations, Hansen test (J-statistics), p-values, p values of AR (2), and number of instruments are shown in the diagnostics section in the following sequence, as indicated in Table 9's diagnostics section.

ranging from 0.3527 to 0.3653, indicating that past levels of ecosystem positive net effect of 22.6857, implying that some cultural characteristics considerably improve mitigation efforts. However, models 4c c5 and 4c c6 have negative net impacts of -7.2370 and -33.3905, respectively, showing that in certain circumstances, cultural interactions may impede climate change mitigation efforts. This emphasizes the need of knowing local cultural dynamics when evaluating the influence of financial instruments on climate efforts.

Control variables are also important in understanding the factors that influence climate change mitigation. Notably, trade consistently has negative coefficients across all models, ranging from -0.7955 to -1.1536, supporting the notion that greater commerce may have a detrimental impact on climate change mitigation due to environmental costs associated with manufacturing and transportation (Levinson, 2009). This conclusion is consistent with current research on the difficulty of reconciling economic commerce with environmental sustainability.

Furthermore, GDPG has negative coefficients throughout the models, implying that economic development, if not controlled sustainably, might undermine climate change mitigation efforts. This is consistent with research vitality are good predictors of contemporary results. Green bonds likewise had positive coefficients across all models, ranging from 0.1206 to 0.2759, demonstrating that green bonds are connected with increased ecosystem vitality and

Table 10: *The relationship between ecosystem vitality and governance indicators*

Model Name	4a g1	4a g2	4a g3	4a g4	4a g5	4a g6	4a g7
Dep. Var:	lnECO	lnECO	lnECO	lnECO	lnECO	lnECO	lnECO
lnECO(-1)	0.3653	0.3527	0.3533	0.3553	0.3535	0.3528	0.3628
	(0.0007)**	(0.0008)**	(0.0007)**	(0.0005)**	(0.0013)**	(0.0010)**	(0.0014)**
lnGB	0.1867	0.1206	0.1787	0.1898	0.2342	0.1531	0.2759
	(0.0032)**	(0.0038)**	(0.0044)**	(0.0041)**	(0.0097)**	(0.0028)**	(0.0047)**
CC	0.3924						
	(0.0084)**						
GE		0.0304					
		(0.0046)**					
PS			-0.032				
			(0.0061)**				
RL				0.1503			
				(0.0043)**			
RQ					0.1598		
					(0.0065)**		
VC						-0.1284	
						(0.0075)**	
FINSTF							-0.1495
							(0.0189)**
Interaction	-0.0804	-0.0682	-0.1571	-0.1362	-0.1662	-0.0915	-0.166
	(0.0016)**	(0.0018)**	(0.0031)**	(0.0016)**	(0.0033)**	(0.0012)**	(0.0020)**
Control Var.							
lnGDPG	0.2305	0.4319	0.3618	0.3365	0.2115	0.3159	0.1225
	(0.0071)**	(0.0036)**	(0.0147)**	(0.0086)**	(0.0100)**	(0.0072)**	(0.0129)**
lnPOPG	0.0506	0.0575	0.0297	0.054	0.0607	0.0655	0.0491
	(0.0009)**	(0.0007)**	(0.0013)**	(0.0008)**	(0.0013)**	(0.0006)**	(0.0008)**
lnTRADE	-1.0264	-1.4107	-1.3273	-1.2659	-1.0882	-1.2414	-0.8627
	(0.0177)**	(0.0154)**	(0.0366)**	(0.0160)**	(0.0277)**	(0.0217)**	(0.0300)**
Diagnostics							
Observations:	652	651	643	647	655	652	652
J-stat.	59.19267	57.81476	56.79972	59.68168	58.43924	59.59883	55.84829
Prob (J-stat)	0.325184	0.371727	0.335409	0.309422	0.35026	0.346144	0.442747
AR (2)	0.9942	0.9472	0.9753	0.9998	0.9489	1.000	0.9956
Instrument	62	62	60	62	62	63	62

Source: Field survey, Segbe (2024)

Note: lnECO(-1) is the lag of the log of the dependent variables in each model. lnGB refers to log of Green Bonds, lnGDPG represent log of GDP, lnPOPG refers to log Population Growth, lnTRADE represent the log of trade as a % of GDP. With the exception of the diagnostics section, all numbers in brackets are the standard errors of the coefficient values; values outside of brackets denote the coefficient values; ** denotes significance at 1% and * denotes significance at 5%. As indicated in the diagnostics part of Table 10, the values of the observations, Hansen test (J-statistics), p-values, p values of AR (2), and number of instruments are presented in the diagnostics section in that sequence.

supporting the idea that financial instruments may have a positive impact on environmental outcomes.

The interaction terms give extra information, with negative coefficients ranging from -0.0682 to -0.1662 across all models. This suggests that interactions between governance indicators and other variables may have a detrimental impact on ecosystem viability, highlighting the complexities of these linkages. The net impacts, which vary from 0.0757 to 0.1432, indicate that while governance indices have beneficial implications, their total impact may be mitigated by unfavorable interactions.

Environmental health and governance indicators

Table 11 looks at the association between environmental health and governance variables across many models. The dependent variable has significant positive coefficients for the lagged term which range from 0.3449 to 0.4873. This consistency suggests that previous levels of environmental health are good predictors of current health outcomes. The green bonds variable shows a troubling trend, with negative coefficients in all models ranging from -0.0315 to -0.4639. This shows that, contrary to predictions, the prevalence of green ties may be associated with poorer environmental health in certain circumstances. This research raises concerns about the efficiency of green finance mechanisms when they are not backed by strong governance structures, perhaps signaling challenges with implementation and accountability.

Looking at the governance indicators, the variable corruption of control has a positive and significant influence (0.248), emphasizing the importance of good governance in improving environmental health. Other metrics, such as government effectiveness and rule of law, reveal negative consequences (-0.0575 and -1.0198, respectively), demonstrating that governance flaws might harm environmental health. Interestingly, voice and accountability show a substantial positive correlation (2.0845), indicating that more civic engagement and involvement might result in better environmental results.

The interaction terms in the models have usually positive coefficients, ranging from 0.0225 to 0.3341. This suggests that the interaction of governance indicators and other elements may improve environmental health under certain circumstances. However, the net impacts, which vary from -0.0203 to -0.3874, indicate that, while interactions may have beneficial benefits, the overall effect of governance indicators in the presence of green bonds is negative.

Environmental health and governance indicators

Table 12 applied the FD-DMM to multiple models to analyze the link between governance indicators and mitigating climate change. The lagged dependent variable has substantial positive coefficients ranging from 0.336 to 0.367 in the dependent variable log of climate change mitigation, which represents climate change health indicators. This suggests that mitigating measures against climate change in the past can accurately anticipate contemporary results. Additionally, all models for the variable "green bonds" show positive coefficients ranging from 0.0527 to 0.5454, indicating a connection between green bonds and improving efforts to mitigate climate change.

Table 11: *The relationship between environmental health and governance indicators*

Eq Name:	4b g1	4b g2	4b g3	4b g4	4b g5	4b g6	4b g7
Dep. Var:	lnHLT	lnHLT	lnHLT	lnHLT	lnHLT	lnHLT	lnHLT
lnHLT(-1)	0.4727	0.4873	0.4459	0.4674	0.4801	0.3449	0.4665
	(0.0004)**	(0.0003)**	(0.0002)**	(0.0003)**	(0.0005)**	(0.0008)**	(0.0004)**
lnGB	-0.383	-0.2799	-0.4639	-0.2425	-0.2157	-0.0315	-0.3785
	(0.0019)**	(0.0025)**	(0.0009)**	(0.0021)**	(0.0016)**	(0.0008)**	(0.0007)**
CC	0.248						
	(0.0029)**						
GE		-0.0575					
		(0.0015)**					
PS			0.0588				
			(0.0007)**				
RL				-1.0198			
				(0.0088)**			
RQ					-0.043		
					(0.0021)**		
VC						2.0845	
						(0.0107)**	
FINSTF							0.144
							(0.0019)**
Interaction	0.1607	0.1026	0.3341	0.1217	0.1073	0.0225	0.2023
	(0.0005)**	(0.0010)**	(0.0006)**	(0.0012)**	(0.0005)**	(0.0005)**	(0.0004)**
Control Var							
lnGDPG	0.6086	0.5456	0.708	0.7155	0.5607	0.282	0.609
	(0.0039)**	(0.0040)**	(0.0024)**	(0.0054)**	(0.0042)**	(0.0033)**	(0.0015)**
lnPOPG	0.0883	0.0872	0.1046	0.1144	0.0974	0.0828	0.0959
	(0.0007)**	(0.0006)**	(0.0002)**	(0.0006)**	(0.0008)**	(0.0009)**	(0.0004)**
lnTRADE	-0.9595	-0.7466	-1.1144	-1.107	-0.8049	-0.9102	-0.9176
	(0.0065)**	(0.0053)**	(0.0034)**	(0.0129)**	(0.0111)**	(0.0081)**	(0.0065)**
Diagnostics							
Observations:	661	662	662	665	665	652	662
J-stat.	57.55524	57.31741	59.79221	53.39061	57.97414	71.96555	58.71767
Prob (J-stat)	0.491788	0.426048	0.374635	0.574251	0.366192	0.062009	0.412304
AR (2)	0.9821	0.8992	0.4711	0.8782	0.2843	0.955	0.823
Instrument	65	63	64	63	62	62	64

Source: Field survey, Segbe (2024)

Note: lnHLT(-1) is the lag of the log of the dependent variables in each model. lnGB refers to log of Green Bonds, lnGDPG represent log of GDP, lnPOPG refers to log Population Growth, lnTRADE represent the log of trade as a % of GDP. Apart from the diagnostics section, all values outside of brackets reflect the coefficient values; ** denotes significance at 1% and * denotes significance at 5%. All values within brackets are the standard errors of the coefficient values. The values of the observations, Hansen test (J-statistics), p-values, p values of AR (2), and number of instruments are shown in the diagnostics section in the following sequence, as indicated in Table 11's diagnostics section.

The idea that financial tools may successfully assist environmental activities is supported by this research, especially when suitable governance mechanisms are in place. Indicating possible negative impacts of interactions between governance indicators and other factors on climate change mitigation, the interaction terms throughout the models primarily show negative coefficients, ranging from -0.4131 to -0.2914. When considered with green bonds, the net impacts, which vary from 0.1714 to 0.3901, indicate that, generally, the influence of governance indicators is still beneficial in some situations.

A variety of influences are shown by the control variables. The majority of models in trade have negative coefficients, ranging from -0.609 to -1.1246, supporting the theory that more trade may actually worsen climate change mitigation because of environmental damage brought on by trade activity. Additionally, GDP growth shows negative coefficients, suggesting that climate measures may suffer from unsustainable economic development. On the other hand, Population has fewer consistent impacts; some models even indicate negative effects, demonstrating that population expansion has varying consequences on attempts to mitigate climate change. Table 12's diagnostics verify the models' resilience. There is a good sample size because there are between 668 and 731 observations. Indicating that we are unable to reject the null hypothesis of instrument validity across models, the

Table 12: *The relationship between climate change mitigation and governance indicators*

Model Name	4c g1	4c g2	4c g3	4c g4	4c g5	4c g6	4c g7
Dep. Var:	lnCCH	lnCCH	lnCCH	lnCCH	lnCCH	lnCCH	lnCCH
lnCCH(-1)	0.3381	0.3574	0.336	0.3478	0.3507	0.3523	0.367
	(0.0023)**	(0.0006)**	(0.0013)**	(0.0004)**	(0.0005)**	(0.0014)**	(0.0016)**
lnGB	0.5454	0.3967	0.4847	0.0527	0.0786	0.3573	0.2836
	(0.0179)**	(0.0102)**	(0.0071)**	(0.0039)**	(0.0050)**	(0.0067)**	(0.0065)**
CC	-0.6693						
	(0.0823)**						
GE		0.3385					
		(0.0077)**					
PS			-0.3439				
			(0.0137)**				
RL				0.3365			
				(0.0134)**			
RQ					0.319		
					(0.0081)**		
VC						1.1464	
						(0.0488)**	
FINSTF							0.9427
							(0.0233)**
Interaction	-0.2914	-0.1715	-0.4131	0.0415	0.0234	-0.1448	-0.1164
	(0.0061)**	(0.0048)**	(0.0047)**	(0.0020)**	(0.0024)**	(0.0029)**	(0.0038)**
Control Var.							
lnGDPG	-0.2343	-0.3579	-0.1729	-0.5301	-0.4208	-0.2135	-0.8332
	(0.0389)**	(0.0097)**	(0.0238)**	(0.0196)**	(0.0216)**	(0.0310)**	(0.0196)**
lnPOPG	-0.0066	-0.0331	-0.0555	-0.0596	-0.0424	0.0291	-0.0295
	-0.0069	(0.0036)**	(0.0057)**	(0.0036)**	(0.0035)**	(0.0051)**	(0.0026)**
lnTRADE	-0.9664	-0.9963	-1.0233	-0.609	-0.8151	-1.1246	0.0117
	(0.0740)**	(0.0253)**	(0.0315)**	(0.0295)**	(0.0298)**	(0.0303)**	-0.0312
Diagnostics							
Observations:	677	676	676	680	679	668	731
J-stat.	58.32253	59.57117	58.04311	60.91264	61.14002	59.11108	59.14442
Prob (J-stat)	0.354227	0.347069	0.399896	0.303667	0.296617	0.294317	0.361485
AR (2)	0.3819	0.9726	0.968	0.9509	0.9782	0.9525	0.9928
Instrument	62	63	63	63	63	61	63

Source: Field survey, Segbe (2024)

J-statistics, which evaluate the validity of the instruments, produce p-values ranging from 0.294 to 0.399. The model assumptions are reasonable, as confirmed by the AR (2) test findings, which also show no significant second-order autocorrelation in the residuals.

Impact of previous environmental performance

The inclusion of a lagged environmental performance variable in all the model specifications indicates the persistent or carry-over effects of past environmental performance on current outcomes. The positive and statistically significant coefficient of the lagged dependent variable provides strong evidence that higher levels of environmental performance in previous periods exert a long-term impact on current environmental performance. In other words, the improvements in environmental performance tend to accumulate and reinforce themselves over time, creating a positive response loop.

The inclusion of the lagged dependent variable effectively portrays the self-sustaining and dynamic nature of environmental performance. This method enables a more detailed and thorough understanding of how green bonds and institutional frameworks interact with past environmental results to determine present and future performance. The strong persistence impact shown consistently across the models emphasizes the need of taking environmental efforts into account, which are path-dependent and long-term in nature.

The statistically significant coefficient of the lagged dependent variable provides strong evidence supporting the appropriateness of the FD-GMM estimator for this analysis. This result validates the dynamic specification of the model and suggests that the empirical findings derived from this approach can be considered reliable for drawing statistical inferences. The significance of the lagged variable not only confirms the persistence in environmental performance over time but also reinforces the suitability of the chosen econometric methodology in capturing and accounting for this dynamic relationship. Consequently, the results obtained through this estimation technique can be viewed with a high degree of confidence, offering a solid foundation for interpreting the relationships between green bonds, institutional frameworks, and environmental performance.

Chapter Summary

An extensive descriptive analysis of the major research variables opens the chapter. According to the descriptive study, several nations have issued more green bonds on average between 2007 and 2022. The chapter continues by examining how institutional frameworks and green bonds differ in their effects on environmental performance. The discussion shows that institutional frameworks and green bonds are necessary to enhance environmental performance, especially in view of the environmental concerns posed by climate change. The chapter also covered how institutional frameworks influence the link between green bonds and environmental performance. The discussion highlighted that strong institutional frameworks are necessary to improve the link between green bonds and environmental performance.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter contains the key results drawn from the entire investigation. In addition, it provides a summary of the findings, recommendations, and concepts for further investigation. A summary of the original data gathered and the study's methodology is given in the first part. The second section presents the key findings and conclusions of the study. Finally, the chapter offers recommendations for future study topics in light of the investigation's limits and consequences.

Summary of the Research

As the years go by compared to the early days, climate change has become a major environmental hazard to the earth and its populations worldwide. The body of research indicates that a number of variables may be able to lessen the environmental damage that climate change poses. The first chapter focused on green bonds as a sustainability tool to assist counter or lessen the threat since the money from these bonds goes toward funding eco-friendly initiatives. This is due to the fact that a nation's overall effect from climate change is reduced the greener bonds it issues, which are specifically designed to fund environmental sustainability programmes. Furthermore, the issuing of green bonds is significantly aided by robust formal and informal institutional structures.

On the link between green bonds, formal and informal institutional frameworks, and environmental performance from a global setting, the literature assessment offered supportive theories in along with actual evidence. Specifically, the signaling theory, ecological economic theory, environmental Kuznet curve, institutional theory and Hofstede's cultural dimensions theory was used. The empirical review posited that existing studies did not provide a clear or conclusive finding on the relationship between green bonds, formal and information institutional frameworks globally. This is because the impact on green bonds and formal institutional frameworks on environmental and firm performance have primarily been examined separately in previous studies. This study however examined the informal and formal institutional frameworks and as well interacted formal and informal institutional frameworks with green bonds globally, to hypothesize that institutional frameworks moderates the relationship between greens and environmental performance of green bond issuing countries.

This study's research approach was based on a positivist philosophical framework and employed quantitative methodologies. Additionally, the study evaluated data and tested hypotheses in order to estimate many models using an explanatory research technique. Due to data availability, the research also used 71 of the 193 nations in the world. Three baseline models were also created during the study. Examining how green bond issuance affects environmental performance is the goal of the first set of model specifications. The third model looks at the moderating impact institutional frameworks have in the link between environmental performance and green bonds, whereas the second model aims to assess the interaction between formal and informal institutional frameworks on environmental performance. The study estimated each model using the First Difference Generalized Method of Moment estimation approach.

Summary of Findings

The results of the investigation showed several interesting and significant conclusions with favorable applications. Examining the relationship between green bonds and environmental performance was the main objective of the study. The third objective examined the function of formal and informal institutional frameworks in moderating the relationship between green bonds and environmental performance. The second objective evaluated the relationship between institutional frameworks and the environmental performance of the countries issuing green bonds. The following table summarizes these objectives:

Table 13 – *Summary of Results on the Hypothesis*

Hypotheses	**Confirmation**
H1: The issuance of green bonds contributes positively to environmental performance.	Failed to Reject
H2: The institutional frameworks of issuing countries exerts a positive influence on the environmental impact of green bonds.	Failed to Reject
H3: Formal and informal institutional frameworks moderate the positive relationship between green bonds and environmental performance.	Failed to Reject

Source: Field survey, Segbe (2024)

The results of the first objective demonstrate that green bonds significantly improved the sample of global countries' environmental performance. This suggests that boosting green bond issuance and funding for ecologically friendly projects will improve a country's environmental performance in the face of climate change challenges. Furthermore, formal and informal institutional frameworks were found to have a substantial positive link with environmental performance based on the second objective. This suggested that maintaining strong institutional frameworks is crucial for decreasing the environmental impact of climate change through improved environmental performance.

The findings of the third objective demonstrate that the institutional framework of the country issuing the green bonds helps to improve the environmental performance of the bonds. In contrast to the independent variable's coefficient in the first model, the addition of the interaction term between green bonds and institutional framework in the model revealed a positive and significant coefficient (1.1512). This shows that better institutional frameworks may enhance the beneficial environmental effects of issuing green bonds by considering elements like regulatory quality, the rule of law, long-term orientation, and uncertainty avoidance, among other things.

The broader relevance of the study to the SDGs is revisited informed by the research findings. It emphasises the study's contribution to SDG 17 (Partnerships for the Goals) by highlighting the importance of international cooperation in green finance. It also discusses the study's contribution to strengthening institutions for sustainable development, promoting sustainable finance more broadly, and enhancing accountability and transparency in the green bond market.

Conclusion

The findings of this study conclude that green bonds are essential for improving environmental performance on a global scale. The significant positive relationship between green bond issuance and environmental outcomes underscores their potential as a vital financial tool to combat climate change. This suggests that increasing the volume of green bonds can effectively channel resources into sustainable projects, such as renewable energy, conservation efforts, and infrastructure improvements. By mobilizing capital for these initiatives, countries can not only enhance their environmental performance but also stimulate economic growth and job creation in green sectors.

Moreover, the study highlights that robust formal and informal institutional frameworks are critical for achieving better environmental performance in countries that issue green bonds. Strong governance structures, high regulatory quality, and active community engagement are necessary components that support the effective implementation of sustainable initiatives. Countries with well-established legal and regulatory frameworks can create an enabling environment for green investments, ensuring that projects are not only financially viable but also environmentally beneficial. This integration of governance and sustainable finance can lead to more effective policy outcomes and greater accountability in the use of green bond proceeds.

Lastly, the study highlights that in order to optimise the influence of green bonds on environmental performance, robust institutional frameworks are required. This link is significantly moderated by the functions of both formal institutions, such as government agencies and regulatory organisations, and informal institutions, such as public awareness and social norms. Efficient regulatory supervision guarantees that green bonds are utilised for the appropriate purposes, and community involvement cultivates a sustainable and accountable culture. Promoting environmental sustainability, encouraging investment in green projects, and eventually lessening the effects of climate change globally all depend on this understanding.

This study has significant relevance to the SDGs, particularly those related to climate action, clean energy, sustainable infrastructure, and sustainable cities and communities. By investigating the role of institutional frameworks in shaping the environmental performance of green bonds, the study's findings can inform policy decisions and contribute to achieving a more sustainable and equitable future for all. This reinforces the study's contribution to the broader sustainable development agenda.

Recommendation.

The various agencies of governments in all nations responsible for the protection of the environment like the environmental protection agencies should collaborate with ministry of finance to actively promote the issuance of green bonds by implementing tax incentives, subsidies, and guarantees to lower the cost of capital for issuers. Financial regulatory agencies should establish clear criteria and standards for qualifying green bonds, enhancing market transparency and investor confidence. Additionally, environmental protection agencies can facilitate public-private partnerships to increase the credibility of green bonds and create dedicated green bond funds to provide stable financing for sustainable projects. By increasing the volume of green bonds, these initiatives can significantly contribute to sustainability efforts and improve overall environmental performance.

Also, there should be a concerted effort to strengthen both formal and informal institutional frameworks within countries. The study demonstrates that robust institutions not only directly improve environmental performance but also enhance the positive impact of green bonds. Policymakers in the various institutions should focus on improving governance structures, regulatory quality, rule of law, and control of corruption. Simultaneously, efforts should be made to foster informal institutions such as social norms, cultural values, and public awareness that support environmental sustainability. By reinforcing these institutional frameworks, countries can create a more conducive environment for green bonds to effectively contribute to environmental performance and climate change mitigation. This would also help by removing barriers to market entry and attracting both domestic and international investors.

Furthermore, understanding how formal and informal institutional frameworks mitigate the influence of green bonds on environmental performance is essential to optimising their advantages. Research and communication initiatives that increase public knowledge of the advantages of green bonds and promote community involvement in sustainable projects should be funded by educational institutions. Governmental organisations and community groups should work together to start educational initiatives that promote social norms that support environmental sustainability. Regulatory agencies should also take part in capacity-building programs to guarantee efficient oversight and assessment of green bond programs. Stakeholders may improve the conditions for green bonds to have a beneficial effect on environmental performance by strengthening both official and informal frameworks.

Lastly, for sustainable development to be more effectively supported, this research recommends incorporating environmental performance indicators into theories of finance, economics, and institutions. New financial products might result from the assessment of sustainability-related investment risks and possibilities using criteria such as the EPI. We will get a better grasp of how sustainability impacts growth and long-term stability in economics by including environmental issues into models. Using these measures can demonstrate how governance and legislation impact sustainable practices for institutional theory. A more balanced approach to growth may be promoted by including these environmental measures into these domains to better understand the relationship between economic activity and environmental sustainability.

Suggestions for Future Research

Future research could expand on this study by examining the long-term effects of green bond issuance on environmental performance. While this study has established a positive relationship, it would be valuable to investigate how this relationship evolves over time and whether there are any lagged effects. Researchers could conduct longitudinal studies to track the environmental impact of green bond-funded projects over several years or decades.

Additionally, future studies could explore the specific mechanisms through which formal and informal institutional frameworks moderate the relationship between green bonds and environmental performance. This could involve a more detailed analysis of different types of institutions and their individual impacts. Researchers might also consider comparative studies across different regions or economic contexts to understand how the effectiveness of green bonds and institutional frameworks varies in different settings. Finally, future research could investigate potential synergies between green bonds and other sustainable finance instruments, and how these interactions are influenced by institutional frameworks.

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APPENDICES

A – A list of samples of 71 countries used and their continent.

Argentina	Egypt	Japan	Nigeria	South Africa
Australia	Estonia	Jersey	Norway	Spain
Austria	Fiji	Korea, Rep. of	Pakistan	Sweden
Bangladesh	Finland	Laos	Panama	Switzerland
Belarus	France	Lavita	Peru	Thailand
Belgium	Georgia	Lithuania	Philippines	Turkey
Brazil	Germany	Luxembourg	Poland	Ukraine
Canada	Greece	Malaysia	Portugal	United Arab Emirates
Chile	Hungary	Marshall Islands	Romania	United Kingdom
China	Iceland	Mauritius	Russia	United States
Colombia	India	Mexico	Serbia	Vietnam
Costa Rica	Indonesia	Morocco	Seychelles	
Cyprus	Ireland	Namibia	Singapore	
Czech Republic	Israel	Netherlands	Slovakia	
Denmark	Italy	New Zealand	Slovenia	

Source: Field survey, Segbe (2024)

B. Endogeneity test

Eq Name:	GB	GDPG	POPG	TRADE
Method:	LS	LS	LS	LS
Dep. Var:	lnEPI	lnEPI	lnEPI	lnEPI
C	2.907	3.2317	3.6008	2.865
	(1.1598)*	(0.7428)**	(0.2128)**	(0.1624)**
RESID_lnGB	-0.0085			
	-0.0352			
RESID_lnGPD		0.0286		
		-0.0783		
RESID_lnPOPG			-0.0614	
			-0.0408	
RESID_lnTRADE				0.1964
				-0.1982
lnGB		-0.0083	-0.0079	0.0107
		-0.0352	-0.0262	-0.0264
lnGDPG	0.0284		0.1271	0.1264
	-0.0783		(0.0170)**	(0.0172)**
lnPOPG	-0.061	-0.0606		0.0737
	-0.0358	-0.0357		(0.0204)**
lnTRADE	0.1961	0.1847	-0.1727	
	-0.1724	-0.1694	(0.0339)**	
Diagnostics				
Observations:	876	876	876	876
R-squared:	0.3626	0.3626	0.0898	0.0752
F-statistic:	5.5022	5.5022	21.4883	17.6967

Source: Field survey, Segbe (2024)