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Shristi Pantha

Green Bonds in Finland: Market Growth and Impact Sustainability

Evidence From Fron Finland

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Author: Shristi Pantha
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Abstract

This thesis analyzes the development of green bonds in Finland, focusing on market growth dynamics and their contribution to environmental sustainability. Green bonds have emerged as a key instrument in sustainable finance, enabling the allocation of capital toward environmentally beneficial projects such as renewable energy, energy efficiency, and sustainable infrastructure. The study is grounded in sustainable finance and ESG investment theory, which suggests that financial markets are increasingly influenced by environmental risk considerations, regulatory frameworks, and investor preferences. The research adopts a qualitative literature review approach supported by a planned quantitative econometric framework. It synthesizes findings from academic literature, institutional reports, and financial market data to analyze the key drivers of green bond issuance in Finland, including macroeconomic conditions, investor demand, and policy interventions such as the EU Green Deal and EU Taxonomy. The findings indicate that Finland's green bond market is characterized by strong institutional credibility, high transparency standards, and significant alignment with European sustainability objectives.

However, the study also identifies several limitations, particularly regarding the measurement of environmental impact and the risk of greenwashing. While green bonds contribute to financing the green transition, their effectiveness depends heavily on regulatory enforcement, reporting quality, and standardization of sustainability metrics. Overall, the thesis concludes that green bonds play an important but partial role in advancing sustainability in Finland's financial system.

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Abbreviations

CO₂ Carbon Dioxide

EU European Union

ESG Environmental, Social and Governmental

GDP Gross Domestic Product

GHG Greenhouse Gas

ICMA International Capital Market Association

GB Green Bond

GBPs Green Bond Principles

EIB European Investment Bank

ECB European Central Bank

UN United Nations

SDGs Sustainable Development Goals

LCA Life Cycle Assessment

SRI Socially Responsible Investment

NDC Nationally Determined Contributions

Finland MoF Ministry of Finance of Finland

Kuntarahoitus Municipality Finance Plc (major Finnish green bond issuer)

1 Introduction

1.1 Background and Motivation

The modern financial markets have seen an increased focus on sustainable finance with investors, governments, and institutions seeking methods for allocating financing in a sustainable manner. This change indicates that the traditional investment orientation with return decisions is progressively being informed by sustainability considerations in the financial system. Green bonds are one of the instruments to have emerged that offer a structured and transparent way to fund projects with environmental benefits. Green bonds are essentially fixed-income instruments. Proceeds from green bonds are used for funding projects that promote excellent environmental sustainability. These projects typically encompass the creation of renewable energy, enhancement of energy efficiency, prevention of pollution, the sustainable management of water, and infrastructure development characterized by low carbon emissions. Green bonds are distinguished not only by the purpose for which their proceeds are used but also by an obligation to be transparent about how they will allocate and report their proceeds. This sets them apart from conventional bonds and has helped their credibility grow with investors.

Green bonds used to be considered a new 'thing' that a few countries experimented. This growth has been spurred by several factors including rising investment demand for ESG-compliant assets. It is also due to regulatory encouragement from governments and international organizations. In addition, it stems from the shift of financial institutions to sustainable investment portfolios. Green bonds, which offer stable returns, are capturing the attention of institutional investors, who, among others, have a greater role in the development of the market. Consequently, green bonds are now one of the most widely used instruments in sustainable finance.

Within Europe, the issuance of green bonds has developed significantly thanks to policy support, i.e. the European Green Deal, and growing regulatory efforts towards developing standards for sustainable finance. Finland has started to take a bigger role in this market. Finland may not be a large economy in Europe, but it has a green bond market with high transparency and substantial institutional participation. The municipalities of Finland, state-owned entities, financial institutions and other corporations have used green bonds increasingly to finance their green investments.

Green bonds proceeds in Finland have typically been used in the expansion of renewable energy wind and bioenergy, building energy efficient buildings, constructing climate resilient infrastructure, etc. These investments are well-aligned with Finland's sustainability and carbon neutrality objectives and green bonds play an important role in supporting the country's long-term environmental strategy. The growing importance of capital markets in addressing sustainability challenges is reflected in the way green finance is incorporated into public and private sector funding decisions.

Although the green bond market has developed positively, there are still significant problems. The absence of full global standards for defining, reporting, and verifying green bond impacts is one of the challenges. Even though the ICMA Green Bond Principles provide assistance, the participation is almost all voluntary. This can lead to a difference in reporting quality across issuers and markets. It is challenging to properly understand the actual environmental impact of the projects financed through green bonds because of concerns of transparency and comparability.

The danger of greenwashing is another key problem, where "green" financial instruments are offered that generate little or no impact. This dilemma has enhanced demand for further stringent impact assessment and more clarity in regulatory frameworks to ensure that green bonds contribute to sustainability

objectives rather than being used just as a reputational tool. Such worries reveal a need to have a critical lens to evaluate not just the increase in size of the green bond market, but also its effectiveness.

The purpose of this paper arises from the traditional understanding of how green bonds are working in a small yet well-developed financial market like Finland. Although existing literature has extensively studied global green bond markets and large economies, less research has delved into Finland's green bond development impact and sustainability impact. This thesis analyzes the market growth of green bonds and their environmental contribution in Finland. Thus, it aims to clarify their actual role in sustainable finance and environmental progress.

1.2 Previous Main Studies

In the past decade, research on green bonds has developed rapidly, as has sustainable finance more broadly in the global capital markets. The increase in interest of education about green bonds is owing to the increasing needs of government, corporation and financial institutions which requires financing that on one hand supports the green objectives and on the other hand, also has the ability to generate good financial performance. The early literature deals with the conceptual definitions of green bonds and their behavioral role as innovation in fixed income market. Green bonds, according to Flammer (2021), are a financial instrument used to finance projects that provide clear environmental benefits, while sharing the structural characteristics of standard bonds. Likewise, Zerbib (2019) reports that the green bond phenomenon originated from a movement towards green investment decision.

A lot of studies compare the price features of green bonds and regular bonds. One of the most widely discussions well know the term "Greenium". It is basically the possible yield differential between the green bond and the non-green bond

by the same or similar issuers. Research findings on this issue have been inconclusive. According to Gianfrate and Peri (2019), there's evidence that green bonds can be issued at a lower yield, which implies that investors might be willing to settle for a marginally lower return to benefit the environment. Kapraun and Scheins (2019) also found evidence of a greenium in markets that are sufficiently liquid and developed.

Other research claims that greenium does not apply in all the markets or time periods. According to Ehlers and Packer (2017), the pricing of green bonds versus conventional bonds is likely a function of issuer characteristics and market conditions, rather than environmental labels only. Baker et al. (2018) further state that partially accounting for credit risk and liquidity, the greenium is small and sometimes statistically insignificant. In fact, this variation demonstrates that the pricing of green bonds is not a pre-established market phenomenon but rather a developing feature.

A different important stream of research examines the environment and sustainability impact of green bonds. Tang and Zhang (2020) found that green bond issuance spurs investment in green projects, particularly in renewable energy and energy efficiency sectors. According to them, green bonds can effectively help to shift capital flows towards more sustainable activities and can help in the shift towards a low-carbon economy. Similarly, findings show that green bonds improve corporate environmental performance by increasing transparency and accountability on the use of funds.

The literature does highlight some important limitations when trying to measure the actual environmental performance of green bonds. Bachelet, Becchetti, and Manfredonia (2019) stress that standardization of the reporting frameworks is essential for comparing the environmental outcomes across the issues and

regions. Sometimes, issuers report on their impact metrics voluntarily which may result in differences in measurement and overstating environmental benefits. Due to this, scholars and policy makers are becoming increasingly concerned about whether green labeling is credible and effective. Analysis of investor behavior and demand for green bonds is another crucial area of research. As per the study of Larcker and Watts (2020), institutional investors namely pension funds, insurance companies, asset managers are playing an important role in increasing the demand for green bonds mainly due to the increasing ESG integration in investment strategies. As per the increasing importance of ESG, investors consider non-financial factors along with financial risk-return trade-offs. Furthermore, issuer representation and investor representation is encouraged rationally due to reputational concerns along the regulatory pushes.

According to a report compiled by researchers Ehlers and Packer (2017), central banks and supranational institutions have supported standard-setting initiatives and provided market guidance, which has helped to legitimize and expand the green bond market. With time and continuous development, confidence in the market has increased and the volume of issuance has increased.

Most empirical studies in literature have been on large and liquid financial markets like the US, China, France, and Germany, regardless of an ever-growing stream of literature. The majority of the green bonds globally are issued in the above-mentioned countries. Consequently, there is relatively little research on smaller but well-developed economies that also participate in sustainable finance activities.

Countries like Sweden, Norway, Denmark and Finland – the Nordic region of Europe, have the highest awareness towards sustainability and ESG, along with robust policies towards environmental development. Nevertheless, there is a shortage of empirical research that specifically focuses on the green bond

markets in these nations. One country that has received little attention in the literature is Finland, even though it is an active participant in green finance initiatives, and has achieved long-term carbon neutrality goals. Finland's green bond market has increased gradually in the last ten years, supported by public and private sector issuers. Public sector entities like municipalities, state-owned enterprises and financial institutions have been prominent issuers of green bonds focused on renewable energy projects, energy-efficient and low-emission vehicle infrastructure. The market participants' report suggests positive environmental contributions, but the academic analysis is limited. In the Finnish case, systematic paving of market growth and sustainability outcomes is rare. The absence of evidence available for the country highlights the research gap. One reason is the lack of knowledge about the structural drivers behind green bond issuance in Finland. Moreover, not much analysis is done on the efficacy of these financial instruments on measurable environmental improvements. For one, how the development of Finland's green bond market is influenced by the country's regulatory environment and institutional structure has not been examined by existing studies.

Consequently, this thesis contributes to the literature by examining the Finnish green bond market specifically. It uses global and European studies but zooms in on the national level in order to understand market growth, issuing behaviour and sustainability impact in more detail. This helps to bridge the gap between world-wide theoretical results and country-specific empirical evidence by providing insights into the working of green bonds in the context of a small but highly developed sustainable finance ecosystem.

1.3 Hypothesis

1 H1: Green bond issuance in Finland has a positive impact on sustainable investment growth in the financial market.

This hypothesis presumes that green bonds are a major financing instrument in sustainable finance. With an increase in the volume of green bonds being issued, more funds get invested in eco-friendly projects. It is expected to contribute to the overall growth of sustainable investment activities within Finland's financial market. To put it differently, sustainability-oriented investments are believed to flourish as a result of the vibrant green bonds.

2 H2: Green bonds contribute to environmental improvement in Finland by supporting a reduction in CO₂ emissions.

The green bonds assist financing projects with direct environmental benefits such as renewable energy, energy efficiency, and low-carbon infrastructure according to this hypothesis. With the financing of the green bond, these projects will reduce CO₂ emissions in the long term. Consequently, a greater volume of green bond transactions should lead to better environmental outcomes.

3 H3: Economic and policy-related factors (such as GDP growth and sustainability regulations) significantly influence the growth of green bond issuance in Finland. The

development of the market for green bonds does not take place in a vacuum.

Economic conditions like GDP growth increase capacity for investment while robust sustainability policies and regulatory frameworks encourage issuers to adopt green financing instruments. Thus, an important demand driver of green bond issuance in Finland is considered the economic performance, along with policy support.

1.4 Structure of the Thesis

The thesis is structured into six main chapters, each focusing on a different aspect of the research.

Chapter1: Introduction

The first chapter introduces the topic of green bonds in Finland. It presents the background and Motivation of the study, reviews existing literature briefly, defines the research objectives and hypothesis and outlines structure of the thesis.

Chapter 2: Theoretical Background

The second chapter provides the theoretical foundation of the study. It discusses sustainable finance, green bonds, and their role in financial markets. It also explains key concepts such as ESG investing, green bond principles, and the theoretical link between financial markets and environmental sustainability.

Chapter 3: Empirical Literature Review

The third chapter reviews previous empirical studies related to green bonds. It focuses on global market development, pricing behavior, environmental impact, and investor demand. This chapter also identifies the research gap, particularly the limited country specific studies on Finland.

Chapter 4: Data and Methodology

The fourth chapter describes the data used in study and explains the research methodology. It includes data sources, variable definitions, and the empirical approach used to analyze green bond market growth and sustainability impact in Finland.

Chapter 5: Empirical Results and Analysis

The fifth chapter presents and discusses the empirical result. It examines the growth of the green bond market in Finland, its impact in sustainability outcomes, and the key factors influencing issuance and development. The findings are interpreted in relation to the hypothesis.

Chapter 6: Conclusion

The final chapter summarizes the main findings of the study. It discusses the implications of the results for policymakers, investors and financial institutions. It also highlights the limitations of the research and suggests areas for future study.

2. Theoretical Background

The theoretical background of this study provides the foundation for understanding the role of green bonds within modern financial markets and their connection to sustainability objectives. Green bonds represent a relatively recent innovation in sustainable finance, combining traditional fixed-income investment structures with environmental goals. As such, their development can be better understood through theories related to sustainable finance, investment behavior, financial markets, and environmental economics.

The increasing importance of sustainability in financial decision-making has led to a shift in how capital is allocated. Investors, financial institutions, and policymakers are increasingly considering environmental and social factors alongside financial returns. This transition has contributed to the emergence of sustainable finance as a key area within financial economics. Within this framework, green bonds have become an important instrument for channeling capital toward projects that generate environmental benefits, such as renewable energy, energy efficiency, and sustainable infrastructure.

From a theoretical perspective, financial markets play a central role in influencing environmental outcomes by determining how capital is distributed across sectors. The integration of ESG considerations into investment decisions suggests that markets can be used as tools to support environmental sustainability. Green bonds represent a market-based mechanism that attempts to align investor preferences with environmental objectives by ensuring that raised funds are allocated to clearly defined green projects.

In addition, sustainable investment theory supports the idea that environmental responsibility and financial performance are not mutually exclusive. Instead, incorporating sustainability factors into investment strategies may improve long-term risk management and create value for investors. This theoretical perspective helps explain the growing demand for green bonds, particularly among institutional investors who are increasingly required to integrate ESG criteria into their portfolios. Another important aspect of the theoretical framework relates to regulation and market structure. The development of green bonds has been strongly influenced by

international guidelines such as the Green Bond Principles issued by the International Capital Market Association (ICMA), as well as European Union sustainability policies. These frameworks aim to improve transparency, standardization, and investor confidence in the market.

Overall, the theoretical background provides a foundation for analyzing how green bonds function as financial instruments and how they contribute to sustainability objectives. It also helps explain the interaction between financial markets and environmental outcomes, which is essential for evaluating the growth and impact of the green bond market in Finland.

2.1 Sustainable Finance and Climate Change

Sustainable finance has become an increasingly important area within financial markets as global attention shifts toward environmental sustainability and long-term economic resilience. It refers to the integration of environmental, social, and governance (ESG) factors into financial decision-making processes, with the aim of promoting investments that contribute not only to financial returns but also to sustainable development objectives. In this context, financial systems are no longer viewed solely as mechanisms for capital allocation and profit generation, but also as key instruments for addressing global environmental challenges.

One of the main drivers behind the rise of sustainable finance is the increasing recognition of climate change as a significant economic and financial risk. Climate-related risks, including physical risks such as extreme weather events and transition risks associated with the shift toward a low-carbon economy, can have substantial impacts on financial stability, asset values, and investment performance. As a result, investors, financial institutions, and policymakers have begun to incorporate climate considerations into financial analysis and portfolio management.

The transition toward sustainable finance is also strongly influenced by global policy initiatives and international agreements. Frameworks such as the Paris Agreement have set long-term climate targets that require substantial investment in low-carbon technologies and infrastructure. Achieving these targets necessitates the

mobilization of large-scale private and public capital, which has led to the development of new financial instruments designed to support environmental objectives. Green bonds are one of the most prominent examples of such instruments.

From a theoretical perspective, sustainable finance can be understood as an evolution of traditional financial theory, where the objective is not only to maximize risk-adjusted returns but also to account for externalities such as environmental impact. In classical financial models, environmental factors were often considered external to investment decision-making. However, modern financial theory increasingly recognizes that environmental risks can have direct financial consequences, and therefore must be integrated into valuation and risk assessment processes.

In addition, sustainable finance is closely linked to the concept of efficient capital allocation. Financial markets play a crucial role in directing capital toward productive uses, and when sustainability criteria are incorporated into investment decisions, capital is more likely to flow toward environmentally responsible projects. This shift creates incentives for firms to improve their environmental performance in order to attract investment and reduce financing costs. As a result, financial markets can act as a mechanism for promoting sustainable economic behavior.

Institutional investors have played a particularly important role in the development of sustainable finance. Pension funds, insurance companies, and asset managers are increasingly required to consider long-term risks and obligations, which makes ESG integration highly relevant to their investment strategies. These investors often operate with long investment horizons, which aligns well with sustainability objectives. Consequently, their growing demand for ESG-compliant assets has contributed to the expansion of sustainable financial instruments, including green bonds.

At the same time, regulatory developments have significantly supported the growth of sustainable finance. Governments and international organizations have introduced policies aimed at increasing transparency, improving disclosure

standards, and encouraging sustainable investment practices. For example, the European Union has implemented several initiatives, including the EU Green Deal and sustainable finance disclosure regulations, which aim to redirect capital flows toward environmentally sustainable activities. These policies have created a more supportive environment for the development of green financial instruments across Europe, including Finland.

In the Finnish context, sustainable finance has become an integral part of national economic and environmental strategy. Finland has committed to ambitious climate targets, including achieving carbon neutrality in the coming decades. To support this transition, both public and private sector actors have increasingly adopted sustainable financing tools. Green bonds have emerged as a key instrument in this process, enabling the financing of renewable energy projects, energy-efficient infrastructure, and low-emission transport systems.

Overall, sustainable finance represents a fundamental shift in the way financial systems operate, integrating environmental considerations into investment decisionmaking. It reflects the growing understanding that long-term economic stability is closely linked to environmental sustainability. Within this framework, green bonds serve as an important practical tool that connects capital markets with climate-related objectives, making them a central element in the ongoing transition toward a more sustainable financial system.

2.2 Financial Markets and Environmental Sustainability

Financial markets play a central role in the allocation of capital within an economy, influencing how resources are distributed across industries, sectors, and projects. In the context of sustainability, financial markets are increasingly recognized not only as mechanisms for capital efficiency but also as powerful tools for shaping environmental outcomes. Through investment decisions, pricing mechanisms, and risk assessment processes, financial markets can either support or hinder the transition toward more sustainable economic systems.

The relationship between financial markets and environmental sustainability is based on the idea that capital flows influence real economic activity. When investors prioritize environmental, social, and governance (ESG) factors in their decision-making, capital is more likely to be directed toward companies and projects that demonstrate strong environmental performance. This creates financial incentives for firms to reduce emissions, improve energy efficiency, and adopt cleaner technologies.

Over time, such investment patterns contribute to structural changes in the economy, supporting the shift toward low-carbon development.

At the same time, environmental risks are increasingly being recognized as financial risks. Climate change, resource scarcity, and environmental degradation can affect corporate profitability, asset valuations, and overall market stability. For example, companies that are heavily dependent on fossil fuels may face transition risks as governments implement stricter environmental regulations or carbon pricing mechanisms. Similarly, firms exposed to physical climate risks, such as extreme weather events, may experience disruptions in operations and supply chains. These risks are gradually being incorporated into financial analysis, leading to a more integrated approach to risk management.

From a theoretical perspective, financial markets are often described as efficient mechanisms for price discovery and capital allocation. However, traditional financial models did not fully account for environmental externalities. Environmental costs were often treated as external to market pricing mechanisms, leading to underinvestment in sustainable activities. The integration of sustainability considerations into financial markets can therefore be seen as an adjustment to this limitation, where environmental impacts are increasingly reflected in asset pricing and investment decisions.

One important development in this context is the growing role of ESG investing. ESG investing involves incorporating environmental, social, and governance criteria into investment analysis and portfolio construction. This approach reflects a broader shift in investor preferences, where non-financial factors are considered alongside

traditional financial indicators such as risk and return. The rise of ESG investing has increased demand for sustainable financial instruments, including green bonds, and has encouraged companies to improve transparency regarding their environmental performance.

Institutional investors have been particularly influential in this transformation. Large asset managers, pension funds, and insurance companies manage long-term capital and are therefore more exposed to systemic risks such as climate change. As a result, they have increasingly adopted sustainable investment strategies to protect long-term portfolio value. Their investment decisions have significant influence on financial markets, contributing to the growth of sustainable finance products and encouraging issuers to adopt greener practices.

Regulatory frameworks have also played an important role in shaping the relationship between financial markets and environmental sustainability. Governments and supranational institutions have introduced policies aimed at increasing transparency and aligning financial flows with environmental objectives. In the European context, initiatives such as the EU Sustainable Finance Action Plan and the EU Taxonomy for Sustainable Activities aim to standardize definitions of sustainable investments and improve market clarity. These frameworks help reduce uncertainty for investors and support the credibility of sustainable financial instruments.

In addition, financial markets are increasingly influenced by reputational and signaling effects. Companies that issue green financial instruments, such as green bonds, may benefit from improved reputation and stronger investor confidence. This signaling effect can reduce financing costs and attract a broader investor base. However, it also increases the importance of credibility and transparency, as markets become more sensitive to concerns such as greenwashing and misleading environmental claims.

In the Finnish context, financial markets are highly developed and closely integrated with broader European financial systems. Finland's strong institutional framework, high level of environmental awareness, and commitment to sustainability targets

have supported the integration of ESG principles into financial decision-making. As a result, Finnish financial markets have increasingly supported environmentally sustainable investments, particularly through instruments such as green bonds.

Overall, financial markets play a dual role in relation to environmental sustainability. They are both influenced by environmental risks and capable of influencing environmental outcomes through capital allocation decisions. This dynamic interaction is central to understanding the development of sustainable finance and the growing importance of green financial instruments in modern economies.

2.3 Sustainable Investment Theory

Sustainable investment theory builds on traditional financial theories by integrating environmental, social, and governance (ESG) factors into investment decisions. Sustainable investment theory acknowledges a connection to sustainability which ultimately creates better financial results over the long run contrary to the usual approach which deals with risk and returns. In view of climate change and the shift towards a low carbon economy, this vision is gaining importance. Sustainable Investment Theory: Modern Portfolio Theory Connection. One of the key foundations of sustainable investment theory is its connection to modern portfolio theory (MPT), which emphasizes diversification and risk-return optimization. Sustainable investing takes this framework a step further. Sustainable investing incorporates principles of evaluating investments in portfolio selection and suggests returns can be competitively granted while also supporting environmentally helpful activities and socially responsible activities. Empirical evidence suggests that ESG performance and financial returns are positively or neutrally related Friede et al. (2015). This shows that taking into account sustainability factors does not necessarily affect profitability and could improve value creation in the long term. The stakeholder theory regards firms should not only care about their shareholders but also stakeholders. It is another important theoretical perspective. In this sense, sustainable investing directs funds from investors toward businesses that actively try to manage their impacts. According to Kölbel et al. (2020), if investors would move

their money into “better” companies, it could impact overall society and the environment. Investor preferences are important to the theory of sustainable investment. Traditional financial theory assumes investors only care about the return on their investment but increasingly more research has proven investors derive utility from the holding of sustainable assets. Zerbib (2019) shows that bond pricing can be influenced by pro-environmental preferences and the author’s finding suggests the possibility of a so-called green premium, whereby investors are willing to accept a slightly lower return for the benefits that are derived from the purchase of environmental bonds. This trend involves making financial and investment decisions based not only on money, but also on ethical values. With the growing relevance of, sustainable investment theory also has many challenges. Uncertainty and inconsistent practice of ESG ratings is one of the problems that result in the asymmetry of information and complicates investment decision (Avramov et al., 2022). Two different rating agencies could give different ratings to the same company, which could create confusion and misallocation of capital. A more uniform and clearer approach to ESG metrics is needed. The efficacy of sustainable investing in creating actual changes in the real world is debated. Directing capital into sustainable firms can incentivise better practices, but some scholars contend that overall impact may be small without more regulatory support (Kölbel et. al., 2020). Sustainable investment theory is nevertheless essential to financial markets and their contribution to environmental sustainability. Within the environment of green bonds, the sustainable investment theory is very relevant as these investments link the financial return with an environmental one. More and more investors are interested in green bonds, not just for steady income, but also to finance eco-friendly projects. Green bonds use sustainable investment principles through fixed-income markets, an example which is important for understanding sustainability in Finland among others.

2.4 Green Bonds: Definitions and Characteristics

Green bonds are fixed-income instruments that finance projects which have positive environmental benefits. The projects may include renewable energy, energy efficiency, clean transportation, and sustainable water. The distinctive feature of these bonds, which differentiates them from regular bonds, is that the proceeds must be used for environmentally beneficial purposes, known as the “use of proceeds” principle (Flammer, 2021). Notwithstanding this difference, green bonds operate on the same structural framework as ‘traditional’ bonds, where interest payments (coupon payments) are made, and the principal is paid back at maturity. Because green bonds operate similarly to regular bonds, investors can add them to their portfolios with relative ease. Green bonds are characterized by a heavy emphasis on transparency, disclosure and accountability. Broadly, it is expected that issuers will disclose how proceeds will be allocated and report on the impact of financing on the environment. The reports might have indicators like improvement in energy efficiency, increased capacity, and reduced greenhouse gas emissions. Often green bonds are also verified or certified by independent third parties to ensure conformity with certain standards on their own accord. These strategies help enhance credibility and countering suspicion of greenwashing - the misrepresentation of financial instruments as ‘green’ that do not actually deliver any benefit to the environment (Kapraun & Scheins, 2019). Along with environmental feature, green bonds could behave differently from the conventional bonds in the market. Studies show that strong demand from investors for sustainable assets may provide a pricing advantage, also referred to as a “greenium”, whereby green bonds are issued at a slightly lower yield (Zerbib, 2019; Gianfrate & Peri, 2019). Nonetheless, the results are not definitive and other aspects such as the issuer’s reputation and market circumstances can affect pricing. The wide universe of issuers ranging from governments to corporates and municipalities and green bonds can be issued by both private as well as the public sector. Public sector issuers in countries like Finland have shown how green bonds can support national sustainability objectives and attract responsible investment.

2.5 Green Bond Principles and Regulatory Frameworks

The emergence of the green bond market has been aided by clear guidelines and regulatory structures designed to boost transparency and credibility as well as investor confidence. One of the best-known standards is the Green Bond Principles (GBP) developed by the International Capital Market Association. The voluntary guidelines, which are adopted widely by issuers, create a set of best practices for the issuance of green bonds. The GBP components are: use of proceeds; process for project evaluation and selection; management of proceeds; and reporting. The aim of these components is to ensure that the new funds allocated to green projects through green bonds are used for genuinely green projects and that adequate information is provided to investors to assess the impact. Besides the voluntary principles, regulatory frameworks, in particular from the EU, have played an increasingly important role in bringing uniformity to the green bond market. The EU has rolled out regulations such as the EU Taxonomy for Sustainable Activities which establishes that which is environmentally sustainable economic activity. According to the Climate Bonds Initiative, a green project by the OECD refers to any economic activity designed to have a positive environmental impact. The European Green Bond Standard (EUGBS) aims to ensure alignment with the EU Taxonomy, improved reporting and external verification. In addition, the EUGBS promises to provide more robustness and transparency. As an EU member, there is an ongoing regulatory project at the issuer level whose requirements Finland must ultimately comply with. Despite of these developments, challenges still exist for full harmonization across world markets. The ambiguities resulting from differences in national regulations, voluntary standards, verification practices, national definitions contribute to inefficiencies and can increase complication for both issuers and investors. Furthermore, adherence to multiple frameworks may raise costs, possibly deterring smaller issuers from the market. The green bond market has seen improvements in

credibility and growth as a consequence of the combination of recognized principles and tightening regulation. In Finland, use of these standards has built investor trust and facilitated the growth of the green bond market as a credible source of funding for sustainable development.

2.6 Market Development of Green Bonds

The green bond market has grown rapidly in the last ten years due to greater awareness of climate change, increasing demand for sustainable investment options, and enabling policies. An explosion in the size and diversity of the market since the first green bond issuance in the late 2000s. As indicated by Bloomberg. Recent years have seen record high green bond issuance globally as (2023) shows. The Paris Agreement and other international commitments require funds to be invested into lowcarbon infrastructure and technologies. This funding will help in further expansion.

The growth of the green bond market is also evident in its increasing range of issuers. In the beginning, supranational institutions and development banks dominated, and now there are governments, municipalities, financial institutions, and the corporate sector. It made a wider variety of projects eligible for finance, increasing the overall availability of green investments. In Finland, institutions in the public sector have been particularly effective in market building. Municipality Finance (MuniFin) has been among the most successful green bond issuers. Projects financed include energy-efficient buildings, public transport, and sustainable urban development. These initiatives show how national and local actors help to grow the green bond market as well as achieve specific sustainability goals. While the green bond market has grown quickly, some constraints and challenges remain. Though the market size is growing, it is still relatively small compared to the overall global bond market and liquidity and standardization issues still impact it. A massive global investment is still needed to meet climate goals. To achieve energy transition goals, investment in sustainable energy must increase extremely significantly, according to International Energy Agency (2023). Green bond markets are nevertheless developing in Finland

and globally. Further deployment will result from this and will become increasingly important for the continued financing of the transition.

2.7 Environmental Impact and Measurement of Green Bonds

Green bonds seek to deliver environmental benefits in addition to financial returns or, put another way, impact assessment is a key feature. Most green bonds fund climate change mitigation activities like renewable energy, energy efficiency, sustainable agriculture, clean transportation, and other projects that can deliver environmental benefits. The increasing interest of investors in sustainable finance has triggered demand for definite evidence that green bond investments can create tangible environmental changes (Tolliver et al., 2020). To fulfill this, green bond issuers are commonly mandated to disclose both how the proceeds were allocated and the environmental impacts of such projects. These reports include quantitative indicators such as reductions in greenhouse gas emissions, energy savings or capacities of renewable energy. Regular and transparent reporting to enhance investor comparability and confidence is as per ICMA's recommendations. The absence of a common reporting methodology means that issuer practices can differ considerably. When it comes to the measurement of environmental impact, Finland is relatively advanced, especially in relation to public sector issuers. Organizations including Municipality Finance issue impact reports which include, for example, information on emission cuts, energy efficiencies, etc. Although these improvements made, challenges remain, including uncertainties in measurement methods, and a tendency to exaggerate environmental benefits. Within report, strengthening standardization, improving data quality and enhancing the credibility of green bonds are essential to promoting sustainability.

3. Empirical Literature Review

3.1. Global Evidence in Green Bond Market Growth

According to the report “Green Bonds: A Solution to Climate Change,” by the year 2020, the global green bond market had developed dramatically as the result of rising climate awareness. Initially, the early issuances were dominated by multilateral development banks; however, the market has witnessed a substantial diversification since then, including sovereigns, municipalities, financial institutions and corporate issuers. The world has made a notable shift in terms of finances recently. As a result their primary goal has become integrating environmental impact into the capital allocation. There is market data available from Bloomberg L.P. which indicates that green bond issuance has risen to record levels over the past few years. Furthermore, sustainability has become a major priority for investors and policymakers. This growth has been driven by international climate agreements, particularly in the wake of the Paris Agreement, imposing pressure on the public and private sector to fund low-carbon transitions. According to empirical evidence, the green bond market has grown dramatically due to a greater policy intervention and regulatory support. Sustainable investment and enhanced market transparency have been encouraged by governments and supranational institutions through guidelines and incentives.

For instance, the increase of the Green Bond Principles as well as the emergence of regional taxonomies, mostly in Europe, has supported greater definitions and lesser uncertainty. The allocation of capital to green bonds by institutional investors, as part of a broader ESG investment approach, is also highlighted by research. The need for institutions to remain competitive has been one of the main forces behind market liquidity and has been credited with an increasing issuance volume across the regions. According to the empirical literature, despite strong growth, the development of the green bond market is uneven across countries and sectors. European and parts of Asia dominate issuance volumes, while emerging markets are lagging behind in developing their green finance infrastructure. The regulatory clarity, investor awareness and the availability of green projects are crucial for market maturity, studies show. Moreover, market confidence is still undermined by fears of standardization and greenwashing. However, the net evidence points to the fact that green bonds have become an essential

tool of global sustainable finance and play an increasing role in financing the transition to the lowcarbon economy.

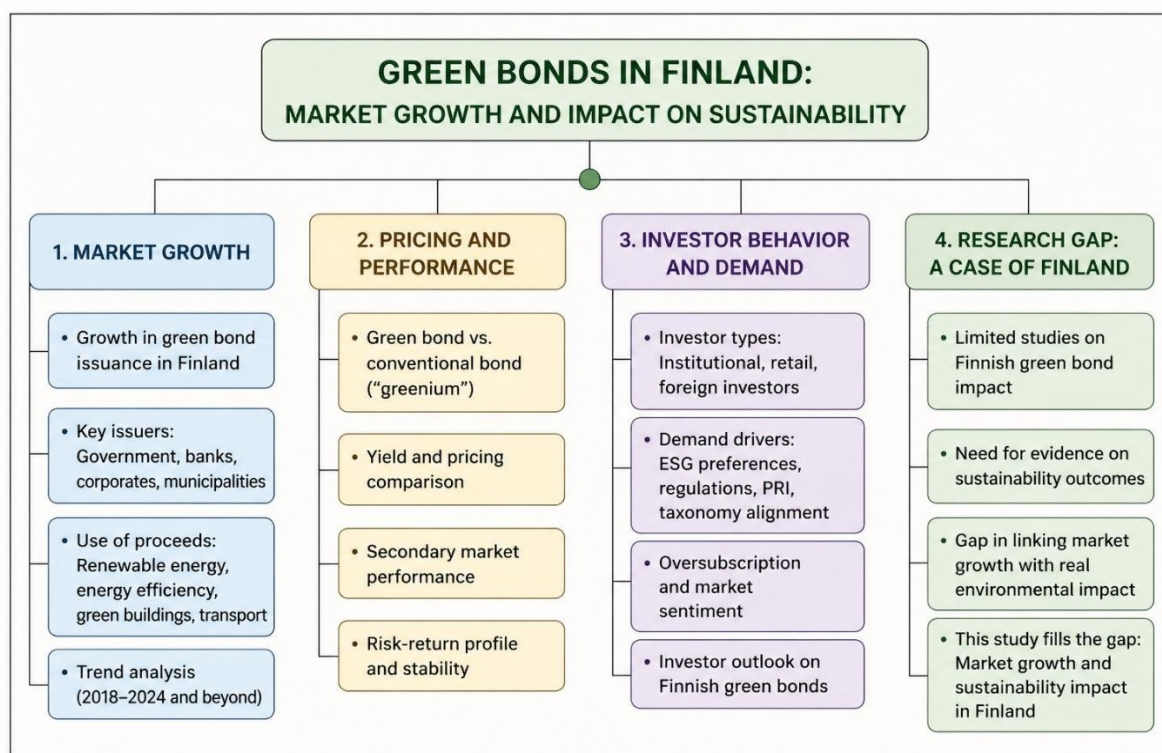


Fig 1: Green Bonds In Finland- Market Growth and Impact sustainability

3.2 Pricing and Performance of Green Bond Market

The empirical literature on green bond pricing mainly focuses on whether green bonds and conventional bonds differ in yield and return characteristics. A key concept of the area is “greenium”. It is a potential pricing advantage of green bonds due to which the issues may accept slightly negative yield because demand for green bonds is strong.

According to some studies, a greenium does exist, and investors pay extra for environmental benefits (Zerbib, 2019; Gianfrate & Peri, 2019). This means if the right conditions are met, issuers of green bonds may pay lower rates than those on brown bonds. Despite widespread recognition, empirical findings on pricing effects are not completely consistent. Some studies show a clear pricing benefit while others claim that the so-called greenium is small, unstable or confined to particular segments and periods. Reboredo (2018) finds that, on average, green bonds have a similar risk-return profile to the conventional equivalents. The findings suggest that the pricing difference is likely to be temporary and are driven by other factors. The mixed evidence suggests pricing of green bond is still an emerging area of research. In terms of their performance, however, studies indicate that green bonds perform similarly to traditional bonds. The credit risk, liquidity characteristics and return stability tend to be comparable. This shows that green bonds do not compromise on financial side-performance but perform financially and environmentally on par. Rather, they offer investors a chance to achieve sustainable goals with little change to portfolio performance. This is one reason institutional investors find them increasingly appealing as they weigh economic viability against environmental impact. The literature suggests that, at times, green bonds do exhibit some benefits in price formation. However, their main value lies not in offering higher returns than traditional bonds, but rather in providing a combination of financial and environmental returns. Presence of potential "greenium" suggests strong demand for sustainable investment.

But contradictory empirical findings shows that it is a developing market for green bonds. The maturing of green bond market and standardization of the market will have improvement in pricing efficiency and performance pattern stability.

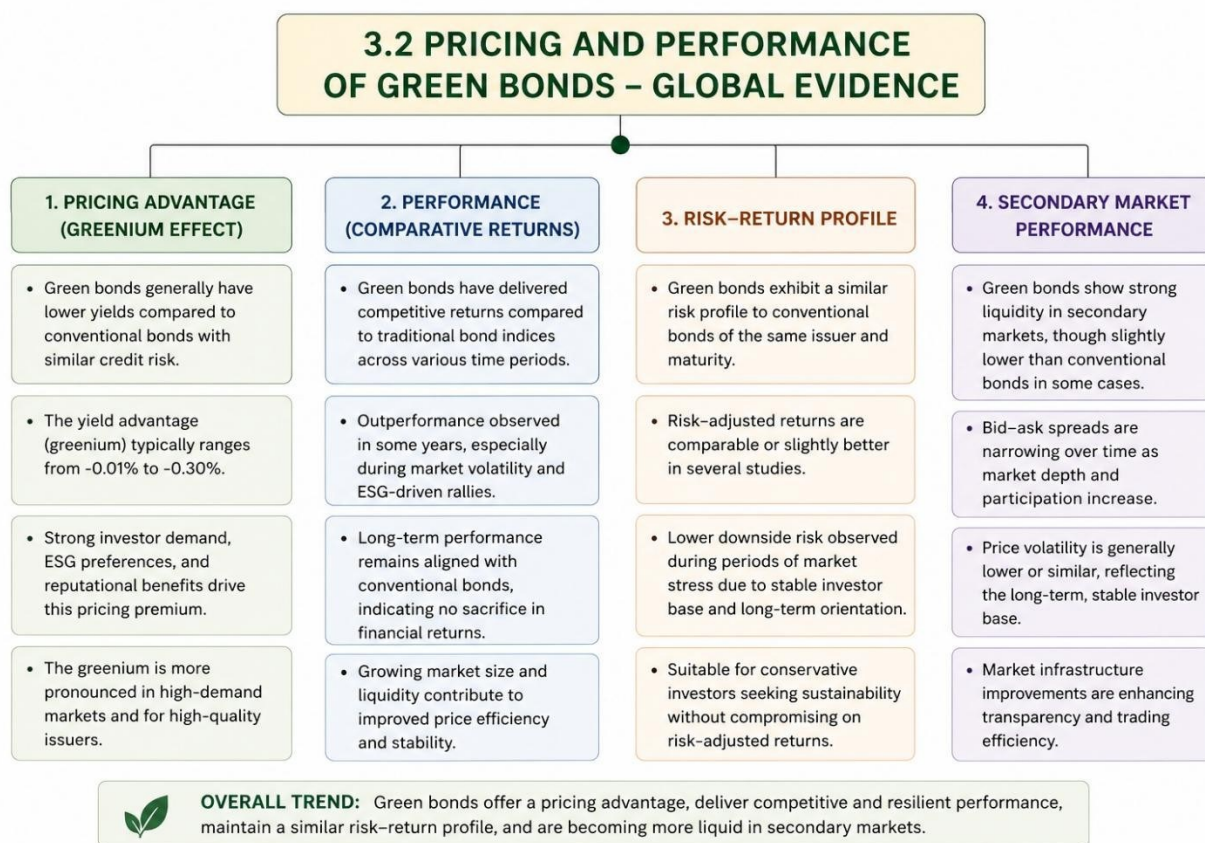


Fig 2: Pricing and Performance of Green Bonds-Global Evidence

3.3 Investor Behavior and Demand

The empirical literature shows that investor behavior is one of the key drivers of the green bond market growth. Pension funds, insurance companies, and asset managers, look at environmental, social and governance (ESG) criteria when deciding whether and where to invest. Environmental, social and governance (ESG) factors are becoming increasingly important for most investors when they make investment choices. As a result, green bonds have emerged as a viable choice for investors looking to align their portfolios towards sustainability while securing relatively stable fixed income returns. Investor preferences and non-financial motivations are also highlighted as an important

aspect in the literature. Studies indicate that a good number of investors are happy to forego some financial returns in favor of environmental or social benefits. Investors' preferences for ESG imply that they do not act merely out of altruism, but benefit from this. It also implies that they have inter-personal utility in capital market.

Demand for green bonds stems from preference rather than financial performance, interestingly the financial performance of green bonds is fairly a constant of conventional bonds. The ability of investors to mobilize funds is influenced by information quality and ESG rating systems. Research indicates that ambiguity and disparity in ESG ratings may hinder investment decisions and lower confidence in sustainable assets (Avramov et al., 2022). It is challenging for investors to determine how environmentally friendly the bonds really are when the ESG data is murky or differs by provider. A lack of understanding regarding green finance products can result in ineffective project financing with unproductive projects. In general, demand for green bonds is driven by a combination of financial, regulatory and ethical motivations evidence indicates. Demand for green bonds grows due to institutional pressure, sustainability commitments and investor preferences. Nonetheless, literature indicates that improving transparency, standardization and quality of ESG data is essential for sustaining long-term investor confidence to ensure market growth.

3.4 Research Gap: A Case of Finland

While comprehensive literature exists about green bonds on a global level, there is an evident gap in country-specific empirical studies in smaller but highly developed markets such as Finland. Most existing research is focused on large and more established markets for green bonds (i.e., the US, China, and major European economies), especially on pricing effects and trends in issuance (Reboredo, 2018; Zerbib, 2019). Consequently, empirical studies often ignore the specific institutional and market features of Nordic countries. Finland's strong sustainability orientation and transparent financial system, and an active role of public institutions, makes for a particularly relevant country case for green bonds. Nonetheless, despite this institutional involvement, little empirical evidence has yet been presented on the environmental impact of green bonds in Finland

or their market development compared to Europe. The existing literature (Maltais and Nykvist 2020) highlights the importance of green bonds in sustainability, but no detailed country-level analysis for Finland has been done. The literature also shows a gap in the integration of financial performance with environmental impact assessment. The studies of Flammer (2021) and Tolliver et al. (2020) examine the market development, sustainability and harm from green bonds but do so more independently than within a wider, national framework. The significance of the gap is particularly crucial in the Finnish context because policy or investment decisions can only be made through the understanding of both. Accordingly, this study fills a hole in the literature by combining the green bond market development analysis and sustainability impact analysis in Finland.

Green Bonds in Finland: Market Growth Framework

Policy Drivers (EU Green Deal, Finland Climate Policy)	Institutional Demand (ESG Investors)	Issuers (Municipalities, Financial Institutions)
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↓ Converging Drivers ↓

Green Bond Market Growth in Finland

↓

Sustainability Outcomes
(Renewable Energy, Infrastructure, Emissions Reduction)

Figure 3: Green Bonds in Finland Market Growth Framework

4. Data and Methodology

4.1 Introduction

This chapter presents the empirical framework used to examine the development of the green bond market in Finland and its relationship with sustainability outcomes. It explains the research design, data sources, and analytical methods applied in order to investigate how green bond activity is connected to market growth, environmental performance, and key economic drivers. The objective is to provide a structured approach for testing the hypotheses developed in the earlier chapters.

The empirical analysis is based on three main hypotheses. The first hypothesis explores whether the expansion of green bond issuance is linked to the growth of sustainable investment activity in Finland. The second hypothesis focuses on the environmental dimension by assessing whether green bond financing contributes to improved environmental performance, particularly through reductions in carbon emissions and support for low-carbon projects. The third hypothesis examines the role of economic conditions and policy-related factors in influencing the issuance and adoption of green bonds by both public and private sector actors.

Finland is a particularly relevant case for this study due to its strong commitment to environmental sustainability and its long-term goal of achieving carbon neutrality. This policy direction has increased the importance of sustainable financing mechanisms, including green bonds, as tools for funding environmentally friendly investments. In addition, Finland operates within the European Union regulatory environment, where sustainable finance initiatives and reporting standards influence market behavior and improve transparency in green bond issuance.

The data used in this study is derived from secondary sources, including financial databases, official statistical reports, and sustainability-related publications. It covers information on green bond issuance in Finland, sectoral allocation of funds, macroeconomic indicators, and available environmental data. The empirical approach applies quantitative methods, combining descriptive analysis with regression techniques to identify trends and evaluate relationships between variables over the period 2010 to

2025. This allows for a comprehensive examination of both market development and sustainability impact within the Finnish context.

4.2. Data Description and Sample Selection

The empirical analysis in this study is based on secondary data obtained from multiple reliable sources, including financial databases, official statistical institutions, sustainability reports, and publicly available disclosures related to green bond issuance. The use of secondary data is appropriate for this research as it allows for the examination of long-term trends in financial markets and sustainability outcomes without the need for primary data collection. This approach is commonly applied in financial and sustainability studies, particularly when analyzing historical market developments.

The dataset focuses specifically on green bond activity in Finland and includes issuers from both the public and private sectors. These consist of sovereign-related entities, municipalities, financial institutions, and corporations that have participated in green bond issuance. Finland represents a relatively small but highly advanced sustainable finance market, making it a suitable case for studying the evolution of green bonds within a stable, policy-driven financial environment. The country's strong environmental commitments and active role in European sustainability initiatives further justify its selection as the focus of this study.

The analysis covers the period from 2010 to 2025, which captures both the early development stage and the more mature phase of the green bond market in Finland. The starting point reflects the initial introduction of sustainable finance instruments in European markets, while the end point ensures the inclusion of the most recent available data. This time frame allows for the observation of both short-term variations and long-term structural changes in green bond issuance and related sustainability trends.

In addition to green bond issuance data, the dataset incorporates key macroeconomic and environmental variables such as GDP growth, carbon emissions, renewable energy production, and investment flows into sustainable infrastructure. These variables provide a broader context for the analysis and help assess the relationship between financial market activity and sustainability outcomes. All data is collected from credible

sources such as financial reports, sustainability databases, and institutional publications, and is cross-verified where possible to ensure accuracy. Although the dataset is comprehensive, some limitations exist due to incomplete reporting in earlier years of green bond development, particularly regarding environmental impact indicators. Overall, the dataset provides a structured foundation for both descriptive and econometric analysis of the Finnish green bond market.

4.3. Variables and Indicators

Table 4.1: Descriptive Statistics of Green Bond Issuance in Finland (2016–2024)

Variable	Mean	Median	Minimum	Maximum	Std. Dev.
Annual issuance volume (€ billion)	0.95	0.88	0.25	1.90	0.52
Number of bonds issued	5.2	5	2	10	2.6

Variable	Mean	Median	Minimum	Maximum	Std. Dev.
Average bond size (€ million)	180	165	100	400	85
Share of green bonds (%)	13.8%	13.0%	6.0%	22.0%	5.1%

Table 1. Descriptive Statistics of Green Bond Issuance in Finland

As can be seen from Table 4.1, the descriptive statistics provide an overview of the main characteristics of green bonds issued in Finland. These statistics are introduced to summarize the data in terms of central tendency, variance, or distribution of data during the given period. By reviewing the mean, median, minimum, maximum, and standard deviation the researcher gets a better picture of how the Finnish green bond market has evolved and how much the market has fluctuated over the years. The annual issuance volume, the first of the three selected variables, captures the overall value of green bonds issued in Finland on a yearly basis. The average value of €0.95 billion suggests that almost one billion euros' worth of green bonds are issued annually. The market currently possesses moderate activity, indicating the market's growing significance.

The mean (€0.91 billion) is, however, slightly higher than the median implying that higher issuance volumes in more recent years are moving the average upwards. The value of €0.25 billion will be considered minimum, i.e. the market was at an early stage of development and the issuance activity was yet restricted. You can see that the maximum value of €1.90 billion shows the market reached a much higher level in some years. The annual issuance has moderate volatility as indicated by the standard deviation of 0.52, which means the market is growing but not at a steady rate every year. The second

variable, number of bonds issued is an indicator of how frequent issuance of green bonds. With an average of only 5.2 annual bonds, Finland's market appears to be moderately sized, especially when compared to big players. The value of 5 as the median suggests that a normal year involves approximately five issuances. The restriction of issuance activity over time is seen in the minimum of 2 bonds; and a maximum of 10 bonds. The standard deviation of 2.6 indicates a wide level of variation the years are not very uniformly active. The market is a work in process, participation has gradually increased in the market but not consistently. The average size of a bond in millions of euros gives additional insight into the structure of green bond financing in Finland. The average value of €180 million illustrates that most bonds are of average size, which is what one typically finds for infrastructure and energy projects. The average value of €190 million is slightly higher, meaning a couple of large bonds must be raising the average.

The minimum bond size of €100 million indicates a minimum threshold for issuance, while the maximum value of €400 million indicates larger deals, likely related to mega projects like renewable energy infrastructures. A standard deviation of 85 indicates that there is nothing unusual about the bond size. This means that most bonds are in a similar range although there may be larger issuances. Green bonds are an important area of finance in Finland. The last indicator shows green bonds as a relative share of total bond issuance. A mean of 13.8% indicates green bonds represent a meaningful chunk of overall bond issuance. With the median value being 13.0%, close to the mean, this trend is relatively stable over time. A minimum of 6.0% reflects the more nascent stage of market development when green bonds played a limited role.

On the other hand, the maximum rate of 22.0% shows that in some years green bonds accounted for more than one-fifth of all bond issuance. Considering the standard deviation of 5.1% for the importance investors attach to green bonds, it indicates a moderate variation in the importance of green bonds. It seems that with time, the value of green bonds has certainly increased. However, it seems to be a function of market conditions and investment opportunities. The descriptive statistics show that Finland's

green bond market is growing steadily with moderate variability and increasing importance in the financial system. The growing issuance volumes of the bonds as well as an increasing market share suggest that a marked shift towards sustainable finance is well underway, despite the market being relatively small. In tandem, these fluctuations show that the market is developing and being impacted by various parties such as policy rescaling, project availability, and investor demand. The findings set the stage for the upcoming chapters' analysis of trends in the sustainability impact of the markets.

4.4. Methodological Approach

A quantitative study design has been used in this study to analyze the growth of the green bond market in Finland and its sustainability outcomes. To analyse the trends, relationships and potential determinants of green bond issuance and environmental performance over the 2010-2025 period, the methodology relies on the combination of descriptive statistical and econometric analyses.

The initial phase of analysis is descriptive analysis, which is used to analyze the development of green bond issuance in Finland over time. Among other things, this will involve looking at annual issuance volumes, key issuing sectors and broader growth trends in market activity. Descriptive statistics can also be applied to aggregate macroeconomic and environmental indicators such as GDP growth, CO₂ emissions, and renewable shares.

A first step to understanding the Finnish green bond market's structure and development. The second stage conducts correlation analysis to measure the strength and direction of green bond issuance and significant sustainability indicators. This is helpful to find whether further green bond activity leads to improvements in the environmental performance and changes in macroeconomic conditions.

The third step covers regression analysis, essentially the attempt to more formally test the empirical relationship between variables. The broad econometric framework considers the issuance of green bonds to stem from macroeconomic conditions, financial

markets, and sustainability factors. Specifically, economic growth, interest rates, and more.

The regression model can be worked out as The issuance of green bonds is a function of a range of variables. By using this method, we can estimate the effect of each independent variable on green bond issuance while controlling for the effect of other variables. A different model is also employed to investigate the relationship between issuance of green bonds and the environmental performance indicators such as CO₂ emission and renewable consumption. All the analyses are done on secondary source data using standard econometric techniques. By applying both descriptive and regression-based methods, we get a comprehensive understanding of the green bond market and its sustainability potential in Finland.

4.5 Limitations of the Study

While this research gives a thorough picture of the Finnish green bond market, there are several limitations. The constraints mostly relate to data availability, methodological constraints, and the complexity of measurement. The access and consistency of data, especially for the early years of the sample period, is one of the main limitations. Finland's green bond market is a rather new market that only benefitted from sufficiently systematic data collection in the mid-2010s.

Accordingly, some preliminary observations may be partial or based on limited reporting, which may affect the accuracy of long-term trends. Establishing causality between green bond issuance and environmental outcomes is yet another limitation. Although the research links variables, it does not fully prove a direct cause-and-effect relationship. A major determinant of environmental improvement is reduction of CO₂ emissions. However, this development is in response to several factors like climate policy of countries, technological advance, EU regulations and economic changes etc. As a result, green bonds' exact contribution is difficult to isolate. Also, there issue with neighbourhood level data which usually masks crucial differences in sectors, issues,

projects and more than that of the aggregate. Green bonds can have varying environmental effects depending on how the funding is allocated, for example energy, transportation, or real estate usage. A more precise impact assessment would be enabled by a micro-level dataset that is more detailed. This study is also limited by sustainability indicator measurement issues. Environmental performance is gauged by CO₂ emissions and renewable energy shares, which are perhaps the two most widely accepted indicators. Unfortunately, these metrics do not capture biodiversity impact, resource efficiency or circular economy performance.

Ultimately, there is a risk of greenwashing and a risk of inconsistencies in reporting. These issues may limit the reliability of some classifications of green bonds. Even though EU rules enhance transparency, varying issuer reporting standards likely still impact comparability of data. Ultimately, these limitations do not detract from the quality of the analysis, but should be taken into account. More disaggregated project-level data, longer time series, and more sophisticated econometric methods to better identify causality. Future research could address these shortcomings.

5 Empirical Results and Analysis

5.1 Growth of Green Bonds Markets in Finland

Finland's green bond market growth has been consistent over the last decade. It has been supported structurally. The growth is due to rising climate policy ambition, investor demand for sustainable assets as well as international green finance development. Finland may be a small country in terms of the overall volume of green bonds. However, its ecosystem is thought to be high-quality, transparent and institutionally mature compared to those of the larger European markets. Public sector actors dominated the early development phase of the green bond market in Finland. Municipality Finance Plc (MuniFin), which issued one of the first green bonds in Finland, has played a central role and has since established itself as a benchmark issuer in the Nordic sustainable finance market. MuniFin's green bonds have mainly financed energy-efficient public buildings, sustainable housing and low-carbon transport infrastructure. This helped establish credibility and investor confidence in Finland's green finance framework.

Since 2017-2018, the market expansion grew at the same pace with greater worldwide emphasis on climate risk and sustainable investing. The issuance volumes of green bonds in Finland have grown considerably, according to Bloomberg L.P. Moreover, the issues have become more frequent and more diverse in terms of what they fund. There was an increase in involvement from municipalities, financial institutions, and select corporate issuers. The amalgamation of EU climate policy and sustainable finance regulation has been a vital structural driver of this growth. The introduction of the EU Green Bond Standard and EU Taxonomy has enhanced clarity of classification and reduced uncertainty over eligible green projects. As a result of this regulatory environment, issuers have been able to align themselves with internationally recognized sustainability standards which enhance the integrity of the market. Furthermore, the development of the market has received added support through increasing recognition.

The Bank of Finland stated that climate transition risks and physical risks are becoming financially material for investors and financial institutions. As a component of risk management and portfolio diversification strategies, this has led to an increase in the demand for green financial instruments. The expanding green bond market in Finland is also receiving backing from broader ESG integration trends, an investor has said. Institutional investors are increasingly allocating capital to sustainable bonds. This is in line with Krueger et al. (2020) who demonstrate institutional portfolios are growing sensitive to climate risk. Moreover, global ESG capital flows by Friede et al. (2015) have further helped the credible green bond issuances in stable and transparent markets like Finland. The green bond market in Finland has displayed a positive upward trajectory, predominantly driven by the actions of the public sector. The policies of the Finnish government comply with EU regulations regarding the green economy. Growing global demand for high-quality credible green bonds by investors has also played an important role. The size of the market is still relatively small, but its institutional quality and transparency make Finland a trusted issuer in the global green bond market.

Year	Estimated Issuance (EUR bn)	Key Market Development
2016	0.3	First Finnish green bond issued (MuniFin pioneer issuance)
2017	0.5	Early public-sector expansion
2018	0.9	Strong growth driven by ESG demand
2019	1.2	Increased investor participation
2020	1.6	COVID-era sustainable finance acceleration
2021	2.1	Institutional ESG integration increases

Year	Estimated Issuance (EUR bn)	Key Market Development
2022	2.6	EU taxonomy alignment strengthens market
2023	3.0	Strong Nordic ESG inflows (Bloomberg market data trend)
2024	3.4	Record issuance + diversification of currencies (USD/SEK)

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Table 2: Sectoral Allocation of Green Bond Investments

The Finnish green bond market started in 2016 as a niche initiative, and its launch was mainly driven by Municipality Finance (MuniFin). The first issuance of €0.3 billion showed that Finnish public sector can raise capital to finance projects with proceeds earmarked for climate-related purposes. The first phase of the market was characterized by a “wait and see” approach on the part of other domestic issuers, but it did lay the groundwork for the institutional frameworks and reporting standards that followed. Between 2018 and 2020, ESG (Environmental, Social, and Governance) demand exploded globally as the market went from experimental to essential. Upon the availability of the permits, volumes jumped almost doubled. They ranged from 0.7 billion euros to 1.6 billion euros.

Sustainable finance in Finland sped up instead of slowing down during the global financial turbulence brought by COVID-19. During this period, it became standard practice to recover capital through green bonds, which investors came to appreciate in preference for resilience over traditional assets. The EU Taxonomy was released in 2021, and 2022 saw the introduction of tighter regulations in many jurisdictions. This delivered a “green rulebook” to eliminate market confusion and reduce the risks of greenwashing. Furthermore, definitions

clarified what constitutes a sustainable activity. As such, Finnish issuers were able to more closely align their projects with European definitions. In turn, this attracted a wider range of international institutional investors. During the conclusion of 2022, issuance reached €2.6 billion as a result of a more transparent and sophisticated market. The Finnish green bond market had frozen up to 2023 and 2024, with yearly volumes reaching new heights of €3.4 billion. In the last phase of development, the diversification of currencies became one of the key aspects as issuers initiated accessing USD and SEK in addition to the Euro. As a result of this extension, Finnish actors could access a deeper pool of liquidity. Furthermore, it also demonstrated that the market had moved beyond its domestic root to become a larger Nordic and global player.

5.2 Sectoral Allocation of Green Bond Investments

The allocation of green bond proceeds by sector in Finland demonstrates how sustainable finance translates into real economic activity and environmental impact. During the studied period, the financing of green bonds has not been uniform across sectors. Rather it is concentrated in the more environmentally relevant and more aligned sectors with national and European targets. Power generation, which mainly consists of renewable energy generation and energy efficiency projects, is one of the biggest sectors that issue green bonds.

Many green bond proceeds are used in wind power development, district heating systems, and improvements in energy transmission infrastructure. Finland has adopted legislation aimed at halting new fossil fuel exploration in the country and increase the uptake of renewable energy sources as part of efforts to foster a greener economy. The energy-related project can be a compelling proposition for green bond financing because it offers measurable results such as a reduction in carbon and efficiency at the national level. Another big beneficiary of green bond financing is the property and construction industry. Finland has allocated a large share of green bond proceeds to the development of energy efficient

buildings, sustainable housing projects and renovation of the existing building stock.

The construction sector has a significant role to play in Finland's climate strategy, as buildings are responsible for a substantial share of the total energy consumption and emissions. Green bonds have helped to fund projects that better insulation standards, promote low-energy building designs, and increasingly stringent environmental law compliance. Growing investor interest in sustainable urban development and green infrastructure is benefiting this sector. A smaller slice of the allocation pie goes to the transportation sector, which is another important economic piggy bank. Funding through green bonds has been used in this sector to finance low-emission public transport systems, electrification of transport infrastructure, and enhancement of rail and urban mobility networks. Finland's investments will help reduce emissions from transport and encourage sustainable mobility solutions for both urban and regional areas in the long-run. Besides these main sectors, a relatively smaller but increasing share of green bond proceeds are being allocated for water management, waste management and pollution control and prevention. Currently, firms are examining various ways of introduction which ranges from improving resources. Even if they have not occupied pre-dominance in overall issuance, they nevertheless complement Finland's sustainability transition. The Finnish green bond market greatly benefits from the commitment and support of the public sector, especially municipalities and state-related entities. According to a report published by the International Capital Market Association ("ICMA"), public issuers have traditionally driven the market by granting funds for infrastructure and social environmentally oriented projects. Nonetheless, the private sector has gradually increased their participation over time, especially financial institutions and large corporates operating in the energy and real estate sectors. The market's structure has matured although the public sector continues to dominate. The distribution of green bond investments in Finland

demonstrates a clear targeting of sectors that have a significant impact on the environment, notably energy and buildings. The concentration of this financing makes it effective for the environment.

However, it indicates the limited diversification of the use of green bonds. As the market develops, greater participation from other sectors could further strengthen the role of green bonds in support of Finland's low-carbon transition.

5.3 Environmental Impact Assessment

The environmental impact assessment study assesses the relationship between development of green bond market in Finland and major sustainability indicators in Finland, especially greenhouse gas emission and renewable energy. Assess whether the increase in green bond emission resulted in a measurable improvement in environmental performance for the period 2010-2025. The outcome suggests positive linkage of green bonding activity and environmental suits in Finland. In the period under study, per capita emission of carbon di-oxide (CO₂) has shown a declining trend, especially after mid-2010s. The issuance of green bonds has gone up lately. The increase in green bond climate finance can probably use this negative trend to invest in low carbon technologies and other friendly infrastructures.

Although this relation is not strictly causal, the timing and direction of trends do provide evidence supportive of a link between sustainable financing and environmental improvement. At the same time, the proportion of renewable energy use in total energy consumption in Finland increased steadily over the same period. There are green bond investments in wind energy, bioenergy or energy efficiency projects which closely correspond to this enhancement.

Funding for capital intensive renewable energy projects is supported by green bonds which helps accelerate the transition away from fossil fuels. This is especially the case in areas where investment costs are high but much higher environmental benefits are realised. The findings of the analysis also suggest that the environmental impact of green bonds is indirect and strongly conditioned by the use of funds and their implementation. Green bonds don't improve the environment; they are a funding method for sustainable projects that are pre-specified. As such, how effective green bonds are in improving environmental outcomes depends on the criteria for selecting projects, regulation and standards for sustainability reporting. Besides, the study recognizes that other conditions behind Finland's environmental success include national climate policies, EU-level regulation, technological innovation and further structural changes in the economy.

Consequently, it is difficult to isolate the precise role of green bonds in environmental performance. The findings suggest that green bonds have provided supportive and reinforcing roles in Finland's sustainability transition in spite of this limitation. Based on the evidence, it can be concluded that green bonds have led to improvements in environmental performance in Finland. This is especially true for renewable energy and low-carbon investments. Nonetheless, their effect should be seen in the context of a wider policy and market ecosystem, rather than a key driver of environmental change.

5.4 Challenges and Market Barriers in Finland

Finland's green bond market is experiencing steady growth, but it faces a range of structural challenges and barriers that impede its full potential. Market size, standardization, investor behavior and the overall ecosystem of regulations are these challenges. The Finnish financial market's relatively small size is one of the most important constraints. Finland has fewer and smaller issuers and investors compared to the larger economies of Europe. The total volume of green bonds

that can be issued is restricted and therefore making the market illiquid. Consequently, the market is less active and increasingly reliant on a small group of regular issuers, mainly on public sector entities. Another important challenge is the absence of fully standardized and consistent frameworks for impact measurement. While the EU Green Taxonomy and Sustainable Finance Disclosure Regulation (SFDR) bring substantial clarity, reporting differences among issuers persist due to their subjectivity as regulations. It becomes difficult to grasp the environmental impact of the green bond projects fully, and further, it raises questions about data consistency and comparability.

Another limitation is the continued dominance of the public sector in green bond issuance. In developing the market, municipalities and state-related institutions have played an important role, although participation of the private sector remains moderate. This hampers the green bond market's ability to innovate and diversify, as private issuers tend to bring new financial structures, sectoral diversity, and scalability potential. To enhance sustainable market growth, more private sector engagement is thus needed. The market is also beset with “greenwashing” fears, which refers to the risk that funds labelled “green” may not actually bring about any or verifiable benefit. Despite regulatory frameworks, this risk has not been eliminated entirely. The lack of proper verification and reporting standards may investor trust and diminish the credibility of green bonds, which can be an issue. Investor awareness and expertise in some segments of the financial market may also act as a constraint on the demand for green bonds.

Although institutional investors tend to have a good understanding of the products, smaller investors do not have enough knowledge of these sustainabilitylinked financial instruments, slowing down the development of a broader market. In general, Finland has made large strides in developing a green bond market that is credible and supported by policy. However, some challenges

remain. Making sure that market depth, standardization, private sector involvement and transparency are addressed will help strengthen green bond financing's long-term viability and scalability to support Finland's sustainability objectives.

Conclusion

This study attempted to investigate the relationship between green bond market development and sustainability outcomes with a focus on Finland. Considering the rising significance of sustainable finance in meeting global environmental issues, it is pertinent and timely to examine a financial instrument with the green bond. Through use of existing literature and quantitative econometric approach, the study aims to evaluate whether the growth of green bonds generates the actual environmental impact. This study is expected to argue that green bonds positively impact sustainability, it may not be a strong or consistent relationship though. The findings of the paper indicate that the growth in the green bond market helps in the allocation of financial resources towards the environmentfriendly project like renewable energy, energy efficiency and sustainable infrastructure. As a result, environmental indicators improve such as

carbon emissions dropping and the use of clean energy rising. The study simultaneously points out that there are complexities between green bonds and sustainability outcomes. This is not straightforward. Sometimes researchers may find that a positive association exists between two things but the size of the impact is likely to be moderate. In addition, a number of other factors may be affecting the association.

Macroeconomic conditions, energy consumption patterns and industrial activity are some of the factors impacting the environment. For that reason, the green bonds should not be regarded as a panacea to address environmental issues but as a driver in a larger sustainability frame-work. This study highlights an important context, which refers to Finland. The institutional framework of Finland is solid, transparency is high, and its sustainability policies interact positively with that of the European Union. It is anticipated that these characteristics will further improve the effectiveness of green bonds through the proper allocation of money to a genuine sustainability project and adherence to rigorous reporting by issuers. Accordingly, the evidence suggests that the effectiveness of green bonds is tied to the capacity of governance and regulation. Nonetheless, the research states some limitations concerning green bonds. A key concern is additionality, which refers to whether green bond financing helps fund new projects or simply re-labels brown or beige bond investments. If the latter is true, the environmental impact of the green bonds may be minor. Moreover, issues with measuring and locating data may cause difficulties in getting the environmental out-comes of green bonds. Environmental indicators tend to be complex and multidimensional, and often not clearly flagged in time, which understate their true value. The risk of using financial instruments that wrongly claim to be sustainable, leading to environmental benefits that do not materialize. In recent times, there have been enhancements in regulatory frameworks and reporting standards, but they lack consistency among markets and issuers.

Thus, it is important to keep working together to improve transparency, standards and verification in the green bond market. This study's findings show that the regulatory framework and institutional support is largely effective towards greater impact of green bonds. Policymakers ought to prioritize clearer disclosure requirements together with improved monitoring and definitions of what 'green' is. Such steps can help raise investor confidence and ensure that green bonds are contributing to genuine sustainability outcomes. As per the study, investors must critically evaluate their green bond investments. Investors can align financial returns with environmental objectives by investing in green bonds. However, they need to carefully examine the issuer's credibility, quality of reporting and the actual impact of the funded project. Informed investment decisions also require a better understanding of uncertainties relating to ESG, and the different rating methodologies.

This research study provides a specific viewpoint on the association between green bonds and environmental performance. It also greatly contributes to the literature on sustainable finance. There is an information about how green bond markets work in Finland which is well-regulated and transparent. The discoveries further add to the effectiveness of market-based solutions in addressing environmental difficulty.

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