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Green Bonds: Filling the Sustainable Development Goals Gap - Investigating the Role of Green Bonds in Financing the Achievement of the SDGs

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Abstract:

Lately, the concept of sustainability has gained growing importance, leading to the creation of financial instruments to address pressing environmental concerns. Among these, green bonds have become a significant tool, aligning financial efforts with environmental preservation and economic growth. This thesis investigates the role of green bonds in achieving the Sustainable Development Goals (SDGs) compared to conventional bonds. It examines the effectiveness of green bonds, explores the influence of the country of issuance, and assesses their impact on firm profitability. Using Ordinary Least Squares (OLS) regression models and a dataset of bonds issued in 2023 across different countries, the study finds that green bonds significantly enhance SDG scores compared to conventional bonds. The impact of green bonds varies by country, with nations having robust regulatory frameworks and supportive policies, such as Denmark and the Netherlands, demonstrating greater benefits. However, green bond issuance shows a negative impact on Return on Assets (ROA), indicating that the financial benefits of these bonds may take longer to materialize. The study underscores the need for a long-term perspective in evaluating green investments and highlights the importance of supportive national policies. Recommendations for future research include exploring longer lag periods, employing longitudinal approaches, and addressing bond misclassification. The research contributes to the field of sustainable finance by providing empirical evidence on the effectiveness of green bonds in achieving SDGs. It also offers insightful information for policymakers, investors, and firms on leveraging green bonds to achieve sustainability targets.

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1. Introduction

The conversation about sustainability has risen to the top of international agendas in recent years. Along with that, financial instruments have been developed to address pressing sustainability issues. Among these, green bonds are playing a growing role (OECD, 2020). Pacts and agreements, such as the Paris Agreement, the Kyoto Protocol, and the United Nations Framework Convention on Climate Change (UNFCCC), were created for this purpose, which have tried to establish specific targets to safeguard the planet. The Paris Agreement, dated 2015, delineated 17 ambitious goals to be achieved by 2030: the Sustainable Development Goals (SDGs). As highlighted by the United Nations, the SDGs are "a universal call to action to end poverty, protect the planet, and ensure that by 2030, all people enjoy peace and prosperity" (United Nations, 2023).

However, as of 2023, the United Nations estimation indicates a stark reality: only 18 percent of the SDGs are on track for global attainment by the designated deadline. Considering these developments, the Sustainable Development Report from the United Nations (2023) underscores a critical imperative: achieving the SDGs necessitates bold and sustained investments across eight key domains of capital-human, infrastructure, natural, innovation, business, social, urban, and cultural. This comprehensive approach underscores the multifaceted nature of sustainable development, demanding concerted efforts across diverse sectors and disciplines. As a study from Islam and Rahman (2023) highlighted, the majority of investment deals are concentrated on just four SDGs: No Poverty (SDG 1), Zero Hunger (SDG 2), Good Health and Well-being (SDG 3), and Decent Work and Economic Growth (SDG 8).

Understanding the mechanism to finance these ambitious goals is crucial for policymakers, investors, and academics alike. The financial landscape has also evolved introducing innovative financial instruments like Green, Social, and Sustainability (GSSS) bonds. These instruments represent the emerging field of green finance, which links financial efforts with environmental preservation and economic progress, as they are designed to positively impact the environment. Green bonds are part of green finance, which, by looking into the definition, is "a type of future-oriented finance that simultaneously pursues the development of financial industry, improvement of the environment, and economic growth" (Noh, 2018, p. 7).

Despite the positive developments, significant gaps remain in financing the SDGs. Previous studies have explored the role of green bonds in advancing sustainable development, highlighting their potential benefits such as expedited fund-raising, enhanced reputation, targeted investment, and positive environmental impacts (Ahmed et al., 2023; Alamgir & Cheng, 2023; Tang & Zhang, 2020). However, challenges such as financial gaps and skewed allocation of investments persist, highlighting the need for innovative financing mechanisms (OECD, 2021).

Addressing the pressing need to explore the effectiveness of financial instruments in achieving sustainability targets, this thesis asks the following research question: *Do green bonds contribute more to the achievement of the Sustainable Development Goals compared to conventional bonds?* This question is motivated by the urgent need to explore the effectiveness of financial instruments in achieving sustainability targets and to fill the gaps identified in previous studies. Determining if green bonds are more effective than conventional bonds in contributing to the SDGs is crucial for guiding investment strategies and policy decisions. Furthermore, analysing how the nation in which they are issued affects their efficacy and how SDGs and green bonds affect a firm's profitability offers a contribution to the literature about green finance.

Building on previous research, this thesis seeks to investigate the efficacy of green bonds in achieving the SDGs and the extent to which they contribute to progress compared to conventional bonds. By examining the correlation between a country's SDG performance and its use of green bonds, this research aims to discern patterns of success and areas for improvement within Europe, leveraging the decisive midpoint year 2023 to assess progress toward the 2030 deadline.

The thesis is structured as follows. The first section includes a thorough analysis of the literature on green bonds, the SDGs, and how they affect company profitability. This section lays the groundwork for the following analysis. After that, I outline the hypothesis, setting the stage for the methodology section, where the data gathered are explained and discussed. Through this structured approach, the study aims to contribute to the literature by exploring whether green bonds are effectively filling this gap compared to conventional bonds. From the literature reviewed, no other paper has addressed a similar research question with the same methodology applied here, aiming to fill this gap and provide new insights into the role of green bonds in sustainable development.

2. **Literature review**

2.1 Green bonds

2.1.1 Introduction to Green Bonds

According to the OECD, Green Bonds are *"debt instruments used to finance green projects that deliver environmental benefits"*. In contract to conventional bonds, the funds raised through green bonds are specifically allocated to finance or refinance environmentally beneficial projects, assets or business activities. Either public or private actors can issue them to raise capital for such projects (OECD, 2021).

The European Investment Bank issued the first equity index-linked bond associated with socially responsible investments in 2007. These so-called Green Bonds, a subset of fixed-income securities, function similarly to conventional corporate and governmental bonds regarding their financial structure, including pricing mechanisms and credit ratings. However, what sets them apart is their designed use of proceeds by issuers for environmentally beneficial projects (Reboredo, 2018). At the beginning, the market for Green Bonds was relatively small and dominated by supranational issuers, particularly between 2007 and 2013 (Monk & Perkins, 2020). This landscape shifted significantly with the introduction of the Green Bond Principles (GBP), voluntary guidelines for the selection, management, evaluation, and disclosure of green projects. They were created by the International Capital Markets Association in 2014 and marked a turning point in the market's growth trajectory (Cortellini & Panetta, 2021).

Green Bonds provide different advantages over conventional bonds. Some of them are the speed of raising funds, the enhancement of a country's reputation in the world market, and the targeted spending of investments and profits (Tang & Zhang, 2020). As Green Bonds also rely on third-party certification, investor confidence is also boosted (Caramichael & Rapp, 2024).

Green bonds are part of the broader Green, Social, Sustainability and Sustainability-linked (GSSS) Bond market. As stated by the OECD (2021), the GSSS has gained power over the last few years and can help to fill the SDG Financing Gap by directing their funds to finance specific projects.

2.1.2 Evolution and Framework of Green Bonds

The GBP is a voluntary framework that aspires to promote sustainability in global capital markets by establishing clear guidelines for green bond issuance. These principles delineate four specific criteria. The first one is the use of proceeds, which mentions how the funds will be allocated. There are specific Green Projects categories, which include, among others, renewable energy, energy efficiency, pollution prevention and control, and so on. The second one is the project evaluation and selection

processes, followed by the management of proceeds and finally reporting. The issuer is required to disclose the use of proceeds and the environmental impact of the projects (Green Bond Principles, 2021). This framework not only provided clarity and consistency, but also facilitated the differentiation between labelled and unlabelled green bonds, increasing investor confidence and accelerating market growth. However, there were other factors that contributed to the performance of green bonds in previous years outside the GBP's implementation. In addition, the increasing concern related to climate-related issues in recent years and the realization that people are responsible for the process of global warming also contribute to the explanation of the great performance of green bonds (OECD, 2020).

2.1.3 Assessing the Impact of Green Bonds

Numerous studies explore the impact of green bonds from various perspectives. Hammoudeh et al. (2020) investigate their role in advancing stakeholder interest and mitigating climate change, finding substantial benefits. Jian et al. (2022) and Yeow and Ng (2021) examine their implication for bond portfolios and corporate performance, respectively. Jian et al. (2022) suggest that green bonds are typically included in short positions in bond portfolios, while Yeow and Ng (2021) indicate that third-party certification enhances the environment but not necessarily financial performance. According to Maltais and Nykvist (2020), investors use green bonds to achieve their sustainability commitments without increasing risk, rather than actively manage their transition risk or diversify their portfolios. Sartzetakis (2020) highlights the crucial role of the green bonds market in financing the transition towards a more sustainable economy and growth.

2.1.4 Green bonds and conventional bonds comparison

From different studies emerged that green bonds have various benefits compared to conventional bonds. Dong et al. (2023) find that green bonds can hedge more risks compared to conventional bonds. In addition, they can be beneficial for pro-environmental features (Jin et al., 2020) and support a low-carbon economy (Hammoudeh et al., 2020). In line with the signalling theory, firms issuing green bonds gain more support from the public because of the pro-environmental signals they send to the market (Flammer, 2021). Regarding the yield of green bonds, i.e. the return that the investor is expecting, studies have shown mixed results. Zerbib (2018) notes a small negative premium for green bonds compared to conventional bonds, meaning that investors are willing to accept a lower yield or below-perceived value. This phenomenon is called "greenium". Conversely, Haddad and Rokhim (2022) find no significant difference in the yield between green and conventional bonds. Between European companies, Gianfrate and Peri (2019) observe that green bonds are more financially convenient for corporate issuers, a benefit that persists in the secondary market. These findings

support the view that green bonds can potentially play a major role in greening the economy without penalizing issuers from a financial point of view.

2.1.5 Corporate and Environmental Performance

The issuance of green bonds can impact both corporate and environmental performance. Flammer (2021) observes post-issuance improvements in environmental performance among green bond issuers, along with positive market responses. Similarly, studies focusing on the Chinese market by Zhou and Cui (2019) and Wang et al. (2020) highlight improvements in companies' stock prices, profitability, and innovation capacity following green bond issuance. Additionally, green bonds can attract long-term-oriented investors who might not otherwise be interested (Baker et al., 2018; Flammer, 2018). However, concerns persist regarding the scalability of these improvements at the firm level and their potential for greenwashing (Sartzetakis, 2020). For this purpose, there is a need for more regulations and transparent and standardized disclosures (Talbot, 2017).

Regarding environmental performance, Fatica and Panzica (2021) find that firms borrowing in green fields experienced a reduction in their carbon intensity, particularly for bonds with an external review, signalling climate-related engagement. Kanamura (2020) notes that the issuance of green bonds correlated with reduced use of fossil fuels. Nevertheless, Benlemlih et al. (2022) suggest that reducing carbon emissions intensity may require additional time and regulatory interventions.

2.1.6 Challenges and Future Directions

Even though green bonds can drive sustainable development, challenges still remain. Sartzetakis (2020) warns against the risk of greenwashing and point out the importance of aligning investments with low-carbon initiatives. Maltais and Nykvist (2020) underscore the need for strong alignments of incentives between issuers and investors to avoid misalignments in green bond investments. Reporting allows investors, regulators, and other stakeholders to determine if proceeds have been allocated to eligible green projects and their environmental impact. While green bonds may enhance overall environmental performance, Benlemlih et al. (2022) suggest that reducing carbon emissions intensity may require longer time.

2.2 SDGs

2.2.1 Introduction of Sustainability and SDGs

The concept of sustainable development was first introduced in 1987 by the United Nations Commission on Environment and Development in the Brundtland Report. Sustainable development aims to meet the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). Building on this concept, the United Nations introduced the

Sustainable Development Goals (SDGs) in 2015 as part of the 2030 Agenda for Sustainable Development. The SDGs are a program aimed at ending poverty, preserving the planet, and ensuring that everybody lives in peace and prosperity by the intended deadline (United Nations, 2015). The SDGs encompass the 5 Ps of development: people, planet, prosperity, peace, and partnerships (Medina-Hernàndez, 2023). These elements are essential for humanity and aim to end famine, ensure peaceful living among people, and protect the planet (Santika et al., 2019).

The SDGs were first introduced during the Paris Agreement by 196 Parties at the UN Climate Change Conference (COP21). During the same conference, they decided to pursue efforts to keep the increase of the global average temperature 2°C above pre-industrial levels. However, due to the current situation, experts have stressed the necessity of keeping the limit to 1.5 °C by the end of this century (Hoegh-Guldberg et al., 2019). At the heart of this agenda is the development of 17 interconnected and measurable SDGs to be achieved by 2030. The 17 goals are divided between 169 associated targets to guide the efforts of the government and non-state actors.

2.2.2 Challenges and current situation

As the second half of the journey toward the achievement of the SDGs began, the United Nations report, as of 2024, drastic statistics. Only 15% of the SDGs targets are on track, nearly 50% shown minimal progress, and one-third is stalled or even regressed (United Nations, 2024). While the COVID-19 pandemic significantly impacted progress, the pace was slow also before 2020. Other factors influencing the current status include climate change, wars, supply-demand disruptions, inflation, energy problems, and trade-offs between various SDGs (United Nation, 2022).

Nevertheless, since its implementation in 2015, significant progress has been made towards the Sustainable Development Goals (SDGs). However, as Benlemlih (2019) highlighted, no country is currently on track to meet these ambitious targets by the designed 2030 deadline. One significant obstacle to achieving the SDGs is financial. According to Beal et al. (2018), an estimated $2.5 trillion must be invested annually to address the significant financial gap impeding growth. This problem is made worse by the skewed allocation of investment towards some SDGs. Islam and Rahman (2023) find in their study that most investments are concentrated on just four SDGs: No Poverty (SDG 1), Zero Hunger (SDG 2), Good Health and Well-being (SDG 3), and Decent Work and Economic Growth (SDG 8). As a consequence, numerous SDGs are left underrepresented and pose significant challenges in attaining them.

Moreover, the emergence of the COVID-19 pandemic has accentuated the urgent need for innovative financing mechanisms to push SDG progress (Runde et al., 2022). Due to the economic disruptions resulting from the pandemic, new approaches for an efficient use of resources efficiency and sustainability are required. Achieving carbon neutrality, a key component of the SDGs package,

demands substantial financial commitments. According to the International Energy Agency (IEA), a staggering $53 trillion is required between 2015 and 2035 solely for energy-related transition investments in order to meet low-carbon targets. This financial burden has only escalated in recent years, emphasising the pressing need for concerted financial efforts to combat climate change and achieve sustainability goals.

2.2.3 SDGs in different countries

Within the European Union, countries show diverse efforts and approaches toward sustainable development and SDGs. Rocchi et al. (2022) highlight discrepancies among member states' progress, with some excelling in specific areas while others lagging. D'Adamo et al. (2022) note that higher GDP per capita does not always correlate with better SDG performance, indicating that economic prosperity does not necessarily lead to sustainable outcomes. However, countries like Sweden, Denmark, the Netherlands, and Austria demonstrate how economic growth can be channelled towards sustainable development, offering hope for enhanced SDG achievement across the EU.

Medina-Hernandez et al. (2023) found that the global North show strong sustainability characteristics favouring SDGs achievement. Emerging economies in Latin America and the Caribbean, Southern Africa, Northern Africa, the Middle East, and East Asia exhibit similar conditions for long-term sustainable growth (Rajnoha et al., 2021). In contrast, the poorest countries, mainly South Asia and Sub-Saharan Africa, show less progress and require continuous efforts for improvement (Dentinho et al., 2021).

2.3 Green bonds to fulfil the SDGs

In the pursuit of achieving the Sustainable Development Goals (SDGs), green bonds emerge as a potential financial instrument poised to bridge the gap between aspirations and reality and might help in the filling of the SDGs financial gap.

2.3.1 Addressing the SDG-Deal Flow Gap

Impact investing, the wider category of sustainable financial instruments to which GSSS instrument also belongs, has great potential to support the SDGs. Yet, a critical observation by Islam and Rahman (2023) points out a significant SDG-deal flow gap within the impact investing market. Their analysis suggests that while impact investing can be effective in advancing certain SDGs, it may not equally contribute to all goals: 80% of the investment deals are linked to SDGs 1, 2, 3 and 8. Furthermore, geographic concentration and the absence of direct impact investment deals targeting specific SDGs pose challenges in maximizing impact across the SDG universe. As emerged, for SDGs 1 (no poverty), 2 (zero hunger) and 7 (affordable and clean energy), the investments are mainly located in

emerging regions. On the other hand, for SDGs 3 (well-being), 4 (quality of education) and 8 (job creation) they are located more in developed regions.

2.3.2 Role of Green Bonds in SDGs Financing

Ahmed et al. (2023) underscore the consistent findings that green bonds serve as a crucial bridge to the SDGs. Their research emphasised the pivotal role green bonds play in financing and promoting sustainable development. Additionally, Alagmir and Cheng (2023) highlight the importance of green bonds as a stimulus for sustainable development, further corroborating their significance in the SDGs agenda. Furthermore, The OECD's report (2021) elucidates the rationale behind scaling up the Green, Social, and Sustainable (GSSS) market to address the SDGs funding gap. By amplifying investment in GSSS bonds, the OECD asserts that substantial progress can be made towards closing the financial shortfall hindering SDG achievement (OECD et al., 2021).

The private sector's involvement is indispensable in advancing the SDGs. However, even though Giri and Chaparro (2023) support the use of precise approaches in order to successfully fulfill SDGs commitments, their insights highlight the lack of precision and rigour in private sector initiatives aimed at SDGs implementation.

2.4 Green Bonds' impact on firm profitability

As previously mentioned, green bonds are financial instruments designed specifically to fund projects with significant environmental benefits. Their issuance has been linked with enhancement in the firm's financial performance and profitability, as noted in various studies (Zheng et al., 2023; Zhou & Cui, 2019).

2.4.1 Firms performance

Drawing back on the literature on financial performance, key financial metrics such as profitability, liquidity, and leverage are essential for assessing a firm's performance. Dirman (2020) explores how these metrics influence financial distress within firms, further suggesting that better management of these areas can improve financial stability. Moreover, Doğan (2013) investigates the relationship between firm size and profitability, highlighting that larger firms tend to have higher profitability. One key indicator to measure the firm profitability is the Return on Assets (ROA), representing the firm's ability to generate earnings relative to its assets. This metric also serves as a benchmark of management's efficiency in using assets to create profits. Heikal et al. (2014) illustrate the usefulness of ROA as an indicator to evaluate how effectively a company can convert the money used to purchase assets into net income or profits.

2.4.2 Green bonds and firm's performance

Green bonds can lead to several benefits in terms of financial performance for the issuing firm. Bhutta et al. (2022) argue that the issuance of green bonds can lead to lower costs of capital, as these bonds appeal to environmentally conscious investors. Moreover, research by Zheng et al. (2023) highlights that Green Bonds can enhance profitability by expanding the scale of corporate financing and operations. The strategic issuance of Green Bonds has also been shown to improve the market reputation of the firm, potentially leading to an increase in stock prices, as investors value their commitment to sustainable practices (Ahmed et al., 2023). This positive market reaction is supported by the findings of Zhou and Cui (2019), who observed that the announcement of green bonds positively impacts stock prices, profitability, operational performance, innovation capacity, and environmental improvement. Furthermore, Ahmed et al. (2023) propose that initiatives involving green bonds, which are specifically aligned with the SDGs, can further enhance firm profitability as measured by ROA and other financial metrics. This link suggests that investing in green projects not only helps in fulfilling environmental and social objectives but also boosts financial returns by improving asset efficiency and profitability.

2.4.3 SDGs and firm's profitability

The adoption of Sustainable Development Goals by firms reflects their commitment to sustainable and ethical practices, which significantly influences their profitability. Firms that integrate SDGs into their business strategies tend to experience enhanced operational efficiencies and access to new markets, which are crucial for long-term profitability (Khan et al., 2021). The alignment with SDGs often necessitates innovation in products and processes, which can substantially mitigate risks associated with ESG factors, thus attracting investments from funds that prioritise sustainability. This in turn will further enhance profitability (Sigurjonsson et al., 2021). The quantifiable improvements in SDGs scores are directly linked to an increase in investor confidence and consumer trust, translating into financial gains (Sinha et al., 2021). Valente and Atkinson (2019) find that high values in SDGs lead to financial benefits to the firm, and for these reasons, firms decide to implement sustainability into their practices. These benefits vary from more resilience in case of unexpected macro events to fewer fluctuations in share prices compared to unsustainable companies.

2.4.4 Synthesis of green bond and SDGs on Firm Profitability

By integrating the impact of green bonds and SDGs, it becomes clear that these are not only complementary but also collectively enhance firm profitability. Companies that leverage green bonds to finance their sustainability projects directly contribute to specific SDGs, such as affordable and clean energy (SDG 7) and climate action (SDG 13). This dual approach fosters a sustainable business model that attracts not only impact investors but also partners and customers who prioritize

environmental stewardship and social responsibility. The combined effect of green bonds and high SDG scores enhances a firm's financial performance by improving investor relations, reducing costs, and increasing revenues through innovative and sustainable products and services (Baldi & Pandimiglio, 2022).

2.5 Theoretical framework

This thesis is based on several well-established theoretical frameworks that together provide a comprehensive understanding of the impact of green bonds on Sustainable Development Goals (SDGs) and firm profitability. Stakeholder Theory, as proposed by Freeman (1984), underscores the importance of addressing the interests of a wide range of stakeholders, including investors, customers, employees, and the community. The issuance of green bonds reflects a firm's commitment to environmental sustainability, aligning with stakeholder expectations and enhancing corporate reputation. According to Barney's (1991) Resource-Based View (RBV), green bonds are strategic resources that improve a company's operational efficiency and sustainability credentials, giving it a competitive advantage. This aligns with Russo and Fouts (1997), who argue that superior environmental performance can result in improved profitability through enhanced efficiencies and innovation. In line with the Signalling Theory, introduced by Spence (1973), green bonds can be used to communicate the firm commitment to sustainability, attracting socially responsible investors and improving market perceptions. This signalling effect is highlighted by Gianfrate and Peri (2019) and Tang and Zhang (2020). Institutional Theory, as explained on corporate behaviour, explains how the adoption of green bonds reflects institutional demand for greater environmental accountability. The variability in green bond impacts across countries can be attributed to differences in institutional frameworks and regulatory environments. Lastly, according to Suchman's Legitimacy Theory (1995), firms try to legitimize their operations by conforming to societal norms and values. Green bonds strengthen this legitimacy by supporting the growing regulatory and market pressures that drive society's emphasis on sustainability and climate action (Kanamura, 2020). This research is informed by these theoretical approaches, which together offer a nuanced view of the connection between green finance, sustainability commitments, and financial performance.

3. Hypotheses development

Drawing from the literature reviewed in the previous section about green bonds, Sustainable Development Goals (SDGs), and their interconnectedness, I have formulated three hypotheses to help answer the research question.

3.1 First hypothesis

The first hypothesis is designed to test whether companies issuing green bonds achieve higher Sustainable Development Goals (SDGs) scores compared to companies that issue conventional bonds. It assumes that green bond issuers, due to their commitment to environmental sustainability, are more likely to align their operations and strategies with the SDGs. It is formulated as follows:

H1: Green bonds are contributing to the achievement of Sustainable Development Goals more than conventional bonds

This hypothesis is supported by the literature indicating that green bonds not only facilitate environmentally beneficial projects but also enhance the issuer's reputation and operational practices in sustainability, i.e. its SDGs score is expected to be higher compared to the one from firms issuing conventional bonds. Flammer (2021) demonstrates that green bond issuers see significant improvements in their environmental performance, which is likely to contribute to higher SDG scores. In addition, studies by Gianfrate & Peri (2019) and Hammoudeh et al. (2020) suggest that the issuance of green bonds can lead to improved market perceptions and increased investor support due to the pro-environmental signals these bonds emit. The research by Zerbib (2018) and Jiang et al. (2020) further corroborates that green bonds typically carry additional benefits such as risk mitigation, which could support broader sustainability goals aligning with the SDGs. Lastly, the significance of green bonds in bridging the financial gap for the SDGs is emphasized by Ahmed et al. (2023). They speculate that issuers of green bonds are probably better aware of SDG-related goals, which in turn leads to higher scores.

3.2 Second Hypothesis

The second hypothesis aims to explore the variability in SDG scores achieved by firms issuing green bonds based on the country of issuance. It presupposes that the impact of green bond issuance on SDGs scores is influenced by the economic and regulatory environment of the issuing country, having therefore a country-based difference.

H2: The impact of Green Bond issuance on Sustainable Development Goals (SDGs) score varies based on the country of issuance.

This hypothesis is built on findings from studies such as those by Rocchi et al. (2022) and Guijarro & Poyatos (2018), which show significant differences in SDG progress across EU countries. This

suggests that national contexts affect the efficacy of green bonds in advancing SDGs. According to D'Adamo et al. (2022), there is an unpredictable correlation between a country's wealth and its SDG performance, suggesting that stronger economies do not always translate into more sustainable results. Additionally, Nguyen et al. (2023) found that institutional development in the issuing country plays a crucial role in determining the environmental and social impacts of green bonds. Islam & Rahman (2023) also stress the challenges in achieving SDGs globally. They suggest that variations in green bonds' impact might be attributable to different national strategies and levels of commitment levels to sustainability programs.

3.3 Third Hypothesis

The third hypothesis explores whether the financial benefits associated with green bonds are amplified in firms with a high commitment to Sustainable Development Goals (SDGs). It postulated that firms deeply integrated with SDGs will obtain greater financial outcomes from green bond issuance as measured by higher values in Return on Assets (ROA). This hypothesis is based on the idea that sustainable practices encouraged by SDGs compliance can improve operational efficiencies and market perceptions, contributing positively to financial and profitability metrics.

H3: The beneficial effects of green bonds on a firm's Return on Assets (ROA) are stronger in firms with a higher commitment to Sustainable Development Goals (SDGs)

This hypothesis is supported by research that indicates companies that actively engaged in sustainability practices, such as those required by SDGs, not only gain more favourable public attention, but they are also better positioned to make effective use of green financing mechanisms, as evidenced by their higher return on their higher return on assets (ROA) than their competitors. Research by Zhou & Cui (2019) and Wang et al. (2020) highlighted that firms issuing green bonds experienced enhancements in stock prices, profitability, and innovation capacity, suggesting a synergistic relationship between green bond issuance and sustainable corporate practices.

Furthermore, studies by Sigurjonsson et al. (2021) and Sinha et al. (2021) highlight the direct relationship between SDGs participation and operational efficiencies, which in turn improve financial performance metrics like ROA. It is thought that these gains are amplified in companies that actively fund their commitments to the SDGs through green bonds, fusing financial strategy with sustainable development goals. Additionally, Baldi & Pandimiglio (2022) emphasize that the complementary strategy of aligning green bond issuance with SDG strategies fosters a sustainable business model that improves investor relations and operational efficiencies, subsequently enhancing also firm's profitability. This hypothesis aims to empirically study whether firms that are both issuing green bonds and highly rated on SDGs commitments indeed show a greater increase in ROA compared to their less committed counterparts.

4. Methodology and Empirical Strategy

4.1 Methodology

This study applies an Ordinary Least Squares (OLS) regression model to investigate the impact of green bond issuance on the Sustainable Development Goals (SDG) scores and profitability of the analyzed firms. The OLS method is chosen due to its efficiency in estimating unknown parameters in a linear regression model, providing Best Linear Unbiased Estimators (BLUE) under the Gauss-Markov theorem assumptions, assuming no perfect multicollinearity, homoscedasticity, and independence of errors (Hutcheson et al., 2008). In particular, as it examines data collected in a single time rather than multiple periods, it uses a cross-sectional analysis.

4.2 Data

The firms that I take into consideration for this study are companies that issued bonds in 2023 across different countries. Among these, there are countries from the European Union (Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden), as well as Australia, Canada, the United Kingdom and the United States. The selection of European countries is supported by studies such as Gianfrate and Peri (2019), which highlight the proactive attitude of European nations in adopting green bonds to achieve sustainability goals. The inclusion of non-EU countries is justified by their significant contribution to the global bond market (Baker et al., 2018). This diverse sample makes it possible to compare findings across various regulatory and economic contexts (Nguyen et al., 2023).

My final sample consists of 474 bonds issued, of which 220 are considered green because in line with the Green Bond Principles, and 254 are conventional. The total number of issuing firms is 157.

4.2.1 Variables

To assess the impact of green bonds on SDG scores, I construct a detailed regression model. For the dataset to assess the impact of green bonds on SDG scores, I choose dependent and independent variables. The dependent variable, given by the sum of each SDG score for each issuing firm, reflects the cumulative impact of a firm's activities on sustainability goals as measured in 2024. The SDG score is derived from an evaluation of positive, negative, or neutral impacts associated with each of the 17 goals. Data on the firms and their relative SDG scores are obtained from Robeco on 02/04/2024 and cover companies within the sample size that issued bonds in 2023, corresponding to the total sum of all SDG scores for the issuing entity at the time the data were retrieved.

The major player of the model is a dummy variable, used to control if the emitted bond is considered "green", i.e. in line with the Green Bonds Principles (GBP). It will obtain a value of 1 if it aligns, or a value of 0 if it is considered a conventional bond. For this variable, the Green Bond Flag from the Excel add-in of Refinitiv Eikon is used.

To control for other factors that may influence SDGs scores, I include the following: the ROA (Return on Assets) of the firm, the D/E (Debt-to-equity ratio), total assets and the ESG score of the issuing firm. The ROA is a measure of the firm financial performance, indicating how successfully and efficiently the firm is using its assets in generating profits (Naeem et al., 2022). Higher profitability allows firms to allocate more resources towards sustainability initiatives, potentially enhancing SDG scores (Filbeck & Preece, 2003). To test the third hypothesis, whether green bonds and SDGs are enhancing the profitability of the firm, ROA is used as dependent variable. Debt to Equity ratio measures the proportion of equity and debt that a company uses to finance its assets. Firms with higher leverage may face financial constraints that limit their ability to invest in sustainable projects, potentially resulting in lower SDG scores (Myers, 1984). A higher Debt-to-Equity ratio generally indicates more aggressive financing with higher debt, which might influence a firm's financial ability to invest in SDGs. Firm's total assets are used as a measure of the overall firm's size, bigger firms are expected to have a bigger impact on their SDG value (Russo & Fouts, 1997). ESG score (Environmental, Society and Governance) is a score number indicating the commitment of the firm to sustainability issues. Firms with higher ESG scores are expected to achieve higher SDG scores due to their strong emphasis on sustainability (Friede et al., 2015). I have retrieved all of these variables from Refinitiv Eikon, and when not possible, manually from FactSet.

To test the second hypothesis, I include a dummy variable describing the country where the bond is emitted. The dummy will have a value of 1 if the bond has been emitted in that specific country, and a value of 0 if not.

It's important to note that the bonds considered are issued in the year 2023, while the SDGs data pertains to the year 2024. This temporal difference allows for the consideration of any lag in the implementation of SDGs strategies by the company. 2023/2024 are also crucial years because they are the middle point between the year of the creation of the SDGs, 2015, and the year they should be achieved, 2030. However, it is important to note that the effect might not be visible yet and it might take longer for the firm to see proceeds from the issuance of the bonds into projects that can be reflected into their SDGs score.

4.3 Regressions

The first regression equation tests if the issuance of green bonds will lead to a higher SDG score for the firm, where Green Bonds is going to be a dummy variable taking a value of 1 if the bond is in line with the Green Bond principle, and 0 if not. The formula will look as follows:

$$SDG_t = \beta_0 + \beta_1 green\ bond_{t-1} + \beta_2 ROA_{t-1} + \beta_3 debt\ to\ equity_{t-1} + \beta_4 log(total\ assets_{t-1}) + \beta_5 ESG\ score_{t-1} + e_t$$

To test the second hypothesis if some countries are contributing to the achievement of the SDGs more than others, I add a dummy variable controlling for the country of emission, and the OLS equation will look as follows:

$$SDG_t = \beta_0 + \beta_1 green\ bond_{t-1} + \beta_2 ROA_{t-1} + \beta_3 debt\ to\ equity_{t-1} + \beta_4 log(total\ assets_{t-1}) + \beta_5 ESG\ score_{t-1} + \beta_6 \sum_{i=1}^{n} \gamma countries + \beta_7 (\sum_{i=1}^{n} \gamma countries * green\ bond_{t-1}) + e_t$$

Here, γ is the coefficient associated with the dummy variable, ith country from the sample size at the time, and the dummy will assume a value of 1 if the bond is emitted in the specific country; otherwise, 0. By including dummy variables for each country, the interaction term between this dummy and the green bond is analysed, examining the relationship between the different countries of issuance. If the coefficients are not significantly different from each other, the effect of green bond issuance on SDGs is consistent across the sample size.

Followingly, the third equation wants to test if the firm issuing green bonds with a higher commitment to SDGs shows a higher ROA (Return on Assets). An interaction term between SDGs and Green bonds is therefore applied to understand the interconnectedness between green bonds, SDG score and the ROA of the firm. The equation will look as follows:

$$ROA_{t-1} = \beta_0 + \beta_1 green\ bond_{t-1} + \beta_2 debt\ to\ equity_{t-1} + \beta_3 log(total\ assets_{t-1}) + \beta_4 ESG\ score_{t-i} + \beta_5 SDG_t + \beta_6 (SDG_t * green\ bond_{t-1}) + e_t$$

4.4 Multicollinearity and robustness checks

To address multicollinearity problem, the Variance Inflation Factor (VIF) for each predictor is calculated. High VIF values indicate multicollinearity, which can distort regression estimates. Robustness checks are performed to ensure the validity of the findings. The Breusch-Pagan test indicates the presence of heteroscedasticity, while the Durbin-Watson test autocorrelation. In case these issues are detected, to address them, Newey-West standard errors are employed. This method

adjusts for both heteroskedasticity and autocorrelation and provides consistent estimates of standard errors. This ensure the reliability and validity of the findings (Newey & West, 1987).

5. Results

5.1 Summary statistics

The firms taken into consideration are companies that issued bonds in 2023 within the countries in the European Union (Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden), along with United Kingdom, United States, Canada and Australia.

Below, Table 1 presents the descriptive statistics for the key variables used in the regression models. This table includes the mean, standard deviation, minimum, and maximum values for each variable, offering a detailed summary of the dataset's characteristics.

To test the second hypothesis, I take into consideration just the EU countries. Table 2 provides an overview of the number of bonds issued by each country included in the analysis. This table guarantees transparency about the distribution of the dataset and the representation of each country.

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
SDG	473	1.1	1.1	-3	1	2	3
Green bond	475	1.5	15	0	0	1	1
D/E	472	2.4	11	-9.2	0.4	2.1	170
Log(Total assets)	472	11	60	-2.7	1.3	4	1045
ESG Score	350	73	14	19	67	83	92

Table 1. Summary statistics of the variables employed in the models

Country	Number of bonds
Australia	9
Austria	18
Belgium	10
Canada	29
Denmark	10
Finland	12
France	102
Germany	42
Greece	2
Hungary	2
Ireland	6
Italy	20
Luxembourg	12

Netherlands	18
Poland	2
Portugal	2
Spain	34
Sweden	6
United Kingdom	45
United States	107

Table 2. Number of bonds issued per country

5.2 Regression results

5.2.1 First hypothesis

The statistical analysis I conduct to evaluate H1, which posits the effectiveness of green bonds in contributing to the achievement of Sustainable Development Goals (SDGs) yields significant results. The initial step involves running a regression model to assess the impact of green bonds on SDG scores, controlling for variables such as ROA, Debt to Equity (D/E), Total Assets, and ESG Score. To ensure the reliability of the estimated coefficients, I check for multicollinearity among the predictors using the Variance Inflation Factor (VIF). The results indicate no significant multicollinearity, confirming that the predictors are not distorting the model. Next, I perform the Breusch-Pagan test to check for heteroskedasticity. Heteroskedasticity is detected in the model (BP = 42.583, p-value =4.489e-08), indicating that standard errors need adjustment to ensure valid inference. Additionally, I conduct the Durbin-Watson test to identify autocorrelation. The test result (D-W = 0.5785, p-value = 0) indicates positive autocorrelation between the variables.

Thergore, to address these issues, I apply the Newey-West standard errors to correct for both heteroskedasticity and autocorrelation, ensuring robust results and providing consistent estimates of the regression coefficients' standard errors (Newey & West, 1987). The final model reveals a

significant positive coefficient for green bonds (β = 0.35999810, p = 0.01055), suggesting that green bonds contribute more substantially to the achievement of SDGs compared to conventional bonds. Furthermore, the model indicates that Debt to Equity ratio (D/E) is significantly associated with SDG scores (β =0.00540882, p = 8.757e-08), reinforcing the importance of a firm's financial structure in sustainable investment outcomes. Specifically, firms with higher D/E ratios tend to have higher SDG scores. The logarithm of Total Assets also shows a significant positive relationship with SDG scores (β = 0.13009471, p = 0.01088), highlighting the role of firm size in advancing sustainable development goals.

Variable	Estimate	Std. Error	T-value	Pr(<|t|)	
(Intercept)	-3.31086449	1.48944383	-2.2229	0.02687	*
Green bond	0.35999810	0.14001060	2.5712	0.01055	*
ROA	0.05525925	0.03863924	1.4301	015359	
D/E	0.0540882	0.00092907	5.8217	1.339e-08	***
Log(Total assets)	0.13009471	0.05080618	2.5606	0.01088	*
ESG score	0.00796327	0.00697366	1.1419	0.25429	

*Table 3. Regression hypothesis 1 after performing the Newey-West test to correct for heteroskedasticity and autocorrelation between regressors. *, **, *** indicates significance at the 90%, 95%, and 99% level, respectively.*

5.2.2 Second hypothesis

The analysis of Hypothesis 2 investigates whether the impact of green bond issuance on Sustainable Development Goals (SDGs) scores varies based on the country of issuance, focusing on European Union countries. This hypothesis posits that the impact of green bond issuance on SDG scores is influenced by country-based factors, such as the economic and regulatory environment of the issuing country.

Due to data limitations and issues of multicollinearity, several countries were excluded from the final model. Specifically, Portugal, Poland and Sweden. This decision is made to ensure robust results and reliable coefficients (Greene, 2012). Australia, Canada, United Kingdom and United Stated were also removed because not part of the EU.

To begin, I built the initial regression model, and the Variance Inflation Factor (VIF) test was conducted to check for multicollinearity among the variables. Although some control variables present high VIF values, these are not expected to distort the model significantly. Following this, the Breusch-Pagan test reveals a high level of heteroskedasticity (BP = 57.257, p < 0.001), and the Durbin-Watson test indicated positive autocorrelation (DW = 0.5946). Given these findings, I apply the Newey-West standard errors to correct both for heteroskedasticity and autocorrelation, ensuring valid estimated coefficients (Newey & West; 1987).

The impact of green bond issuance on SDG scores varies significantly across countries. Austria, Denmark, Finland, Hungary, Luxembourg and the Netherlands present significant results, indicating that these countries tend to have higher SDG scores compared to others. For instance, Denmark (Estimate = 0.8606, p = 0.001) and the Netherlands (Estimate = 1.1257, p < 0.001) showed a pronounced positive effect, aligning with their robust frameworks supporting green finance (OECD; 2021). Observing the interaction term between the country and green bond issuance, significant positive coefficients were found for Austria, Denmark, Hungary, Luxembourg, and the Netherlands, indicating that green bond issuance in these countries is particularly effective in enhancing SDG scores. However, negative interactions were found in some countries, such as Austria and Denmark, suggesting a less pronounced positive effect of green bonds on SDG scores in these regions. This result might be influenced by the limitations of the study, such as the short time interval and the small sample size. It is important to note that in the real world, the outcome might differ. Overall, the outcome offers strong evidence in favour of this hypothesis and is consistent with previous research (Rocchi et al., 2022; Guijarro & Poyatos, 2018).

Variable	Estimate	Std. Error	T-value	Pr(<|t|)	
(Intercept)	-2.42124497	1.10442308	-2.1923	0.028876	*
Green bond	0.33989705	0.23788343	1.4288	0.153755	

ROA	-0.00086122	0.00327882	-0.2627	0.792933	
D/E	0.00052444	0.00109209	0.4802	0.0631309	***
Log(Total assets)	0.12283890	0.04041182	3.0397	0.002509	**
Austria	0.64189135	0.26748300	2.3997	0.016818	*
Belgium	1.15728185	0.15562816	7.4362	5.409e-13	***
Denmark	0.86066148	0.17317220	4.9700	9.586e-07	***
Finland	1.42211321	0.51267583	2.7739	0.005773	**
France	0.13097765	0.42727332	0.3065	0.759335	
Germany	0.56020005	0.32256293	1.7367	0.083133	.
Greece	0.33826996	0.17290775	1.9564	0.051051	.
Hungary	-0.42281166	0.23372319	-1.8090	0.071125	.
Italy	0.03678958	0.27483805	0.1339	0.893575	
Luxembourg	0.33568717	0.29789982	1.1268	0.260418	
Netherlands	1.12568366	0.15386749	7.3159	1.209e-12	***
Spain	0.26555129	0.27784145	0.9558	0.339712	

Green bond:Austria	-0.45722405	0.27175959	-1.6825	0.093185	.
Green bond:Belgium	-0.32232895	0.23659397	-1.3624	0.093185	.
Green bond:Denmark	-0.31251818	0.23665764	-1.3205	0.187333	
Green bond:Finland	-1.02007743	0.44845339	-2.2747	0.023404	*
Green bond:France	-0.27468760	0.41991689	-0.6541	0.513356	
Green bond:Germany	-0.47466018	0.35755030	-1.3275	0.185016	
Green bond:Greece	-0.3398705	0.23788343	-1.4288	0.153755	
Green bond:Hungary	-0.3398705	0.23788343	-1.4288	0.153755	
Green bond:Italy	0.18016525	0.34590089	0.5209	0.602726	
Green bond:Luxembourg	-0.33989705	0.28069212	-1.21096	0.226570	
Green bond:Netherlands	-0.6851002	0.27951279	-2.4511	0.014629	
Green bond:Spain	-0.11481820	0.33212840	-0.3457	0.729729	

Table 4. Robust model without values with multicollinearity problem and NA.. Newey-West standard error are applied to correct for heteroskedasticity and autocorrelation., **, *** indicates significance at the 90%, 95%, and 99% level, respectively.*

5.2.3 Third hypothesis

The regression analysis aimed to test Hypothesis 3, which posits that the beneficial effects of green bonds on a firm's Return on Assets (ROA) are more pronounced in firms with a higher commitment to Sustainable Development Goals (SDGs). The methodological approach I choose include the

creation of an interaction term between SDGs and Green Bonds to examine the combined effect of them on ROA.

In the analysis, I follow several diagnostic steps to ensure robustness and accuracy. Firstly, I perform the Variance Inflation Factor (VIF) test to check for multicollinearity among the predictors. The VIF value for the interaction term is within the acceptable range, indicating no severe multicollinearity issues. Next, the Breusch-Pagan test was conducted to check for heteroskedasticity, which was detected with a value of 31.332 (p= 2.19e-05). Furthermore, the Durbin-Watson test indicates the presence of autocorrelation (D-W Statistic = 0.8337604, p =0), with a value significantly lower than 2. Due to the presence of both heteroskedasticity and autocorrelation, I apply a robust model using Newey-West standard errors to ensure valid inference.

The results from the robust model indicated a significant negative impact of Green Bond issuance on ROA (Estimate = -05866482, p = 0.0560000). This suggests that all else being equal, green bond issuance is associated with a lower ROA compared to conventional bonds. The SDG variable, although not significant (p = 0.0970471), indicated a positive direction, suggesting a potential positive impact on SDG scores on ROA. However, the interaction term (SDG_Green_bond_Interaction), indicate that the interaction between high SDG scores and green bond issuance negatively impact ROA.

Interestingly, results reveals that the D/E ratio has a significant negative correlation with ROA (Estimate = -0.0092643, p = 0.0003037), implying that a higher debt-to-equity ratio is associated with a lower ROA. The log of Total Assets shows a significant positive relationship with ROA (Estimate = 0.1228389, p = 0.002509), indicating that larger firms tend to have a better ROA. However, the ESG Score do not show a significant relationship with ROA (Estimate = -0.0081788, p = 0.4990177). The study's findings align with some literature that points to the challenging balance between pursuing sustainability and maintaining profitability (Flammer, 2021; Gianfrate & Peri, 2019).

Variable	Estimate	Std. Error	T-value	Pr(<|t|)
(Intercept)	20.4377213	3.0345663	6.7350	6.953e-11 ***
Green bond	-0.5866482	0.3059354	-1.9176	0.0450000 .
SDG	0.3141121	0.1887799	1.6639	0.0980471 .

D/E	-0.0092643	0.0025385	-3.6495	0.0003037	***
Log(Total assets)	-0.6766553	0.1233959	-5.4836	8.113e-08	***
ESG score	-0.0081788	0.0120853	-0.6768	0.4990177	
SDG:Green bond	-0.4527818	0.2242613	-2.0190	0.0442679	*

Table 5. Regression hypothesis 3 with Newey-West standard error.*, **, *** indicates significance at the 90%, 95%, and 99% level, respectively.

6. Discussion

6.1 Hypothesis 1

In the regression analysis for Hypothesis 1, I find that green bonds contribute more significantly to the achievement of Sustainable Development Goals (SDGs) compared to conventional bonds. This result aligns with the literature that highlights the role of green bonds in directing capital towards environmentally sustainable investments, in turns increasing the SDGs score of the firm (Ahmed et al., 2023; Alamgir & Cheng, 2023).

Green bonds are designed to fund projects that have explicit environmental benefits, such as renewable energy, energy efficiency, pollution prevention, and sustainable agriculture. This specific focus ensures that capital raised through green bonds directly contributes to environmental sustainability. Studies by Flammer (2021) and Gianfrate & Peri (2019) show that companies issuing green bonds often experience significant enhancement in their environmental performance, which in turn is reflected in higher SDG scores.

The positive coefficient for green bonds in the model suggests that firms issuing green bonds are more likely to engage in practices that lead to better environmental outcomes. This corroborates with Jin et al. (2020) and Hammoudeh et al. (2020), who found that green bonds help firms to hedge more risks and support a low-carbon economy. These bonds signal a firm's commitment to sustainability, which can enhance its reputation and operational practices, leading to higher SDG scores.

Moreover, the results highlight the significant role of Debt-to-equity (D/E) ratios in the context of green bond issuance. As emerged from my analysis, firms with higher D/E ratios tend to invest more in sustainable projects. This investment behaviour aligns with the findings of the OECD (2021),

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which argue that innovative financial structures, including green bonds, are essential to bridge the SDGs funding gap.

The positive impact of firm size (as measured by total assets) on SDGs scores suggests that larger firms, which typically have more resources and better access to capital markets, are more capable of issuing green bonds and investing in sustainability initiatives. This finding is consistent with Russo and Fouts (1997), who note that larger firms often have more significant environmental impact and greater capacity for implementing sustainability programs.

Additionally, the ESG score, although not significant in this model, remains an important indicator of a firm's overall commitment to environmental, social, and governance issues. Firms with high ESG scores are generally more attractive to investors seeking to align their portfolios with sustainable and ethical practices. This may result in improved financial performance and a reduced cost of capital, encouraging businesses to pursue sustainable objectives even more.

These findings have significant implications, since they imply that financial markets can better align with sustainability goals and increase the value of SDGs by using financial instruments like green bonds. This alignment not only increases a firm's reputation, as found in previous studies, but also helps society to more towards more sustainable development practices, which in turn can lead to a lower impact on the surroundings (Jin et al., 2020; Hammoudeh et al., 2020). Furthermore, the evidence supports the development of policies that encourage the issuance of green bonds, possibly incentivized through tax breaks or enhanced investor disclosures on sustainability impacts, as suggested by the Green Bond Principles (2021).

6.2 Hypothesis 2

The analysis I conduct to evaluate Hypothesis 2 aims to determine if the impact of green bond issuance on SDGs scores varies based on the country of issuance. This hypothesis suggests that the effectiveness of green bonds in advancing SDGs scores is influenced by the specific economic, regulatory, and institutional contexts of different countries. The results support the hypothesis, aligning the results also with previous studies (Rocchi et al., 2022; Guijarro & Poyatos, 2018).

The different impact of green bonds based on the country of issuance highlights the importance of the national context in determining the effectiveness of green bonds. Countries such as Austria, Denmark, Finland, Hungary, Luxembourg, and the Netherlands exhibited significant positive results, indicating that green bond issuance in these countries is particularly effective in enhancing SDG scores. For instance, Denmark and the Netherlands showed a pronounced positive effect, aligning with their robust framework supporting green finance (OECD, 2021).

The interaction terms between green bond issuance and country-specific dummies explain this variability. Countries such as Austria and Denmark display significant interaction effects. This

suggests that while green bonds are generally beneficial for advancing SDGs, their effectiveness is contingent on the supportive policies and financial infrastructures present in each country. This aligns with the literature suggesting that the regulatory environment and national policies play a critical role in the effectiveness of green financial instruments (Rocchi et al. 2022).

The presence of supportive governmental policies and incentives, such as tax breaks, subsidies, or favourable regulatory environments, can significantly improve the effectiveness of green bonds. For example, Denmark and the Netherlands have implemented policies that promote green finance and encourage the issuance of green bonds, resulting in higher SDG scores (Dikau & Volz, 2021). These policies not only attract more issuers but also ensure that the projects funded by green bonds align with national sustainability targets and contribute effectively to environmental conservation and climate change mitigation. On the other hand, in countries with less developed green finance frameworks or weaker regulatory environments, the impact of green bond issuance on SDG scores may be less pronounced. This could be due to a lack of transparency and accountability in the use of green bond proceeds, which may lead to suboptimal allocation of funds and potential issues such as greenwashing. As a result, the environmental benefits of green bonds in these contexts may not be fully realized, underscoring the need for stronger regulatory oversight and policy support.

The significant positive effect of green bonds on SDG scores in certain countries aligns with the findings of Flammer (2021) and Gianfrate & Peri (2019), who stated that green bonds can enhance a firm's environmental performance. The results from this study extend these insights by highlighting the role of national contexts in mediating these effects. This aligns with the literature suggesting that the regulatory environment and national policies play a critical role in the effectiveness of green financial instruments (Rocchi et al., 2022).

These findings highlight how crucial it is to take into account national contexts when evaluating the effectiveness of green bonds in promoting sustainable development. The significant impact of Green Bond issuance on SDG scores underscores the need for tailored policy measures and financial strategies that align with the unique economic and regulatory landscapes of each different countries. For policymakers and investors, understanding these implications can guide more effective deployment of green bonds to achieve SDG targets across various regions. This could include the creation of tax incentives, subsidies, or introducing disclosure requirements that increase transparency and investor confidence in green bonds. In this way, countries can leverage green bonds more effectively to drive sustainable development and achieve their environmental goals.

6.3 Hypothesis 3

The results from the analysis of Hypothesis 3 provide nuanced insights into the relationship between green bond issuance, firm commitment to Sustainable Development Goals (SDGs), and financial

performance as measured by Return on Assets (ROA). The hypothesis suggests that green bonds' beneficial effects on a firm's ROA would be more pronounced in firms with a larger commitment to SDGs. However, the results did not support this hypothesis, revealing a significant negative impact of green bond issuance on ROA and an insignificant interaction effect between high SDG scores and green bond issuance. This suggests that, in the short term, firms issuing green bonds may experience higher costs or lower immediate financial returns. This finding aligns with some aspects of the literature highlighting the challenges and potential short-term financial drawbacks of green bond issuance (Zhou & Cui, 2019; Gianfrate & Peri, 2019).

Moreover, I have found no significant interaction effect between high SDG scores and green bond issuance on ROA. This might indicate that the financial benefits of green bonds and SDG commitments are not synergistic, at least not immediately. This result is in contrast with some studies that suggest green bonds can enhance firm profitability by attracting environmentally conscious investors and improving public perception (Gianfrate & Peri, 2019). However, it is consistent with other research indicating that the financial benefits of sustainability initiatives may take longer to materialize (Flammer, 2021; Zhou & Cui, 2019).

The negative impact of green bond issuance on ROA could be attributed to several factors. Firstly, the initial costs associated with green projects can be high, and the returns on these investments may accrue over a longer period than conventional investments. Secondly, firms that are more committed to SDGs might allocate resources to projects that have high environmental or social value but lower immediate financial returns. This strategic choice reflects a broader commitment to sustainability and long-term value creation, even if it entails short-term financial sacrifices (Kanamura, 2020).

The lack of significant relationship between ESG scores and ROA in this study might be due to the specific measure of ESG and SDG scores used, which may not fully capture the firm's commitment to sustainable practices. Additionally, the time frame of the study might be too short to observe the long-term financial benefits of ESG and SDG initiatives.

The findings underscore the complexity of integrating sustainability with financial performance. The short-term financial drawbacks of green bonds highlight the need for firms and investors to adopt a long-term perspective when evaluating the benefits of sustainable investments. Future research should explore additional variables and longer time frames to further elucidate the dynamics between green bonds, SDG commitments, and financial performance.

7. Limitation and further discussion

7.1 Limitations

The study presents several limitations that should be considered when interpreting the results and proposing future research directions. One primary limitation is the use of just a one-year lag to assess the impact of green bond issuance on SDGs scores, which might not capture the full effects, as the benefits of green investments often take longer to materialize. Future research should explore the impact of longer lag periods for a more comprehensive understanding. Another limitation is due to the small sample sizes. This can lead to various issues as the risk of random variability and lack of precision and reliability. In the future, a bigger sample size should be used. In addition, the historical issuance of bonds by firms is not considered. Firms that issued conventional bonds in the study year might have issued green bonds in previous years, which can potentially influence their SDG scores. Future studies should consider tracking the history of bond issuance over multiple years.

There is also a potential issue of bond misclassification, where some conventional bonds might have been used for green purposes, and vice versa. Future research should employ more precise criteria for bond classification and find ways to enhance transparency and accountability in green markets. Other variables, such as regulatory changes, market conditions, or firm-specific characteristics, were not included in the model but could influence the outcomes. To capture the multifaced impact of green bonds on SDGs, future studies should include a broader range of variables to better capture the impact of green bonds on SDGs.

7.2 Future implications

The findings of this study have important implications for policymakers, investors, and firms. Policymakers should implement stricter regulations and standards for green bonds to prevent greenwashing and ensure that the proceeds are employed in sustainable projects. Incentives such as tax breaks or subsidies for green bond issuers could also be explored to encourage more firms to adopt sustainable practices. Investors should adopt a long-term investment horizon to fully benefit from the positive impacts of green bonds and seek bonds with rigorous third-party certifications to avoid greenwashed investments. Firms should recognize the long-run benefits of issuing green bonds in terms of financial performance, corporate reputation, and alignment with global sustainability goals. Future research should focus on developing more sophisticated models with a wider range of variables and longer time horizons.

7.3 Economic significance

This study highlights the potential of green bonds to bridge the gap between financial objectives and sustainability targets. The findings suggest that green bonds effectively direct capital toward projects that generate significant environmental and social benefits. For policymakers, the study provides evidence-based insights to guide the development of regulatory frameworks and incentives aimed at promoting green finance. For investors, the research highlights the long-term financial and reputational benefits of incorporating green bonds into portfolios, balancing short-term financial returns with sustainability goals. For corporations, the study emphasizes the strategic advantages of issuing green bonds, including enhanced reputation, improved stakeholder relations, and alignment with global sustainability initiatives, positioning firms as leaders in the growing market for sustainable finance.

8. Conclusions

The purpose of the thesis is to determine whether green bonds contribute more significantly to the achievement of Sustainable Development Goals (SDGs) compared to conventional bonds. It also try to explore if the country of issuance influences their effectiveness and determine the impact of green bonds on firm profitability when aligned with SDGs. The findings provide clear answers to these research questions as well as insightful information for future work in this area.

The research clearly shows that green bonds contribute more to the achievement of SDGs than conventional bonds. By funding projects with explicit environmental benefits, green bonds directly improve SDG scores. This demonstrates their effectiveness as a important financial tool for global sustainability initiatives. This research involves a thorough literature review, hypothesis development, and empirical analysis using Ordinary Least Squares (OLS) regression models. In this thesis, I analyse bonds issued in 2023 across various countries, focusing on their impact on SDG scores of the issuing firms and their firm profitability. To ensure the validity of the result, I perform robustness checks, such as multicollinearity, heteroskedasticity, and autocorrelation.

The analysis supports the first hypothesis that green bonds contribute more to SDGs than conventional bonds. This positive correlation highlights that green bonds effectively channel investments into projects that yield environmental benefits, improving the overall SDG performance of the issuing firms. The second hypothesis, concerning the impact of green bonds on firm profitability, yields different results. Countries with strong regulatory frameworks and supportive policies, like Denmark and the Netherlands, present a more significant positive impact from green

bonds. This suggests that the national context plays a critical role in maximizing the benefits of green bonds. The third hypothesis, concerning the impact of green bonds on firm profitability, yields also interesting results. While green bond issuance has a significant positive effect on SDG scores, it shows a negative impact on Return on Assets (ROA). This indicates that the financial benefits of green bonds may not be immediately apparent and highlights the need for a long-term perspective when evaluating and choosing these investments. The absence of a significant interaction between high SDG scores and green bond issuance on ROA suggests that the financial returns of sustainable initiatives might take longer to materialize.

With this study, I try to add to the growing body of literature on sustainable finance by providing empirical evidence on the role of green bonds in the achievement of SDGs. The results highlight the significant role of national contexts in determining the effectiveness of green bonds and underscore the importance of supportive regulatory frameworks and policies. Additionally, the research offers insights into the complex relationship between green bond issuance, firm commitment to SDGs, and financial performance, emphasizing the need for a long-term perspective in evaluating sustainable investments.

In conclusion, this research demonstrates that green bonds are a powerful tool for achieving the Sustainable Development Goals, in particular when supported by robust national policies and regulatory frameworks. Policymakers should implement stricter regulations and standards for green bonds with rigorous third-party certifications to avoid the risk of greenwashing. Firms should recognize the long-term benefits of issuing green bonds for financial performance, corporate reputation, and alignment with global sustainability goals. The study emphasizes the potential of green bonds to bridge the gap between the achievement of the SDGs, finally contributing to a more sustainable future. Future research that expands upon these findings will further enhance the role of green bonds in achieving global sustainability goals and push the field of sustainable finance forward.

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