# Corporate Green Bonds, Stock Reactions, and Corporate Financial Performance in the U.S.

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## Abstract

The rapid growth of green bonds highlights their increasing use as a financing tool for eco-friendly projects in response to the global environmental crisis and societal demand for sustainability. Our study, utilizing data from Bloomberg and the WRDS database, examines the relationship between U.S. companies' green bond issuance over the past decade, its impact on stock market responses, and corporate performance to identify the driving forces behind such issuance. Our findings show that green bonds exert minimal impact on both short-term and long-term stock market reactions and investment returns. Interestingly, companies with lower environmental scores saw benefits in the form of positive firm valuations. This indicates profit maximization remains a dominant force in the U.S. investment landscape. The divergent expected firm values between non-financial and financial sectors suggest signaling theory as the primary motivator behind issuing green bonds. However, this trend, which allows companies who have lower ESG environmental scores or in non-financial sectors to reap greater benefits with minimal investment, could inadvertently promote greenwashing for issuers in these certain groups. This issue is tied to the current stage of development in Environmental, Social, and Governance (ESG) practices and related financial tools. The rapid growth of ESG activities, including green bond issuance, juxtaposed with the sluggish evolution of national policies, could potentially encourage greenwashing activities. Despite employing various methods to minimize biases, the limitations in sample size prevent us from entirely eliminating all potential influences. Therefore, further development in the corporate green bond market in the U.S. would help for researchers to get more comprehensive and reliable results.

***Keywords***: Corporate Green Bonds, Stock Reactions, Corporate Performance, Signaling, Greenwashing, ESG Environmental Score, Non-financial/financial Industries.

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# I. Introduction

With growing global concern for environmental issues, sustainable finance has emerged as key to achieving environmental improvement goals. Green bonds are a typical sustainable financial instrument. The first green bonds were issued in 2008 by a supranational institution – the World Bank (Cioli et. al., 2020). Subsequently, the rapid growth of green bonds in 2013 and 2014 increased the demand for green bond performance data. The first green bond indices – S&P Green Bond Index – were launched in 2014, marking the beginning of market maturity (Kochetygova & Jauhari, 2014). According to a 2017 report by Morgan Stanley[1], the value of newly issued green bonds doubled from 2015 to 2016 to 81 billion USD and doubled again by 2017 to 2018. Currently, green bonds are clearly defined in the International Organization of Standardization (ISO) and the International Capital Market Association (ICMA). In the latest version of 2021, ISO[2] defines green bonds as "bonds whose net proceeds or an amount equivalent to the net proceeds will be exclusively applied to finance or refinance in part or in full new or existing eligible projects, assets and supporting expenditures". The emergence of green bonds has been followed by the development of corporate green bonds, which currently represent around 66% of the total global green bond issuance (Caramichael & Rapp, 2022). According to Flammer (2021), corporate green bonds are bonds that allocate their funds specifically to support environmentally friendly and climate-conscious initiatives, such as renewable energy, sustainable building development, and natural resource preservation.

Before 2013, corporate green bonds were virtually non-existent globally, yet they soared to $5 billion within that year (Flammer, 2021). Following that, the skyrocketed change occurred in the global corporate green bonds market, totaling almost $400 billion in 2021 (Caramichael & Rapp, 2022). Compared to conventional bonds, "green" labelled bonds illustrate their commitments on contributing to green projects. The information gap between investors and companies clouds the credibility of these issuances, necessitating nuanced regulations and policies to standardize this emerging financial tool. Accordingly, the decision of issuing green bonds rather than conventional bonds may appear perplexing due to the supplementary regulatory obligations that augment the administrative and compliance expenditures of the bonds. So as to clarify the rationales and characteristics of the investing market behind the issuance, we study how the corporation's preference for green labelling the bond instead of issuing a conventional one is associated with the corporate performance.

The impact of corporate green bonds on corporate performance has sparked considerable debate in academic literature. Some studies have discovered a noteworthy positive relationship between stock reactions and the issuance of green bonds (Zhou & Cui, 2019; Wang et al., 2020; Flammer, 2021; Sisodia et al., 2021). These studies have examined samples from either the global market or the Chinese market. On the other hand, other articles have found a significant negative correlation between the cumulative abnormal returns and corporate green bond, utilizing a worldwide sample (Roslen et al., 2017; Lebelle et al., 2020). As to other firm performance, Sisodia et al. (2021) observes a positive correlation between Tobin's Q and corporate green bond issuance, analyzing a worldwide sample. Tan et al. (2022) discovered a positive correlation between return on equity (ROE) and corporate green bond issuance, focusing on a sample from China. In contrast, Yeow and Ng (2021) found no significant impact of corporate green bonds on financial performance, specifically in relation to return on assets (ROA), using a worldwide sample.

[1] See Morgan Stanley, "Behind the Green Bond Boom", October 11, 2017. Retrieved from: https://www.morganstanley.com/ideas/green-bond-boom.
[2] See ISO, "ISO 14030-1: 2021", September 2021. Retrieved from: https://www.iso.org/standard/43254.html.

Flammer (2021) identifies three main rationales in current research discussions: signaling, greenwashing, and the cost of capital. Numerous studies have established that the green premium is not prevalent in nations with efficient markets like the U.S. (e.g., Chiang, 2017; Larcker & Watts, 2020; Tang & Zhang, 2020; Flammer, 2021). Signaling theory is a popular tactic employed by companies seeking to establish their credibility with the public. By issuing green-labeled bonds, a company is signaling to the market its commitment to eco-friendly projects (Flammer, 2021). To bolster the signal's credibility, companies engage in reporting and seek third-party verification. However, some investors question the signal's credibility, which leads to greenwashing allegations that the company is merely using a green filter to make a profit rather than truly taking on environmental responsibility (Flammer, 2021). Alternatively, the relationship between corporate green bond issuance and agency problems raised by the Bancel and Glavas (2018) indicated that managers may issue green bonds for their personal reputation instead of company margins.

From an investor's viewpoint, a notable economic study by Pederson et al. (2021) is dedicated to creating efficient frontiers that incorporate ESG factors and developing CAPM models modified for ESG considerations. These innovative models facilitate the inclusion and examination of diverse investor types, each with unique preferences. They highlight the intricate responses in the investment market to ESG ratings, brought about by the interplay and balancing of these varied investor interests.

Our empirical analysis assesses the impact of corporate green bonds on U.S. corporate performance, using a dataset compiled from Bloomberg's fixed income database. The dataset includes all publicly and privately issued corporate green bonds in the United States monitored by Bloomberg, spanning from January 1, 2013, to December 31, 2022. The decision to focus on the United States is motivated by two key factors. Firstly, recent research revealed a notable anomaly: while CARs were positive in most of the countries, they were negative in the U.S. (Autio, 2022). This anomaly necessitates an independent investigation into the unique market dynamics of the US. Secondly, despite targeted studies in the top two issuing regions, the US, as the third largest issuer, remains unexplored. This presents an opportunity to fill a gap in the literature and understand the specific drivers shaping market reactions in this influential economic landscape.

To initiate the empirical analysis, we present several crucial features associated with corporate green bonds in the U.S. marketplace based on time, industry, and issuers. In Figure 2, by tallying the amount of corporate green bonds that are listed in Bloomberg, the U.S. corporate green bond issuance peaked since 2013, totaling $52.82 billion. In the last decade, the total amount of corporate green bond issuance in the U.S. reached to $171.15 billion dollars. The public issued green bonds included in our empirical analysis are 95 in total, which corresponds to $71.56 billion (42%) and 49 unique issuers. In the ten industries that have issued corporate green bonds during the last decade, the top three leaders are financials, utilities, and consumer discretionary.

*[Insert Figure 2 here]*

After detailing the essential features of green corporate bonds, we first analyzed their impact on both short-term and long-term stock markets. This was done by evaluating the cumulative abnormal returns (CARs) and buy-and-hold abnormal returns (BHARs) during green bond issuances. Using event study methods, we noted a short-term negative market response around the time of bond announcements. For example, the CAR, as per the CAPM model, was -1.28% in the two-day pre- and post-announcement window, differing from zero at a 5% significant level. Notably, first-time issuances, green bonds with lower environmental scores, and green bonds issued from non-financial sectors showed constant significant negative CARs. However, when comparing green bonds to conventional bonds on a bond-level

basis, the differences were not statistically significant. Our extensive regression analyses revealed no notable differences in short-term CARs between firms issuing green and conventional bonds. Similarly, the BHAR differences from zero were insignificant across various time frames, from monthly to yearly.

Our study also explored the effect of green bond issuance on financial performance. The impact of issuing green bonds versus conventional bonds on ROA was found to be insignificant. In contrast, Tobin's Q value indicated a positive and significant change at the 5% level, both in the year of issuance and the subsequent year, with beta-coefficients of 0.311 and 0.272, respectively. Further subsampling analysis discovered that these significances came from the issuers who have lower environmental scores or non-financial issuers.

Our findings indicate that profit maximization drives the U.S. investment market, with the issuance of corporate green bonds primarily serving to signal environmental commitments. However, a concerning trend arises when lower environmental score companies gain greater benefits for less efforts, suggesting a potential trend for greenwashing in the future. Therefore, this paper suggests government intervention to counter this trend by addressing the gap between the rapid increase in green bond issuances and the slow development of relevant policies. The value of our research lies in its unique focus on the U.S. market, incorporating long-term stock market analysis, utilizing various methodologies and indicators, and discussing multiple theories.

The subsequent sections of this paper are structured as follows: Section II provides the theoretical framework and hypotheses development, Section III describes the data and outlines the characteristics of corporate green bonds in the U.S., Section IV introduces the empirical methodologies, Section V presents the results of the tests, Section VI summarizes the results, and Section VII discusses the study's outcomes, implications, and limitations.

# II. Theoretical Background and Research Questions

## II.1. Corporate Green Bonds and Corporate Financial Performance

Issuing corporate green bonds can yield various potential benefits for companies. First of all, it enables companies to secure dedicated debt financing to fulfill their capital requirements for green projects. Additionally, showcasing environmental commitment helps establish the company as a responsible corporate citizen to enhance brand value and corporate reputation and act as a catalyst for sustainable development (Yeow & Ng, 2021). Moreover, engaging in green projects facilitates the development of green markets, attracting "green" investors and consumers, thereby directly benefiting the company in terms of value and returns. Lastly, companies can directly benefit from the U.S. government's support for green initiatives. The Inflation Reduction Act[3], signed into law by President Biden in August 2022, offers grants, loans, and incentives to foster a new clean energy economy in the United States (The White House, 2022). For instance, the Department of Energy's announcement in November 2022 about accelerating domestic production of electric heat pumps provided $250 million in DPA grants to assist entities with up to 50 percent of the cost of establishing or expanding production capacity.

While governments and non-profit organizations issue green bonds primarily to support environmental causes, corporations, as for-profit entities, have to consider the interests of various stakeholders when taking on environmental responsibilities, as per stakeholder theory (Freeman, 1984). These stakeholders encompass shareholders, creditors, employees, suppliers, consumers, and potential investors. As conflicts of interest among different stakeholders may generate different corporate green bond issuance mechanisms, which in turn result in different impacts on corporate performance.

From the existing literature, there are conflicting views on the impact of green bond issuance by firms on firm performance. Some of the previous literatures have analyzed the impact of corporate green bond issuance on short-term corporate performance using cumulative abnormal returns as the empirical test objective. Many studies found that investors responded positively to corporate green bonds (Baulkaran, 2019; Zhou & Cui, 2019; Flammer, 2021; Tan et al., 2022). Moreover, most of the literature addressing environmental performance studies finds that firms that issue green bonds have better environmental performance (Fatica & Panzica, 2021; Yeow & Ng, 2021; Makpotche et al., 2023). However, some research on corporate social responsibility (CSR) and environmental, social, and governance (ESG) practices has found that companies genuinely committed to CSR and ESG initiatives may do so at the expense of their corporate value. Di Giuli and Kostovetsky (2014) discovered a significant negative correlation between a company's ESG/CSR scores and its ROA and stock returns. They also found that a continued expansion of ESG/CSR policies could lead to underperforming stocks and deteriorating ROA.

## II.2. Company Perspective: Potential Mechanisms

There are multiple potential rationales behind the corporate green bond issuance, which can vary the effects on corporate performance: 1) conveying an environmental commitment to the market; 2) taking potential benefits from greenwashing; and 3) agency problem.

### *II.2.1. Signaling*

Signaling theory suggests that companies can reduce information asymmetry by taking on additional costs that are not easily replicable (Akerlof, 1970; Spence, 1973). By doing so, they demonstrate the characteristics or quality of themselves or their products, conveying credible information to the market.

[3] See The White House, "Inflation Reduction Act Guidebook | Clean Energy", January 2023. Retrieved from: https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/.

Applying this theory to the issuance of green bonds, a company's act of issuing such bonds can be seen as a credible signal of their environmental commitment to the market. The company incurs the cost of labeling itself as "green" in order to access special financing, which can be broken down into the environmental commitments and the additional costs incurred.

Due to the effect of information asymmetry, companies know more about the internal situation compared to investors. When a company has specific needs of involving external stakeholders, it becomes necessary for the company to disclose relevant information to the market to fulfill that purpose. The distinguishing characteristic of green bonds, as opposed to conventional bonds, is the inclusion of a green label. Through the issuance of green bonds, a company explicitly expresses its intention to finance the green projects, thereby signaling its commitment towards the environment.

To establish the credibility of the signals, the company may bear the costs associated with labeling the bonds as authentic green instruments. As the recommendation of obtaining third-party certifications from the Green Bond Principles (GBP), the additional costs incurred by the company to issue a milestone report in compliance with GBP guidelines[4], obtain third-party certification, and cover related proxy expenses are considered as practical approaches for delivering a trustworthy green signal.

By considering the willingness of companies to bear additional costs, the signals of environmental commitment conveyed through the issuance of green bonds appear to be credible. Thus, signaling theory implies that credible signals from firms to the market can have an effective positive impact on stock returns and future firm performance. Flammer (2021) make a prominent contribution by demonstrating that the dominant mechanism behind corporate issuance of green bonds is signaling theory.

### *II.2.2. Greenwashing*

However, in comparison to green commitments, companies may place a greater emphasis on the potential benefits behind the issuance of green bonds. In order to secure advantages such as benefiting from government incentives, attracting a broader base of green investors, realizing both short-term and long-term corporate gains, achieving higher ESG scores, and enhancing corporate reputation, companies may be more inclined to strategically issue green bonds. In other words, companies may seek to attain greater profits through a strategic "greenwashing" approach, which refers to the deceptive practices employed by corporations to deceive the public about their environmental commitments. It involves the dissemination of false or misleading information to create a positive perception of a company's environmental efforts (Flammer, 2021). For instance, in 2010, General Electric launched the "Ecomagination" campaign to showcase their environmental initiatives, while simultaneously lobbying against new clean air regulations proposed by the U.S. Environmental Protection Agency (EPA) (Delmas & Burbano, 2011). Similarly, LG, in the same year, marketed Energy Star refrigerators with a government-backed eco-label, but 10 of its refrigerator models with certification had disqualified energy-use measurement tags (Netto et al., 2020).

With information asymmetry, the presence of misleading narratives, and questionable eco-labeling practices has the potential to turn green-labeled bonds into a new form of greenwashing for companies, causing concerns among investors. One of the concerns is the absence of standardized methods for assessing environmental performance. For instance, a study reveals that in voluntary reporting regimes, Scope 3 emissions, which encompass greenhouse gas emissions indirectly generated by firms through their supply chain, product use, and waste disposal activities, constitute a significant portion of the total

[4] See ICMA, "Green Bond Principles", June 2021. Retrieved from: https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/.

carbon footprint. However, on average, only around 22% of Scope 3 emissions are reported by participating firms (Blanco et al., 2016). This indicates that due to the lack of standardized accounting approaches, companies may selectively disclose carbon performance data to create the illusion of compliance (Mercereau et al., 2020). Moreover, the inconsistent and unaudited disclosures and reports undermine the effectiveness of mandatory reporting requirements. For example, companies often opt to include information in unaudited sustainability reports instead of the financial documents recommended by the Task Force on Climate-related Financial Disclosure (TCFD) (Eccles & Krzus, 2018). Similarly, while the GBP provide guidelines for the use of proceeds from green bonds, they primarily rely on recommendation rather than mandatory requirements. In other words, companies can potentially engage in greenwashing by employing unconventional methods to account for environmental performance or by issuing unaudited reports.

Current studies have shown that greenwashing is common in the corporate green bond market (Yeow & Ng, 2021; Schmittmann & Gao, 2022; Xu et al., 2022). Focusing on the issuance of green bonds and green innovation, Shi et al. (2023) suggest that companies issuing green bonds do not significantly enhance their green innovation capabilities. Instead, they concentrate on strategically pursuing green innovation. Specifically, the study found that the number of green patents filed by companies did not increase after the issuance of green bonds. This implies that companies aim to create an environmental image by superficially increasing the number of green patent applications, without substantial improvements in green innovation. Furthermore, from a policy perspective, research by Bartram et al. (2021) indicates that differentiated regional policies may lead to internal reallocation efforts by companies to mitigate regulatory costs. In some cases, subsidiaries responsible for green projects may outsource or transfer pollution-related projects to the parent company or other subsidiaries, and in some instances, even engage in cross-border outsourcing, thereby merely shifting or potentially exacerbating environmental issues. Bartram et al. (2021) also noted that financially constrained companies have a stronger incentive for internal reallocation due to climate incentive policies. These studies collectively suggest an imbalance between the rapid expansion of green bond issuance and the existing framework of government policies.

Given these scenarios, concerns about greenwashing in the market are likely to prompt investors to conduct voluntary greenwashing reviews. In the short term, this may result in negative feedback in the market, yet this repercussion is typically of short duration. In essence, the stock price tends to recover after the event. Additionally, if a company strategically issues green bonds without a genuine commitment to green projects, their valuation and environmental scores may perform well before the greenwashing is formally disclosed.

### *II.2.3. Agency Problem*

Another possibility behind a company's decision to issue green bonds is an agency problem. One of the typical agency problems arises within a firm when there is a conflict of interest between the shareholders and the managers (Jensen & Meckling, 1976). Managers may not always act in the best interest of the shareholders, which can lead to potential losses or inefficiencies for the owners. Prior research on Corporate Social Responsibility (CSR) suggests that management may pursue CSR initiatives due to self-interest (Bénabou & Tirole, 2010). Specifically, managers might strategically engage in CSR activities to gain favor with socially active stakeholders, securing personal career advancement (Cespa & Cestone, 2007). Alternatively, managers might participate in CSR by misusing corporate resources to safeguard their personal reputation (Masulis & Reza, 2014). These decisions, made at the expense of reducing firm value and shareholders' interests, indicate that corporate involvement in social accountability may be driven by agency problems.

Since both environmental and social responsibility are linked to reputation, there might be similarities between a firm's decision to invest in social responsibility and its decision to invest in environmental initiatives. Investments in green projects and the corresponding financing decisions can help managers to build a personal image of environmental friendliness. Issuing conventional bonds for financing green projects can help optimize the allocation of investor funds by offsetting the higher costs and risks associated with green bonds. However, agency issues might encourage managers to issue green bonds, potentially causing misallocation of investor funds. Alternatively, managers may display a greater inclination to fund green projects, even if these projects have negative net present value (NPV) or are less favorable compared to non-green alternatives.

Up to now, there has been limited research on the relationship between corporate green bonds and agency problems. However, Bancel and Glavas (2018) have shed light on this matter by revealing that agency problems play a significant role in driving the issuance of corporate green bonds. Their study identifies key indicators related to agency problems, such as board size, value of floating shares respective to market capitalization, and stock bid-ask spread, which influence the decision to issue green bonds. Additionally, Buchanan et al. (2018) found a significant negative correlation between ESG/CSR indicators and Tobin's Q. They concluded that when agency issues are more pronounced, the costs associated with over-investing in ESG/CSR by companies lead to more substantial declines in corporate value for companies with higher ESG/CSR scores. Consequently, the issuance of green bonds driven by agency problems may negatively impact firm value and shareholders' interests, ultimately affecting the overall financial performance of the company.

### II.3. Investor Perspective: Potential Moderators

Besides discussing the potential mechanisms behind the corporate green bond issuance, we also investigate several potential moderating factors that could influence the results, which are first-time issuance, the influence of ESG's environmental factors, and the difference between financial and non-financial sectors.

#### *II.3.1. First Time Issuance*

Similar to comparing initial public offerings (IPOs) with subsequent stock sales, a company's first issuance of green bonds signifies a decision to engage in environmental responsibility. This debut in the green bond market can be viewed as a milestone since the investors are more likely to be surprised by this shift from no prior engagement, making first-time issuers stand out compared to repeat issuers. Several studies indicated that companies that issue green bonds for the first time tend to experience higher stock returns (Tang & Zhang, 2020; Flammer, 2021).

#### *II.3.2. ESG Scores*

ESG is a global standard for sustainable development frameworks and programs that address the increasingly critical issues of environment, society, and governance, following corporate social responsibility (CSR). According to Principles for Responsible Investment (PRI)'s definition of responsible investing, ESG plays a crucial role for companies in their investment analysis and decision-making process for sustainability while helping investors assess corporate behavior and predicting future financial performance. Since the ESG principles were formally proposed in 2004, they have undergone progressive development in terms of assessment systems and disclosure rules. Among these advancements, ESG scores have emerged as crucial factors in evaluating a company's sustainable performance (Drempetic et al., 2019). Notably, a meta-analytic study examining ESG practices and company financial performance found that in 90% of the 2,200 independent papers analyzed, there was a positive or neutral correlation between ESG scores and company financial performance (Friede, Busch & Bassen, 2015).

Nevertheless, due to the presence of different types of investors in the market, the impact of ESG scores on company performance seems more complicated. Pederson et al. (2021) utilized several extensive datasets to develop and compare the ESG-efficient frontier theory with conventional portfolios. Findings indicate portfolios including ESG ratings have lower maximum Sharpe ratios than those without ESG elements, implying a potential trade-off between high ESG standards and financial efficiency. While higher ESG levels can yield the best Sharpe ratio, further increases might reduce it, leading profit maximizers to prefer financially sound over highly ESG-rated companies.

To summarize, in markets where ESG gains prominence, its ratings certainly influence corporate financial performance, but in a nuanced way. When dominated by ESG-motived investors, a higher ESG score typically aligns with stronger financial health. Alternatively, in markets where investors prioritize Sharpe ratio maximization, companies with modest ESG scores but are announced to participate in green projects might show superior financial metrics.

#### *II.3.3. Financial Industries vs. Non-Financial Industries*

Financial firms are often excluded from empirical studies or examined separately as influential factors due to their higher leverage and heightened sensitivity to financial risks (Foerster & Sapp, 2005). Zhou and Cui (2019) conducted separate tests on the cumulative abnormal returns of the corporate green bond issuance in financial firms and non-financial firms. Despite similar levels of significance and correlation, financial firms exhibited higher average cumulative abnormal returns. This finding supports the notion that the financial sector displays greater sensitivity to financial risks. Alternatively, Lebelle et al. (2020) found a significant positive relationship between leverage and cumulative abnormal returns during corporate bond issuance events. This suggests that financial firms are more likely to experience amplified market reactions to the issuance of green bonds in terms of cumulative abnormal returns because of the higher leverage.

### II.4. Research Questions

By discussing the potential mechanisms and moderating factors related to the issuance of green bonds by U.S. companies, we construct three research questions:

**RQ1**: *What is the impact of U.S. companies issuing green bonds on their stock returns and company financial performance?*

- **RQ1.1**: *Does the issuance of green bonds by companies lead to changes in their stock returns? Do they change in the long-term or the short-term?*
- **RQ1.2**: *What impact does the issuance of green bonds by companies have on their return on assets?*
- **RQ1.3**: *How does the issuance of green bonds by companies affect their firm valuations?*

**RQ2**: *What are the primary factors driving the issuance of green bonds by U.S. companies?*

**RQ3**: *How do the potential moderators affect the impact of U.S. companies issuing green bonds on stock returns and/or company financial performance?*

- **RQ3.1**: *How does the first-time issuance of corporate green bonds affect the stock returns?*
- **RQ3.2**: *How do the ESG scores of the green issuers affect the stock returns and company financial performance?*
- **RQ3.3**: *How do the different sectors of the corporate green bond affect the stock returns?*

# III. Data

## III.1. Corporate Green Bonds in the U.S.

### *III.1.1. Data Source*

Using Bloomberg's fixed income database, we extracted and compiled a database of U.S. corporate green bonds. Specifically, we chose corporates as the asset classes to exclude municipal bonds. By utilizing the "Fields" filtering function, this database encompasses all corporate green bonds, including both mature and active bonds (i.e., selecting "All" in the field "Security Status" and "Yes" in the field "Green Instrument Indicator"). We also set the "Country/Region of Incorporation" to include only the United States.

Given the paper's focal point on studying U.S. corporate green bonds within the last decade, we opted for the timeframe ranging from January 1, 2013, to December 31, 2022, in the field "Announce Date" and yield a total of 436 corporate green bonds with 171.57 billion dollars, which is 9.81% of the global green bonds and 0.82% of the U.S. bonds. For each bond, Bloomberg provides comprehensive information including issuers, issuing industry, issue size, coupon rate, credit rating, announcement date, issue date, maturity date, third-party guarantor, and whether there is an ESG report available. While maintaining the aforementioned filtering criteria and information selection, we obtained two data subsets by altering the field "Is Company Private", resulting in "Yes," and "No" categories. By conducting a data pivot using the compiled database, we aggregated key attributes for the issuance of green bonds by U.S. corporations.

To clarify whether the green bonds are certified or self-labelled, we also applied the filter function called "Self-reported Green", which "indicates that the issuer has self-reported that the net proceeds of the fixed income instrument will be applied toward green projects or activities that promote climate change mitigation or adaptation, or other environmental sustainability purposes"[5]. According to the result, all of the bond we found for the public corporate green bonds in U.S. are self-reported instead of certified.

### *III.1.2. Corporate Green Bonds in the U.S. over Time*

In Table 1a, the reported data shows the annual issuance quantity and amount of green bonds by companies. The issuance of U.S. corporate green bonds grew from $2.5 billion (corresponding to 3 bonds) in 2013 to $52.82 billion (corresponding to 84 bonds) in 2021. By 2022, the growth trajectory showed a slight decline, but remained at a level similar to 2020. The data corresponding to these statistics has been visualized in Figures 1 and 2.

*[Insert Figure 1 and Table 1a here]*

It is noteworthy that in 2015, the total issuance amount of $8.09 billion corresponded to 144 bonds. Further investigation revealed that SolarCity, before its public listing, had sequentially issued $784 million (corresponding to 140 bonds) in late 2014, 2015, and early 2016. This company was founded by Peter Rive and Lyndon Rive, cousins of Tesla's CEO Elon Musk, in 2006 and was later acquired by Tesla for $2.6 billion in 2016 to be restructured as Tesla Energy and went public[6]. Excluding this exceptional issuance activity that could be related to the acquisition preparations, the growth trend of U.S. corporate green bonds exhibited a cliff-like increase after 2018. The underlying reasons for this growth characteristic might be linked to the global trend of increased issuance of corporate green bonds (Flammer, 2021) and the continuous improvement of relevant principles. For instance, the International

[5] See "Self-reported Green's Explanation", 2023. Retrieved from: Bloomberg Terminal
[6] See Wikipedia, "SolarCity", November 26, 2023. Retrieved from: https://en.wikipedia.org/wiki/SolarCity.

Capital Market Association released the third version of the GBP in mid-2018 after three years of development.

### *III.1.3. Corporate Green Bonds in the U.S. over Issuers*

In Table 1b, we compiled the overall data for the U.S. corporate green bonds by using the different types of issuers. By separating the issuers into private and public, there are 341 private issuances and 95 public issuances, which correspond to $100 billion and $71.56 billion respectively. For public issuance, there are 81 unique green bond issuer days. The 49 unique issuers occupied 60% of the issuance amount in the public issuance. These separated observations are used in the empirical tests for different purposes including matching, heterogeneity tests, and robustness.

*[Insert Table 1b here]*

The 95 public green bonds in U.S. covered 10 industries. According to the pie charts in Figures 3 and 4, the financial sector holds a predominant position in terms of both the number and volume of issues. It commands 44.21% of the total number of issues and 37.03% of the total issue amount. In stark contrast, the utilities sector, ranking second, comprises a significantly smaller portion of the market, with 14.74% of the issues by number and 15.76% by amount, both markedly less than the financial sector's shares.

*[Insert Figure 3 and Figure 4 here]*

## III.2. Corporate Green Issuers in the U.S.

### *III.2.1. Data Source*

The data pertaining to individual firms are sourced from various origins, as elucidated in the following description. Except the firm age that is sourced from the respective company websites, accounting data for the corporate green issuers is extracted from the "Fundamentals Annual" database within Standard & Poor's Compustat North America. This database contains various identities (including tickers and global company keys) and detailed accounting records for each company. To construct the dataset for this study, we transformed the raw data into the required formats. Specifically, firm size is represented as the natural logarithm of the book value of the total assets in USD. Firm leverage is calculated as the debt (the sum of short-term and long-term debt) divided by the book value of total assets. ROA is defined as the ratio of net income to the book value of total assets. Tobin's Q is calculated as the ratio of the firm's total asset market value (the total assets' book value plus the product of the difference between market value and book value per share of common shares outstanding) to the book value of total assets. Revenue growth is determined as the percentage of the difference between the firm's total revenue for the current year and the total revenue for the previous year relative to the total revenue for the previous year.

The stock market data for the issuing companies is sourced from Compustat North America's daily securities database, which includes necessary company authentication identifiers, daily stock prices (the closing one) and daily liquidity (the ratio of the trading volume and shares outstanding).

The ESG data for the issuing companies is sourced from the ESG data section within the financial analysis ("FA" function) of various companies, which can be found in the Bloomberg database. The ESG Financial Materiality Score ranges from 0 to 10, with 0 indicating no data points in any of the ESG areas and 10 signifying maximum scores in all ESG areas. Meanwhile, the ESG Disclosure Score ranges from 0 to 100, with 0 representing companies that disclose none of the ESG data points included in the score, and 100 representing those that disclose every data point.

The specific metrics we utilize in this study, namely the BESG E Score and E Disclosure Score, are extracted from the environmental pillar within the ESG Financial Materiality and ESG Disclosure Score sections. These scores are constructed by aggregating data from seven distinct areas, including air quality, climate change, ecological & biodiversity impacts, energy, materials & waste, supply chain, and water. While the BESG E Score primarily focuses on how a company's environmental sustainability practices impact its financial performance, the E Disclosure Score emphasizes the degree of transparency exhibited by a company in disclosing its environmental sustainability data.

### *III.2.2. Summary Statistics of Public Green Issuers in the U.S.*

As previously stated, there are 95 corporate green bonds issued by public companies. In Table 2a, we compiled summary statistics for the public corporate green bonds issued in the U.S. Concerning bond credit ratings, this research utilized the Moody's Rating method. Conforming to the credit rating agency's categorization of 21 rating levels (with ratings up to baa3 falling within the investment grade category, and those beyond being classified as speculative grade), we established a binary variable, where bonds in the investment grade category were allocated a value of 1, and bonds in the speculative grade category were assigned a value of 0. The credit rating for the 95 publicly listed companies is 0.674.

*[Insert Table 2a here]*

Furthermore, we have summarized the characteristics of 95 green bonds issued by publicly companies in terms of their issuance amount, maturity length, and coupon rate. The results indicate that the average issuance amount for these green bonds is $0.753 billion, with an average maturity period of 8.9 years. The average coupon rate for these bonds is 4.906%. In terms of the characteristics of the companies issuing these green bonds, the average firm size is $11.129 billion, with an average firm age of 51.8 years. The average firm leverage is 0.379; ROA stands at 2.13%; Tobin's Q is 2.257; and revenue growth is 9.34. Notably, the firm leverage at time *t* we summarized in Table 2a includes the green bond issuance while the firm leverage at time *t-1* we used in other regressions does not. The data are derived from the fiscal year of the green issuance. Besides, with regards to ESG financial materiality, the average environmental score for these corporate green bonds is 3.609 out of 10, and the environmental disclosure score is 44.568 out of 100. The two ESG scores with varying degrees of incompleteness, which is attributed to the fact that these companies did not furnish the relevant data to Bloomberg.

Based on the firm-level data of these issuers, it is apparent that the characteristics of firms issuing green bonds encompass a wide spectrum. They include firms with differing debt levels, a range of return on assets figures, diverse market valuations, and a spectrum of environmental and disclosure scores. This diversity underscores the broad adoption and increasingly popular trend of green bond issuance across various sectors within the United States.

# IV. Methodology

## IV.1. Event Study

The event study methodology examines how stock prices react to the disclosure of a specific event or news announcement. We employ this methodology to assess the short-term and long-term impacts of companies announcing the issuance of green bonds on the stock market. The key raw data required for this methodology includes the event date of the green bond issuance, daily stock prices for specific periods before and after the issuance, and corresponding market stock prices. In general, short-term event studies utilize daily stock returns, whereas long-term event studies examine abnormal returns over an extended time frame.

Bonds are typically issued with two significant dates in the process: the announcement date and the issuance date. Since investor reactions to specific events occur at the time when information is disclosed, the announcement date (conveying new information) is deemed a more suitable event date than the issuance date (containing pre-existing information). The announcement date for the green bond issuances utilized in this study is derived from the Bloomberg Fixed Income Database.

In general, the reactions of the stocks are typically measured using abnormal returns. A commonly used risk model for assessing short-term and long-term impacts is the simple market model by assuming that actual stock returns are derived using

$$R_{i,t} = \alpha_i + \beta_i \times R_{m,t} + \varepsilon_{i,t} \tag{1}$$

where $R_{i,t}$ is the return on the security $i$ in period $t$. $R_{m,t}$ is the market portfolio return in period t, which is calculated as the value weight return of CRSP firms incorporated in the U.S. and listed on NYSE American and the NASDAQ. $\beta_i$ is the coefficient of the security relative to the market return. $\alpha_i$ is the constant of the model, and $\varepsilon_{i,t}$ is the residual. The estimated return for each issuer can be calculated using

$$E(R_{i,t}) = \hat{\alpha}_i + \hat{\beta}_i \times R_{m,t} \tag{2}$$

The abnormal return (AR) for security $i$ in period $t$ is the difference between the known actual retu the estimated return calculated based on this model as

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) \tag{3}$$

### *IV.1.1. Short-run Event Study*

Cumulative Abnormal Return (CAR) is a commonly used method for studying the short-term impact of specific events on a company's stock returns. It is calculated as the sum of abnormal returns as

$$CAR_{i,t} = \sum_{t=1}^{T} AR_{i,t} \tag{4}$$

In this study, we utilized the U.S. Daily Event Study Program available in the WRDS database. Stock data for individual companies were obtained from the CRSP daily stock file. In addition to supplying the essential data, including stock tickers and specific event dates (day 0), We provided three critical pieces of information to the program to obtain the results. These details encompassed defining the event window (comprising its start and end points), establishing the estimation window (including the relevant parameters and gap), and setting the minimum threshold for valid returns. Following Krueger's (2015) recommendation, given the possibility of information becoming public before the official announcement, we created three distinct time windows, covering daily, weekly, and bi-weekly intervals. These intervals

were denoted as [-10, 10], [-5, -5], [-2, 2]. To ensure methodological consistency, we designated the estimation window as [-250, -50], spanning the 200 trading days leading up to the event day, serving as the baseline for return estimation. Besides, we enforced a minimum observation requirement of 180 within this baseline, guaranteeing that no more than 20 trading days were omitted, thereby maintaining the test's validity.

### *IV.1.2. Long-run Event Study*

The Buy-and-Hold Abnormal Returns (BHAR) method is a commonly employed approach for studying the long-term effects of specific events on a company's stock performance. Its fundamental concept revolves around assessing the impact of an event on a security's price performance by comparing the stock returns of the event-afflicted company with those of similar companies that did not undergo the event. The key advantage of BHAR lies in its ability to accurately capture the genuine magnitude of returns from an investment strategy. In the extensive literature on this subject, Barber and Lyon (1997) as well as Kothari and Warner (1997) are notable for being early proponents of this feature-matching-based empirical framework, which has gained widespread adoption.

This paper utilizes the Long-Horizon Event Study Program in the WRDS database, which employs a feature-based matching investment portfolio method to construct benchmark data for non-event companies, referring characteristics such as company size and book-to-market value. Therefore, in this model, the $R_{m,t}$ mentioned in formulas (1) and (2) are not market portfolio returns but characteristic-based matched portfolio returns.

Differing from the abnormal returns used in CAR, the calculation method for BHAR, as seen in formula (7), is

$$BHAR_{i,t} = \prod_{t=1}^{T}(1 + R_{i,t}) - \prod_{t=1}^{T}\left(1 + E(R_{i,t})\right) \tag{5}$$

Specifically, in estimating the returns for BHAR, there are two different calculation methods. The first calculation method is

$$\prod_{t=1}^{T}\left(1 + E(R_{i,t})\right) = \prod_{t=1}^{T}\left(1 + \sum_{i=s}^{n_t} w_{i,t}R_{i,t}\right) \tag{6}$$

where $n_t$ is the number of securities in period $t$, $w_{i,t}$ is an equal-weight or value-weight factor of security $i$ in period $t$. In this approach, annual rebalancing is considered, assuming that each portfolio undergoes complete restructuring during each time period. Subsequently, it calculates the compounded average stock return for the portfolio over the specified investment horizon. Nevertheless, the rebalancing methods introduce potential issues like new listing bias and rebalancing bias. In response to these concerns, Mitchell & Stafford (2000) proposed an alternative strategy: establishing a baseline portfolio at a specific time period (e.g., t=1), which remains unchanged throughout the investment horizon. Following this logic, the second method for calculating BHAR is

$$\prod_{t=1}^{T}\left(1 + E(R_{i,t})\right) = \sum_{i=s}^{n_t}\left(w_{i,s}\prod_{t=1}^{T}(1 + R_{i,t})\right) \tag{7}$$

where $w_{i,s}$ is a value-weight factor of security $i$ at initial period $s$. This method initially computes the compounded returns for the securities comprising the portfolio and then averages the returns of each security (i.e., without annual rebalancing). Among the four BHAR outcomes, the equal-weight approach

in method 1 and the value-weight approach in method 2 are used to mitigate the issue of assigning excessively high weights to recent observations.

To narrow down the desired time intervals for obtaining the required results from the WRDS Program, we provide three essential pieces of information, aside from the company ticker and the announcement date of the green bond issuance, which are MINWIN, MAXWIN, and MONTH. MINWIN sets the minimum inclusion period for companies in the long-term event study sample, MAXWIN defines the maximum calculation window for the algorithm after the event, and MONTH indicates the selected timeframe for BHAR calculation and reporting. To maximize the retention of the sample size, we enter the same number in the three columns by selecting commonly used time measurement units including one month (1) and one quarter (3).

### IV.2. Matched Samples

To further confirm whether green bonds have a different impact on issuers compared to conventional bonds in the short term or long term, we created matched samples based on corporate green bonds (CGBs) and corporate green issuers (CGIs), respectively. Through CGBs-based matching, we focused on comparing the impact of green bonds versus conventional bonds on CARs. Through CGIs-based matching, we aimed to compare the post-issuance performance of green issuers versus conventional issuers, including ROA and Tobin's Q.

In line with the methodology used for collecting data on green bonds, the dataset for conventional bonds in this study was also sourced from the Bloomberg Fixed Income Database. Following the replication of all filtering criteria applied to green bonds, an extra filter based on the ticker was added. This filter was configured to exclude issuers who had previously issued green bonds. In order to mitigate confounding effects, we removed duplicate bond issuances from the dataset of conventional bonds, specifically targeting bonds issued by the same issuer on the same day.

The methodology employed in this study, known as the interval matching method, shares similarities with the traditional I/S (referring to industry and size) matching method utilized by Ritter (1991) and Yi (2001). However, there is a key distinction: in addition to controlling for industry, several pivotal variables were selected as reference criteria. These variables were used to create intervals, and the dataset was sorted accordingly. The objective was to identify a control group that closely resembled the experimental group in terms of these chosen variables. In instances where complete data for the control group was unavailable, the subsequent closest dataset was selected based on a predefined priority order. For a more detailed discussion of the specific procedures, please refer to the subsequent sections on CGBs-based and CGIs-based matched samples.

#### *IV.2.1. CGBs-Based Matched Samples*

Before proceeding with CGBs-based matched samples, we began by averaging all variables (including coupon rate, issuance amount, and maturity length) for green bonds issued by the same company on the same day. Following the bond matching method inspired by Zerbib (2019) and adhering to certain constraints, we selected coupon rate, issuance amount, and announcement date as pivotal reference variables and defined specific interval limits. To specify, we categorized eligible conventional bonds as those meeting the following criteria: (i) coupon rates deviating by up to 1 percentage points in either direction from the coupon rate of the corresponding green bond, (ii) issuance amounts falling within a range from one-fourth to four times the amount of the green bond, and (iii) announcement dates within a six-month window of the green bond's announcement date. In instances of multiple qualifying conventional bonds, we prioritized them based on the similarity of their maturity lengths (a specific variable).

Following the specified constraints, we conducted one-to-one matching, resulting in the selection of conventional bonds matched to 80 unique issues of green bonds for daily observations. Table 2b provides a comprehensive overview of the descriptive statistics for both datasets and the outcomes of the differential analysis. It's worth noting that, in addition to the bond-level characteristics, relevant variables intended for use in regression models have been consolidated in this statistical table. These variables include shares liquidity and the annual fundamental data of the issuing companies. Regarding the differential analysis outcomes, it's evident that experimental companies and control companies exhibit substantial similarity in all bond-level attributes. Notably, the null hypothesis of equal means cannot be rejected, with p-values ranging from 0.2799 to 0.9886. However, at the company-level, firms issuing green bonds significantly differ from those issuing conventional bonds in terms of size (p-value = 0.0028), Tobin's Q (p-value = 0.0287), and environmental disclosure scores (p-value = 0.0367). Specifically, companies issuing green bonds are larger in scale (11.31 > 10.25), have lower valuations (1.95 < 2.90), and maintain higher environmental disclosure scores (43.72 > 36.85). This suggests that within the same industry, companies that possess (i) greater stability and influence, (ii) more investment opportunities or a heightened focus on debt financing, and/or (iii) higher levels of environmental disclosure are more likely to issue green bonds.

*[Insert Table 2b here]*

#### *IV.2.2. CGIs-Based Matched Samples*

In the CGIs-based matched samples, alongside ensuring identical year and month controls, we incorporated company size, company leverage, and company age as critical reference variables, imposing specific interval constraints. To clarify, we defined eligible companies issuing conventional bonds as those meeting the following conditions: (i) the size of the green bond-issuing company fluctuated within a range of plus or minus 2; (ii) the leverage of the green bond-issuing company fluctuated within a range of plus or minus 0.15; (iii) the age of the green bond-issuing company fluctuated within a range of plus or minus 15. In cases where multiple qualifying control groups were identified, we ranked them based on the similarity of revenue growth (a specific variable). Besides, we also confirm that the conventional issuers issue the conventional bonds in the same year as the green issuers.

Following the specified constraints, we performed one-to-one matching, resulting in the selection of conventional bond-issuing companies paired with 47 unique issuers of green bonds. Recognizing potential variations stemming from different months of annual financial reporting across companies, we retained only 40 unique issuers of green bonds and their corresponding conventional bond-issuing companies, all of which aligned their annual financial reporting to December. Table 2c displays the statistical results following this adjustment. In this differential analysis, all features exhibit similarity (p-values ranging from 0.3199 to 0.9726).

*[Insert Table 2c here]*

### IV.3. Regressions

Following the event study and two distinct matched sample groups, we conducted regression analyses to delve deeper into the influence of corporate green bond issuance on various aspects of company performance, including CARs, ROA, and Tobin's Q. We primarily employed multiple linear regression with a binary variable representing green bond issuance as the main independent variable, which helps assess whether green bond issuance significantly affects firm performance compared to conventional issuance. In addition, we incorporate control variables at both bond and company levels based on different dependent variables. For bond-level controls, these include bond size, coupon rate, maturity length, investment grade, and stock liquidity. On the firm-level, controls involve firm size, firm leverage, revenue

growth, BESG E score, and the E disclosure score. In particular, the BESG E score is also employed as a potential moderating element, which represents a categorical factor in subsampling regression models. Notably, the dummy variable is assigned a value of 1 when the BESG E score falls below the median BESG E scores, otherwise, it is set to 0. In addition, we also set the financial and non-financial industries as another categorical factor in subsampling regression models.

Furthermore, all regression models are employed by the Variance Inflation Factor (VIF) to assess the presence of multicollinearity. When VIF values range between 1 and 5, it signifies a moderate level of multicollinearity (Shrestha, 2020). A VIF exceeding 10 indicates that the regression coefficients are poorly estimated, indicating the presence of multicollinearity (Thompson et al., 2017).

The general regression model examining CARs (cumulative abnormal returns) is refined by modifying the tiers of control variables within the model, which are to assess the effects of green bond issuances. In specific, the regressions are outlined as follows:

$$CARs = \alpha + \beta_1 Green + \beta_m BondControls_{m,i,t} + \beta_n FirmControls_{n,i,t-1} + \varepsilon \quad (8)$$

Furthermore, we compiled a dataset specific to conventional bond issuances by green bond issuers for CARs to ensure there is no other conventional bond issuances that creates disruptive effects in the analysis of green bond issuance. The approach involved configuring the "Ticker" filter to include these issuers. By calculating date intervals spanning 10 business days before and after 80 distinct issuer-day observations, we filtered out observations from the dataset where green bond issuers were issuing conventional bonds that did not fall within these intervals. Consequently, we generated a refined green bond dataset devoid of other conventional bonds' influences based on this criterion. Building upon the prior matched samples' outcomes, we merged the corresponding conventional bonds and conducted regression analyses utilizing the same model.

For long-term financial performance indicators like ROA and Tobin's Q, we exclusively use company-level control variables in our analysis. Recognizing that these long-term metrics are affected by their past data, we also incorporate data from the previous year as part of our control variables in the regression models. The corresponding models for this dataset are outlined as follows:

$$ROA = \alpha + \beta_1 Green + \beta_2 ROA_{i,t-1} + \beta_n FirmControls_{n,i,t-1} + \varepsilon \quad (9)$$

$$Tobin's\ Q = \alpha + \beta_1 Green + \beta_2 Tobin's\ Q_{i,t-1} + \beta_n FirmControls_{n,i,t-1} + \varepsilon \quad (10)$$

Notably, since the CARs reflect the market reactions based on the short-run stock returns, the one-on-one matched samples we used in the regressions are the conventional bonds with three bond-level interval constraints. In contrast, since the ROA and Tobin's Q are two long-term corporate performance indicators, the one-on-one matched samples we used in the regressions are the conventional issuers with three firm-level interval constraints. Therefore, the samples themselves are entirely distinct from each other.

Ultimately, we developed two groups of subsampling regression models for CARs, ROA, and Tobin's Q. In specific, in the first subsampling regression model, we segmented the BESG E score into high and low scoring groups. In the second subsampling regression model, we separated the issuers' industry into financial industries and non-financial industries. Furthermore, for the sake of structural coherence across the models, we adhered to the previously outlined control variables and modeling procedures for each of the dependent variables, except that we take BESG E score out of the firm-level control variables or exclude the industry fixed effect respectively when running their specific subsampling regression models.

# V. Empirical Results

## V.1. CARs Results

### *V.1.1. Short-run Event Study General Results*

Table 4 presents findings from an event study utilizing the CAPM model to assess the influence of companies issuing green bonds on the stock market. For the sample of companies issuing green bonds, which includes 80 observations, the average CAR is -1.28% and statistically significant at the 5% level in [-2,2]. The findings indicate that the stock market responded negatively to the announcement of green bond issuances during the two trading days before and after the issuance. Compared to Flammer (2021) that has 0.49% positive CARs in the event window [-5, 10] in the global market, the impact on CAR is more severe in the adverse direction but with shorter period.

*[Insert Table 4a here]*

### *V.1.2. Short-run Event Study Cross-Sectional Heterogeneity Results*

To a further extent, Table 4b investigates potential moderating factors. In particular, we divided the sample into three panels: first-time issuance vs. seasoned issuance, lower BESG E score vs. higher BESG E score, and financial industries vs. non-financial industries.

In Panel A, the findings indicate that among the 48 observations in the first-time issuance group, the average CAR in the event window [-2, 2] exhibit statistically negative at the 5% level. The average CAR for first-time issuance stands at -2.07%, which is 0.79 percentage points lower than the full sample average. In contrast, the seasoned issuance group did not demonstrate statistically significant average CAR. Similar with the previous literature, this result affirms that the initial issuance of green bonds tends to provoke a more pronounced market response.

*[Insert Table 4b here]*

In Panel B, we conducted analyses considering BESG E score as potential moderating factors. In both cases, the results indicate that when dealing with sample groups possessing environmental scores above the median, the average CAR tends to be positive but fails to reach statistical significance. Conversely, for sample groups with scores below the median, the average CAR is -2.24%, which is not only lower than the full sample average but also statistically significant at the 5% level, indicating a negative market reaction. Comparing to the existing literatures that have significant positive average CARs in environmental score above the median, our result indicates that the significant negative average CAR in the U.S. in contributed by the issuers who have lower environmental scores.

In Panel C, we segregated the sample into financial industries and non-financial industries to analyze the CARs. It was observed that companies within the financial sector issuing green bonds also have negative average CAR but do not exhibit statistical significance. However, in the non-financial sector, the average CAR is -2.12% and significantly negative at the 5% level. Compared to Flammer (2021) that has higher positive average CAR after excluding the financial sectors' issuers, our result agrees that the higher economic significance is contributed by non-financial sectors regardless the direction of the effect.

### *V.1.3. Short-run Event Study Robustness Results*

When calculating short-term abnormal returns, we also considered the option to substitute the simple market model with the Fama-French Carhart model. This particular model incorporates three additional relevant factors into the daily stock returns of each firm. Specifically, Equation (1) and Equation (2) were replaced with Equation (11) and Equation (12) below:

$$R_{i,t} = \alpha_i + \beta_{1i} \times R_{m,t} + \beta_{2i} \times SMB + \beta_{3i} \times HML + \beta_{4i} \times WML + \varepsilon_{i,t} \quad (11)$$

$$E(R_{i,t}) = \hat{\alpha}_i + \hat{\beta}_{1i} \times R_{m,t} + \hat{\beta}_{2i} \times SMB + \hat{\beta}_{3i} \times HML + \hat{\beta}_{4i} \times WML \quad (12)$$

where SMB is the return of the size factor. HML is the return of the book-to-market factor. WML is a return of the momentum factor. We employ this model as one of the robustness tests.

In Panel A of Table 4c, the results based on Fama-French Carhart model, whether applied to the entire sample or utilized for subgroup analyses based on moderating factors, generally mirror the outcomes obtained with the CAPM model. This shift can be attributed to the Fama-French Carhart model's broader inclusion of company-specific characteristics beyond market returns, which suggests that the higher economic significant results observed in the CAPM model may have been driven by variations in company-specific attributes.

*[Insert Table 4c here]*

In Panel B of Table 4c, we conducted another robustness test by excluding events where companies announced the issuance of conventional bonds within two weeks before or after they announced the issuance of green bonds. Among the remaining 37 observations, both the CARs calculated using the CAPM model and those using the Fama-French Carhart model consistently showed statistically significant negative values in the event window [-2, 2] following the announcement of green bond issuance. Additionally, the average CAR is higher compared to the results obtained from the full sample group. As indicated in the table, our test results maintain their robustness after accounting for the potential confounding influences.

To further confirm the statistical significance of the differences in CARs between the two groups, we conducted paired t-tests for the event window [-2, 2] (Panel C of Table 4c). The results reveal a statistically significant negative difference at the 10% level. This suggests that, compared to issuing conventional bonds, the issuance of green bonds triggered a more pronounced negative investor response in the days surrounding the announcement. This heightened reaction appears to be primarily driven by information potentially leaking ahead of the announcement.

### *V.1.4. Full-Sample Based Regression Results*

Table 4d presents the outcomes of three types of regression models using full-sample based CARs as the outcome variable. In particular, column (1) to column (3) applied standard regression models; column (4) and column (5) used low/high environmental score subsampling regression models; column (6) and column (7) relied on financial and non-financial subsampling regression models.

In standard regressions, by adjusting the control variables from only including bond-level control variables, only including firm-level control variables, to including both bond-level and firm-level control variables, we can see that although the beta-coefficients between green variable and the CARs in the event window [-2, 2] are negative, none of them are statistically significant. This result suggests that although there is a significant negative average CAR existing before and after the green bond issuance, the green issuance might not be the reason that explained the different CARs between the green bond issuers and conventional bond issuers. By observing the regressions, the consistent significant effects might come from the revenue growth of the companies. In column (2) and column (3), the revenue growth is consistently and positively correlated with the CARs. When considering all control variables we set in our study, the stock liquidity is negatively correlated with CARs, which indicates more selling.

*[Insert Table 4d here]*

Column (4) and column (5) reveal that there is no significant relationship between the green variable and CARs, which means that the issuance of green bonds does not have a significant impact on CARs after treating the BESG E score as a moderator. Similarly, the beta-coefficients of green variable are insignificant in column (6) and column (7), which means that there are no significant CARs existing even if we allow non-financial/financial industries to be different subsamples. These findings suggest that the significant negative CARs observed in the event study section may be attributed to market factors, such as COVID-19, and stock liquidity, which are negatively significant in most of the cases, rather than the issuance of green bonds, environmental scores, or non-financial/financial industries.

#### *V.1.5. Bond Impact Immune Sample Based Regression Results*

Table 4e employed the same structure in Table 4d but focuses on the sample that filters out the effects of conventional bond issuances by green bond issuers within a 10-business-day window around the issuance. Nevertheless, consistent results were found after this detailed filtering, which implied that the insignificant CARs are not caused by the delusion of the conventional bond impacts. Moreover, the negative correlation between BESG E score and CARs in full sample based standard regressions disappeared after applying the exclusions of the disruptive effects from the conventional bond before the certain green or conventional bond issuance.

*[Insert Table 4e here]*

### V.2. BHARs Results

Table 5 presents the long-term market impact measured using BHAR. This table showcases eight BHAR results across two event windows, calculated using four different methods for estimating expected returns. Due to the fact that companies announcing the issuance of green bonds are often emerging or subsidiary firms, the sample size gradually decreases as the measurement period extends. The test results reveal that the average values of all eight BHARs are not statistically significant (all p-values are greater than 0.1). In other words, the issuance of green bonds by companies did not result in long-term abnormal stock returns.

*[Insert Table 5 here]*

### V.3. ROA Results

Table 6a features regression models focusing on the ROA that is over a full fiscal year following the bond issuance based on the corporate green issuers matched samples, which used the different group of samples rather than the CARs. Under the standard regression model, which is column (1), the beta-coefficient between the green variable and $ROA_{t+1}$ is negatively insignificant, indicating that the issuance of green bonds, compared to conventional bonds, does not significantly influence a company's long-term return. Instead, the factors that reliably predict the $ROA_{t+1}$ are the company's historical ROA and its revenue growth. It is clear that there is a significant positive correlation at the 1% level between a company's past $ROA_{t+1}$. However, there is a notable negative coefficient, also significant at the 1% level, between revenue growth and $ROA_{t+1}$, which could indicate that a rapid increase in revenue might be associated with reduced operational efficiency or a decrease in the incremental benefits gained from additional revenues.

*[Insert Table 6a here]*

In the subsampling regression models from column (2) to column (5), most of the beta-coefficients for green variable are negatively insignificant, which are consistent with the results found in standard regression models. Nevertheless, the green variable in column (3) exhibits a significant negative correlation (beta-coefficient = -5.08) solely with $ROA_{t+1}$ in the higher environmental score group. This observation lends partial support to the idea from Pederson et al. (2021) that companies with higher

environmental scores may be willing to sacrifice operational efficiency and returns in their pursuit of further environmental improvements. From a corporate standpoint, this decision might also entail agency-related concerns. However, it is important to acknowledge that the reliability of this finding is somewhat compromised due to the limited sample size in the higher-score group (number of observations = 21).

Similarly, Table 6b is the combined regression models including the standard regression model and subsampling regression models but focusing on the ROA at the issuance year. Unsurprisingly, none of the beta-coefficients between the green variable and $ROA_t$ display significant results. However, instead of the negative correlation, there are some positive correlations existing from column (2) to column (3), which may possibly generate a slight up-then-down curve for green issuers' ROA. However, it is important to know that the reliability of this prediction is also restricted by the limited sample size.

*[Insert Table 6b here]*

**V.4. Tobin's Q Results**

Table 7 displays regression model outcomes with Tobin's Q value a fiscal year after the bond issuance or at the issuance year based on the corporate green issuers matched samples. In contrast to the ROA findings, the green variable has significant positive coefficients with both of the Tobin's Q in the two periods at 5% significance level, which are 0.272 at Tobin's $Q_{t+1}$ (Column (1) in Table 7a) and 0.311 at Tobin's $Q_t$ (Column (1) in Table 7b) respectively. These results indicate that green bond issuers are likely perceived more favorably by investors in terms of future value compared to issuers of conventional bonds. Additionally, among the control variables that reliably predict Tobin's $Q_{t+1}$, besides historical Tobin's Q, is revenue growth, which is negatively correlated with Tobin's $Q_{t+1}$ at the 1% level, hinting at possible inefficiency in the companies' strategies for revenue growth. This inefficiency might raise investor concerns about sustainable growth, potentially lowering market valuations. However, the economic significance is minimal, as indicated by the small beta coefficient (beta-coefficient = -0.023).

*[Insert Table 7 here]*

In Column (2) and Column (3) in Table 7a and Table 7b, we observe a significant positive relationship between the green variable and Tobin's $Q_{t+1}$ as well as Tobin's $Q_t$ in the lower environmental score group, with a 5% level of significance (beta-coefficient = 0.293 and 0.481). This confirms Pederson et al. (2021)'s idea that companies with lower environmental scores can achieve higher firm valuations with relatively minimal efforts. Essentially, investors who prioritize metrics like the Sharpe ratio and consider ESG factors appear to hold significant influence in the market.

Besides, in column (4) and column (5) in Table 7a and Table 7b, the subsampling analysis based on non-financial/financial industries showed significances in both Tobin's $Q_{t+1}$ and Tobin's $Q_t$. In specific, the green variables are 0.445 and -0.243 and statistically significant at 5% level in non-financial subsampling group and financial subsampling group for Tobin's $Q_{t+1}$. Likewise, for Tobin's $Q_t$ the green variables are 0.430 and -0.201 and statistically significant at 10% level in those subsampling groups. From these findings, it is reasonable to predict that there is a gradual increase in Tobin's Q from the issuance year to the year after based on the industries' subsampling.

**V.5. Robustness: Reverse-Causality Regression Results**

To address concerns of reverse causality, we examined whether there were notable differences in a company's pre-bond-issuance ROA and Tobin's Q that might influence their decision to issue green bonds. We conducted this analysis using both CGBs-based matched samples in full sample group and bond impact immune group as represented in column (1) to column (4) in Table 8. It became evident that

companies with lower leverage were more inclined to issue green bonds. Notably, we did not find any significant relationships between ROA, Tobin's Q, and the issuance of green bonds in either analysis. Furthermore, when we conducted CGIs-based matched samples in column (5) and column (6) in Table 8, we also noticed that there are no significant associations between ROA, Tobin's Q, and the decision to issue green bonds. Additionally, the historical BESG E Score of the issuer did not appear to impact the choice to issue green bonds. These collective results reinforce the notion that there is no reverse causality between a company's decision to issue green bonds and its ROA or Tobin's Q. Moreover, the finding in Table 8d, where companies with lower leverage are more likely to issue green bonds, suggests that companies may exercise caution when deciding to issue green bonds compared to conventional bonds.

*[Insert Table 8 here]*

## VI. Results Summary

This research builds on previous studies to validate U.S. investors' attitudes toward green bond issuance across different industries. Consistent with many prior studies, U.S. investors view the issuance of green bonds by companies as a signaling mechanism. A key discovery is that U.S. investors tend to trust the authenticity of green bonds issued by non-financial companies more. Conversely, investors may view the financial sector's indirect involvement in green projects as greenwashing, suspecting that funds from green bonds could be diverted elsewhere.

Industry-segmented event analysis shows investor skepticism regarding short-term returns from green project investments. Non-financial sectors show significantly negative CARs, while the financial sector exhibits an insignificantly positive outcome. In the long-run, investors seem to believe more in the long-term value creation from investing in green projects. Therefore, non-financial sectors that send credible signals could have a higher expected corporate value than sectors perceived as greenwashing.

For those regressions, we included fixed effects for both year and industry. When including control variables, our analysis shows no significant relationship between CARs, ROA, and green bond issuance. Tobin’s Q value displayed significant positive results in the general regression models, with further subsampling model analysis indicating that this significance primarily arises from companies with lower environmental scores or non-financial industries.

Besides, we performed VIF tests across all our regression models. The tests revealed that for the main independent variable - green variable, VIF values were all below 2.5, with the exception of certain control variables that recorded VIF values slightly higher, ranging between 4 and 5. Additionally, the average VIF values for most regression models and control variables remained well below 5.

Further, combining results from our subsampling analysis based on environmental factors, investors might favor companies with lower environmental scores. These companies, due to their lower starting point, are believed to have more marginal benefits and better future value prospects. Companies with higher environmental scores might miss out on these high marginal gains due to their high starting point. Therefore, in the short-term, investors trust that high environmental score companies engaging in green projects won’t incur significant losses. However, for long-term trends, companies with lower environmental scores are deemed more likely to gain higher value from participating in green projects. These results highlight the complex considerations investors have about corporate green projects, enhancing the study's practical relevance.

# VII. Discussion and Conclusion

## VII.1. Results and Contributions

This study examines how green bond issuance by U.S. companies affects their future performance across four categories: short-term stock market response, long-term stock market response, return on assets, and corporate valuation.

Unlike prior research focused on global and Chinese markets, our findings show that U.S. investors react negatively in the short term to green bond announcements. This negativity is particularly pronounced for initial green bond offerings, companies with lower environmental ratings, or issuers in non-financial sectors. However, subsequent analyses involving pair-differences for firms issuing conventional bonds and regression models encompassing additional control variables suggest that the issuance of green bonds is not the direct catalyst for the observed short-term negativity in CARs during the event study. Consequently, we posit that the negative CARs witnessed may be attributed to other factors, such as the impact of COVID-19 or a combination of various control variables. In terms of prolonged stock market responses, our study indicates that in the United States, the issuance of green bonds does not trigger long-term abnormal fluctuations in stock prices. Furthermore, in the realm of a company's extended financial performance, there emerges no significant correlation between the asset return rate and the issuance of green bonds. However, a notable positive correlation is evident between the firm valuation and its issuance of green bonds. Deeper exploration through subsampling regression analysis uncovers that this significance predominantly emanates from companies with lower environmental scores or non-financial sectors. In essence, investors exhibit a more favorable outlook regarding the long-term value of companies boasting lower environmental scores or directly participating in the green projects.

From a theoretical standpoint, in the United States, investors' responses to companies issuing green bonds align more closely with Pederson et al.'s (2021) ESG efficient frontier theory. When ESG factors are considered in investors' decision-making, market reactions vary based on the dominant investor preferences. In a market driven by investors seeking profit maximization, there is a tendency to invest in companies with lower initial environmental scores. This strategy aims to achieve portfolio diversification while maximizing the Sharpe ratio, ultimately leading to an increase in future company valuations. Conversely, companies with higher initial environmental scores may be seen as making greater sacrifices in terms of costs and benefits to achieve a higher environmental rating. However, in a market led by environmentally motivated investors, the dynamics are expected to be the opposite.

Furthermore, the integration of ESG environmental scores into investment decisions by investors signifies the effective transmission of green signals. Post the issuance of green bonds by a company, an uptick in the firm valuation, the additional costs needed for green bond issuance, the cautious investment approach by companies in the reverse causality tests, and the absence of substantial links with historical long-term financial performance collectively attest to the authenticity of environmental commitments. If a company's issuance of green bonds merely serves as a declaration of its environmental dedication without regard for its own interests, it prompts inquiries. The emergence of a green premium in subsampling models and an upswing in the firm valuation may imply that companies with lower scores engage in greenwashing to capitalize on the potential for enhanced marginal returns. Alternatively, companies with higher scores, possibly driven by managerial motives like personal reputation or interests, might be willing to sacrifice corporate interests for involvement in green initiatives (i.e., negative $ROA_{t+1}$ in the above/equal environmental score category). Consequently, these factors could account for why the issuance of green bonds does not significantly impact on short-term stock returns and long-term asset returns for companies. Additionally, given the existence of diverse investor types in the market, this

evolving equilibrium could be an additional rationale for the absence of pronounced effects on short-term and long-term returns.

Our research makes several notable contributions to the field of corporate green bonds. (1) We shift the focus to the U.S. market, providing fresh insights distinct from prior studies concentrated on global and Chinese markets. (2) We pioneer the incorporation of long-term stock market feedback, offering additional views of how the market reacts over time. (3) Our study explores and consolidates various potential theories, enriching our understanding of the factors influencing green bond issuance. (4) We employ diverse methodologies, including event studies, regression models, and subsampling analyses, providing a well-rounded perspective. (5) We analyze green bond issuance from multiple angles using various financial indicators. In summary, our findings suggest that in the U.S., the investment market is primarily composed of investors who consider ESG environmental scores and aim to maximize profits. Furthermore, the issuance of green bonds effectively conveys green signals to the market. However, the profitable trend observed among companies with lower environmental scores may incentivize greenwashing, where firms achieve higher returns with fewer investments. Thus, we consider that there is a possibility of a new wave of greenwashing in the U.S. green bond market if there are no significant changes in the current policy frame.

### VII.2. Implications of the Findings

The findings of this study offer insights for investors, companies, and relevant policymakers. Firstly, for investors, a long-term investment approach with companies issuing green bonds appears to be a more prudent strategy, in contrast to short-term speculation. Government incentives for ESG activities, such as green bond issuance, are crucial drivers of the green economy's development. In the broader economic and corporate context, specialized financing for green projects is becoming increasingly important in the long run. Companies issuing green bonds to signal their green commitment show innovative awareness and capitalize on government-supported opportunities. Consequently, consistent with our results from the Tobin's Q regression models, these companies show greater profit potential in the future compared to those not engaging in green financing. Thus, investors' decisions to focus on and moderately invest in companies issuing green bonds as part of a long-term investment and hedging strategy are rational and objective. However, due to the immaturity of policies and regulatory frameworks in the emerging ESG sector, coupled with the rapid surge in green bond issuance due to government incentives, an imbalance is existing within the still-developing ecosystem. In other words, the moderately negative significant results observed in CARs in U.S. market may signal a slowdown in the trend of green bond issuance. As anticipated, a news article by Mookerjee and Lee (2023) on September 25 stated that "Hedge fund managers are piling into short positions in ESG stocks as they hunt for bogus green claims and valuations inflated by record stimulus." This suggests that companies issuing green bonds may face skepticism and challenges in the short term within the investment market. Therefore, until policies and regulatory frameworks are further refined, the spontaneously initiated mechanism of greenwashing penalties within the investment market will likely to some extent constrain the short-term stock market performance of companies issuing green bonds. Besides, investors should approach with heightened vigilance when dealing with companies experiencing hard financial circumstances, including tight liquidity, overvaluation, high leverage, or confronting particular and challenging situations. This is due to the increased likelihood that these companies may employ greenwashing as a strategy to alleviate their immediate difficulties.

In the current scenario, it appears that companies with lower ESG environmental scores or in non-financial sectors can issue green bonds more profitably compared to those with higher scores or in financial sectors. However, this situation, characterized by low investment and high returns, may pose a

raising risk of greenwashing. To prevent companies with greenwashing intentions from participating, organizations genuinely committed to conveying their environmental commitment to the market may need to be prepared for additional expenditures. Specifically, companies could consider enhancing the transparency of their green projects, seeking stronger guarantees (beyond third-party guarantees found in databases like Bloomberg, typically provided by parent companies to their subsidiaries), and assembling more specialized teams to improve the efficiency of green projects in terms of environmental contributions and disclosure of environmental impacts. Although short-term profits may decrease, issuing green bonds to signal a company's commitment to environmental engagement and making moderate investments in green projects can yield long-term advantages. It's worth noting that engagement in environmental initiatives can motivate companies to innovate in their products or services, thereby expanding growth prospects and bolstering sustainability capabilities.

Finally, due to the challenges posed by the encouraging trend from the investment market for issuers who have lower environmental scores, which highlight the deficiencies in the policy framework for ESG development, governments should gradually establish specific regulations and strengthen oversight. Dubash (2023) emphasizes that making concerted efforts at the national level in climate policy is more efficient and expeditious in driving global climate and environmental improvements than relying on the expectation of a global consensus guiding national policies. For corporate green bond issuance, governments can begin by tightening the existing voluntary reporting policies. This entails transitioning some selective reporting requirements into mandatory ones to enhance companies' disclosure levels and discourage greenwashing attempts. Additionally, governments can augment the specific details and reporting standards in existing policies, tailored to various industries, project types, and reporting stages. They can also further standardize and unify ESG rating mechanisms to enhance the rigor and feasibility of these ratings. However, it's essential to be mindful that overly strict and regionally diverse policies can sometimes have unintended consequences. As observed by Bartram et al. (2021), imbalances in regional policies can lead to internal reallocations by companies seeking to evade regulatory costs. Therefore, while refining standards, it's crucial to ensure coordination and harmonization between local, national, and global policies, which presents a significant challenge in perfecting the policy framework. Furthermore, policymakers should exercise caution when devising appropriate differentiated subsidies to mitigate distortions arising from the implementation of environmental policies, as highlighted by Bartram et al. (2021).

### VII.3. Research Limitations and Future Research

Our study's limitations include its early-stage focus and exclusive attention to the U.S. market. These limitations pertain to sample size, time constraints, and generalizability. Firstly, the study is constrained by the relatively small number of companies that have issued green bonds in the United States since the inception of the first such issuance in 2008. In the period from 2008 to 2012, only two companies in the United States issued green bonds. The study's dataset includes nearly all the samples of public corporate green bonds from the Bloomberg database over the past 15 years. In other words, the limited number of companies participating in green bond issuance restricts the overall sample size of this research. Due to the limited sample size, we also cannot apply the robustness of leaving the distance between the lower and higher environmental scores in the subsampling regressions, which increases the potential for bias in the conclusions.

Additionally, as the environmental sustainability landscape evolves, the impact of corporate green bond issuance on various dependent variables may also change. Therefore, this study is subject to time-related constraints. Lastly, this research exclusively focuses on the U.S. market, making it unable to explore the correlations between different political, social, and economic factors and corporate green bond issuance.

In essence, the study has limitations in terms of its ability to provide generalizable insights and applicability to the broader landscape of global corporate green bond issuance.

Moreover, referred from Caramichael and Rapp's (2022) findings that "the greenium is linked to two proxies of demand pressure, oversubscription and green bond index inclusion, highlighting mechanisms through which the greenium can be allocated as demand for the bonds outpaces supply" and the earlier findings that "investment in improving responsible employee relations, environmental policies, and product strategies contributes substantially to reducing firm's cost of equity" (Ghoul et al., 2011), the oversubscriptions of the corporate green bonds in the current stage might be a reason of the negative CARs and the contradictory results in the existence of greenium. Nevertheless, due to the limitations on the oversubscription related data and the space of the paper, adding the further relevant analyses are challenged. Hence, our paper is limited in its exploration of primary mechanisms, omitting discussions on greenium.

Future research should explore several areas, including industry-specific impacts of green bond issuance. As sample sizes expand, there will be opportunities to conduct more specific studies focusing on different industries. Companies from various industries may be influenced by different dominant factors when it comes to issuing green bonds. Therefore, further research can delve deeper into the similarities and differences of these factors. Moreover, investigating the correlation between corporate green bond issuance and companies' merger and acquisition (M&A) decisions is another potential research area. It can explore whether issuing green bonds is perceived as a financing mechanism during M&A processes and whether companies being acquired or merged with may use green bond issuance as a commitment to their green orientation, thereby enhancing their corporate value. These future research directions have the potential to provide a deeper understanding of the green bond market and corporate strategic decision-making.

**References**


Adams, R., Almeida, H., & Ferreira, D. (2009). Understanding the relationship between founder–CEOs and firm performance. *Journal of Empirical Finance*, *16*(1), 136–150. https://doi.org/10.1016/j.jempfin.2008.05.002

Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, *84*(3), 488–500. https://doi.org/10.2307/1879431

Autio, V. (2022). Market reaction to green bond announcements: evidence from the European markets.

Bancel, F., & Glavas, D. (2018). Are Agency Problems a Determinant of Green Bond Issuance? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3215318

Barber, B. M., & Lyon, J. D. (1997). Detecting long-run abnormal stock returns: The empirical power and specification of test statistics. *Journal of Financial Economics*, *43*(3), 341–372. https://doi.org/10.1016/s0304-405x(96)00890-2

Bartram, S. M., Hou, K., & Kim, S. (2021). Real effects of climate policy: Financial constraints and spillovers. *Journal of Financial Economics*, *143*(2). https://doi.org/10.1016/j.jfineco.2021.06.015

Baulkaran, V. (2019). Stock market reaction to green bond issuance. *Journal of Asset Management*, *20*(5), 331–340. https://doi.org/10.1057/s41260-018-00105-1

Bénabou, R., & Tirole, J. (2010). Individual and Corporate Social Responsibility. *Economica*, *77*(305), 1–19.

Blanco, C., Caro, F., & Corbett, C. J. (2016). The state of supply chain carbon footprinting: analysis of CDP disclosures by US firms. *Journal of Cleaner Production*, *135*, 1189–1197. https://doi.org/10.1016/j.jclepro.2016.06.132

Brush, T. H., Bromiley, P., & Hendrickx, M. (2000). The free cash flow hypothesis for sales growth and firm performance. *Strategic Management Journal*, *21*(4), 455–472. https://doi.org/doi.org/10.1002/(SICI)1097-0266(200004)21:4%3C455::AID-SMJ83%3E3.0.CO;2-P

Buchanan, B., Cao, C. X., & Chen, C. (2018). Corporate social responsibility, firm value, and influential institutional ownership. *Journal of Corporate Finance*, *52*, 73–95. https://doi.org/10.1016/j.jcorpfin.2018.07.004

Caramichael, J., & Rapp, A. C. (2022). The Green Corporate Bond Issuance Premium. *International Finance Discussion Papers, 1346*, 1–46. https://doi.org/10.17016/ifdp.2022.1346

Cespa, G., & Cestone, G. (2007). Corporate Social Responsibility and Managerial Entrenchment. *Journal of Economics & Management Strategy*, *16*(3), 741–771. https://doi.org/10.1111/j.1530-9134.2007.00156.x

Cioli, V., Andrea Colonna, L., Giannozzi, A., & Roggi, O. (2021). Corporate Green Bond and Stock Price Reaction. *International Journal of Business and Management*, *16*(4), 75. https://doi.org/10.5539/ijbm.v16n4p75

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. *California Management Review*, *54*(1), 64–87. https://doi.org/10.1525/cmr.2011.54.1.64

Di Giuli, A., & Kostovetsky, L. (2014). Are red or blue companies more likely to go green? Politics and corporate social responsibility. *Journal of Financial Economics*, *111*(1), 158–180.

Drempetic, S., Klein, C., & Zwergel, B. (2019). The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review. *Journal of Business Ethics*, *167*(2), 333–360. https://doi.org/10.1007/s10551-019-04164-1

Du, X. (2015). How the Market Values Greenwashing? Evidence from China. *Journal of Business Ethics*, *128*(3), 547–574. https://doi.org/10.1007/s10551-014-2122-y

Dubash, N. K. (2023). Rebalance attention from global target setting toward national climate politics and policy. *Science*, *382*(6666). https://doi.org/10.1126/science.adk7428

Eccles, R. G., & Krzus, M. P. (2018). Why Companies Should Report Financial Risks from Climate Change. *MIT Sloan Management Review*, *59*(3), 1–6.

Fatica, S., & Panzica, R. (2021). Green bonds as a tool against climate change? *Business Strategy and the Environment*, *30*(5). https://doi.org/10.1002/bse.2771

Flammer, C. (2021). Corporate Green Bonds. *Journal of Financial Economics*, *142*(2), 499–516. https://doi.org/10.1016/j.jfineco.2021.01.010

Foerster, S. R., & Sapp, S. G. (2005). Valuation of financial versus non-financial firms: a global perspective. *Journal of International Financial Markets, Institutions and Money*, *15*(1), 1–20. https://doi.org/10.1016/j.intfin.2004.01.003

Freeman, R. E. (1984). *Strategic Management : A Stakeholder Approach*. Cambridge University Press. (Original work published 1984)

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, *5*(4), 210–233. https://doi.org/10.1080/20430795.2015.1118917

Ghoul, S. E., Guedhami, O., Kwok, C. C., & Mishra, D. R. (2011). Does corporate social responsibility affect the cost of capital? *Journal of Banking and Finance, 35(9)*, 2388–2406. https://doi.org/10.1016/j.jbankfin.2011.02.007

Jensen, M. C., & Meckling, W. H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics*, *3*(4), 305–360.

King, M. R., & Santor, E. (2008). Family values: Ownership structure, performance and capital structure of Canadian firms. *Journal of Banking & Finance*, *32*(11), 2423–2432. https://doi.org/10.1016/j.jbankfin.2008.02.002

Kochetygova, J., & Jauhari, A. (2014). Climate Change, Green Bonds and Index Investing: The New Frontier. *S&P Dow Jones Indices LLC*, 1–15.

Kothari, S. P., & Warner, J. B. (1997). Measuring long-horizon security price performance. *Journal of Financial Economics*, *43*(3), 301–339. https://doi.org/10.1016/s0304-405x(96)00899-9

Krüger, P. (2015). Corporate goodness and shareholder wealth. *Journal of Financial Economics*, *115*(2), 304–329. https://doi.org/10.1016/j.jfineco.2014.09.008

Lebelle, Lajili Jarjir, & Sassi. (2020). Corporate Green Bond Issuances: An International Evidence.

*Journal of Risk and Financial Management*, *13*(2), 25. https://doi.org/10.3390/jrfm13020025

Loderer, C. F., & Waelchli, U. (2010). Firm Age and Performance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1342248

Marcellin Makpotche, Kais Bouslah, & Bouchra M'Zali. (2023). Long-run performance following corporate green bond issuance. *Managerial Finance*. https://doi.org/10.1108/mf-12-2022-0588

Masulis, R. W., & Reza, S. W. (2014). Agency Problems of Corporate Philanthropy. *Review of Financial Studies*, *28*(2), 592–636. https://doi.org/10.1093/rfs/hhu082

Mercereau, B., Neveux, G., Sertã, J. P. C. C., Marechal, B., & Tonolo, G. (2020). Fighting climate change as a global equity investor. *Journal of Asset Management*, *21*(1), 70–83. https://doi.org/10.1057/s41260-020-00150-9

Mitchell, M. L., & Stafford, E. (2000). Managerial Decisions and Long-Term Stock Price Performance. *The Journal of Business*, *73*(3), 287–329. https://doi.org/10.1086/209645

Mookerjee, I., & Lee, S. T. T. (2023, September 25). Short Sellers Mount Attack on ESG Stocks Bloated From Green Hype. *Bloomberg.com*. https://www.bloomberg.com/news/articles/2023-09-25/short-sellers-mount-attack-on-esg-stocks-bloated-from-green-hype

Netto, S. V., Sobral, M. F. F., Ribeiro, A. R. B., & Soares, G. R. da L. (2020). Concepts and forms of greenwashing: a systematic review. *Environmental Sciences Europe*, *32*(1). https://doi.org/10.1186/s12302-020-0300-3

Pedersen, L. H., Fitzgibbons, S., & Pomorski, L. (2021). Responsible Investing: The ESG-efficient Frontier. Journal of Financial Economics, 142(2). https://doi.org/10.1016/j.jfineco.2020.11.001

Ritter, J. R. (1991). The Long-Run Performance of initial Public Offerings. *The Journal of Finance*, *46*(1), 3–27. https://doi.org/10.1111/j.1540-6261.1991.tb03743.x

Roslen, S. N. M., Yee, L. S., & Ibrahim, S. A. B. (2017). Green Bond and shareholders' wealth: a multi-country event study. *International Journal of Globalisation and Small Business*, *9*(1), 61. https://doi.org/10.1504/ijgsb.2017.084701

Sattar, A. R. (2019). Determinants of Return on Assets. *European Online Journal of Natural and Social Sciences*, *8*(3), pp. 526–534. https://european-science.com/eojnss/article/view/5740

Schmittmann, J. M., & Gao, Y. (2022). Green Bond Pricing and Greenwashing under Asymmetric Information. *IMF Working Papers*, *2022*(246), 1. https://doi.org/10.5089/9798400227004.001

Shrestha, N. (2020). Detecting Multicollinearity in Regression Analysis. *American Journal of Applied Mathematics and Statistics*, *8*(2), 39–42. https://doi.org/10.12691/ajams-8-2-1

Sisodia, G., Joseph, A., & Dominic, J. (2022). Whether corporate green bonds act as armour during crises? Evidence from a natural experiment. *International Journal of Managerial Finance*. https://doi.org/10.1108/ijmf-10-2021-0501

Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics*, *87*(3), 355–374. https://www.jstor.org/stable/1882010

Sucuahi, W., & Cambarihan, J. M. (2016). Influence of Profitability to the Firm Value of Diversified Companies in the Philippines. *Accounting and Finance Research*, *5*(2).

https://doi.org/10.5430/afr.v5n2p149

Tan, X., Dong, H., Liu, Y., Su, X., & Li, Z. (2022). Green bonds and corporate performance: A potential way to achieve green recovery. *Renewable Energy*, *200*, 59–68. https://doi.org/10.1016/j.renene.2022.09.109

Tang, D. Y., & Zhang, Y. (2018). Do shareholders benefit from green bonds? *Journal of Corporate Finance*, *61*(101427). https://doi.org/10.1016/j.jcorpfin.2018.12.001

Thompson, C. G., Kim, R. S., Aloe, A. M., & Becker, B. J. (2017). Extracting the Variance Inflation Factor and Other Multicollinearity Diagnostics from Typical Regression Results. *Basic and Applied Social Psychology*, *39*(2), 81–90. https://doi.org/10.1080/01973533.2016.1277529

Wang, J., Chen, X., Li, X., Yu, J., & Zhong, R. (2020). The market reaction to green bond issuance: Evidence from China. *Pacific-Basin Finance Journal*, *60*, 101294. https://doi.org/10.1016/j.pacfin.2020.101294

West, M. (2011). *Moody's Investors Service*. Ratings.moodys.io. https://ratings.moodys.io/ratings

Xu, G., Lu, N., & Tong, Y. (2022). Greenwashing and Credit Spread: Evidence from the Chinese Green Bond Market. *Finance Research Letters*, *48*, 102927. https://doi.org/10.1016/j.frl.2022.102927

Yeow, K. E., & Ng, S.-H. (2021). The impact of green bonds on corporate environmental and financial performance. *Managerial Finance*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/mf-09-2020-0481

Yi, J. (2001). Selection Methods of Control Samples: A Comparison of Two Matching Methodologies. *Mountain Plains Journal of Business and Technology*, *2*(1). https://openspaces.unk.edu/mpjbt/vol2/iss1/7/

Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance*, *98*, 39–60.

Zhou, X., & Cui, Y. (2019). Green Bonds, Corporate Performance, and Corporate Social Responsibility. *Sustainability*, *11*(23), 6881. https://doi.org/10.3390/su11236881

## Appendices

**Figure 1. Numbers of CGBs**

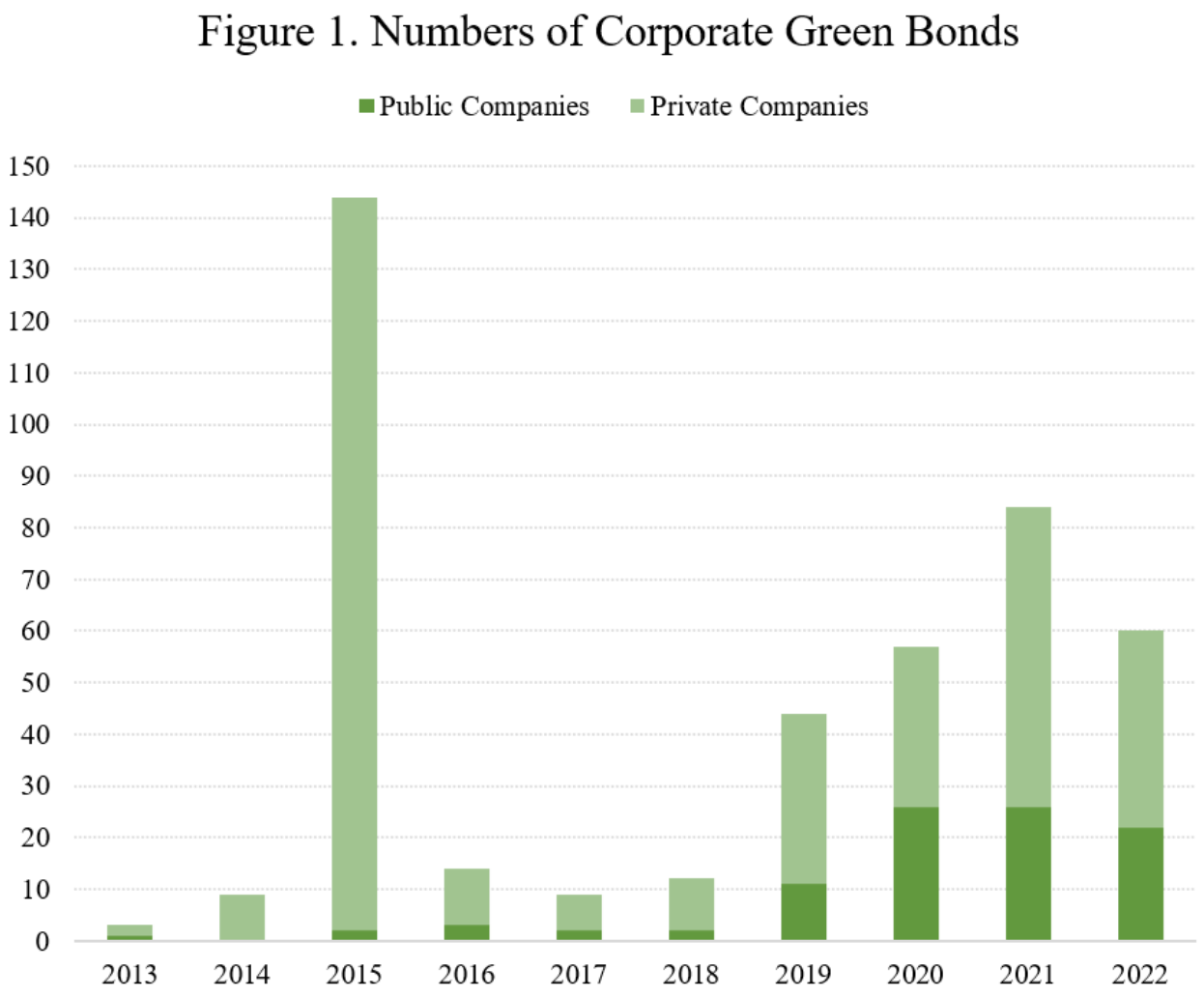

**Figure 2. Issuance Amount of CGBs (in $B)**

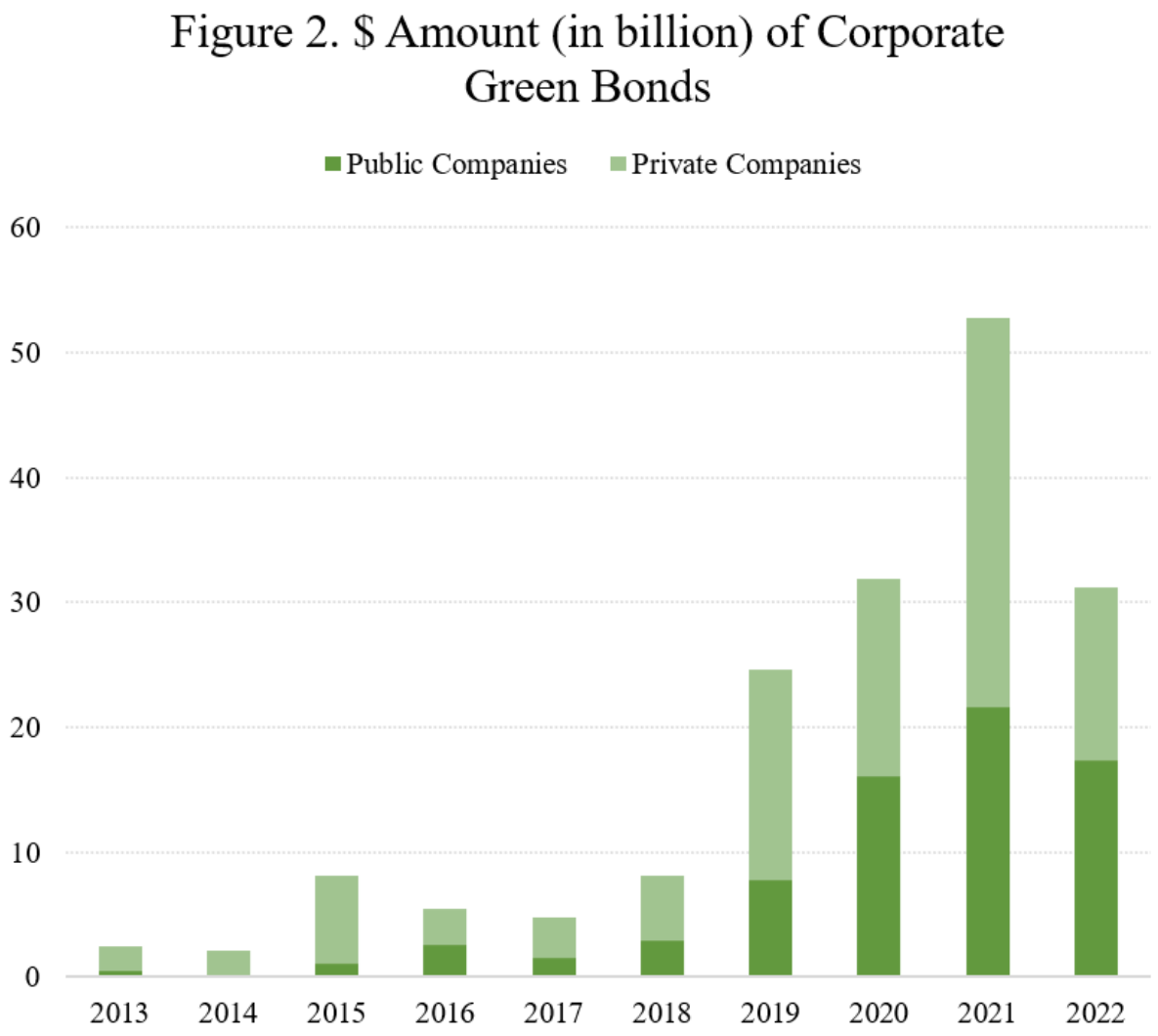

**Figure 3. Number of Public CGBs in US**

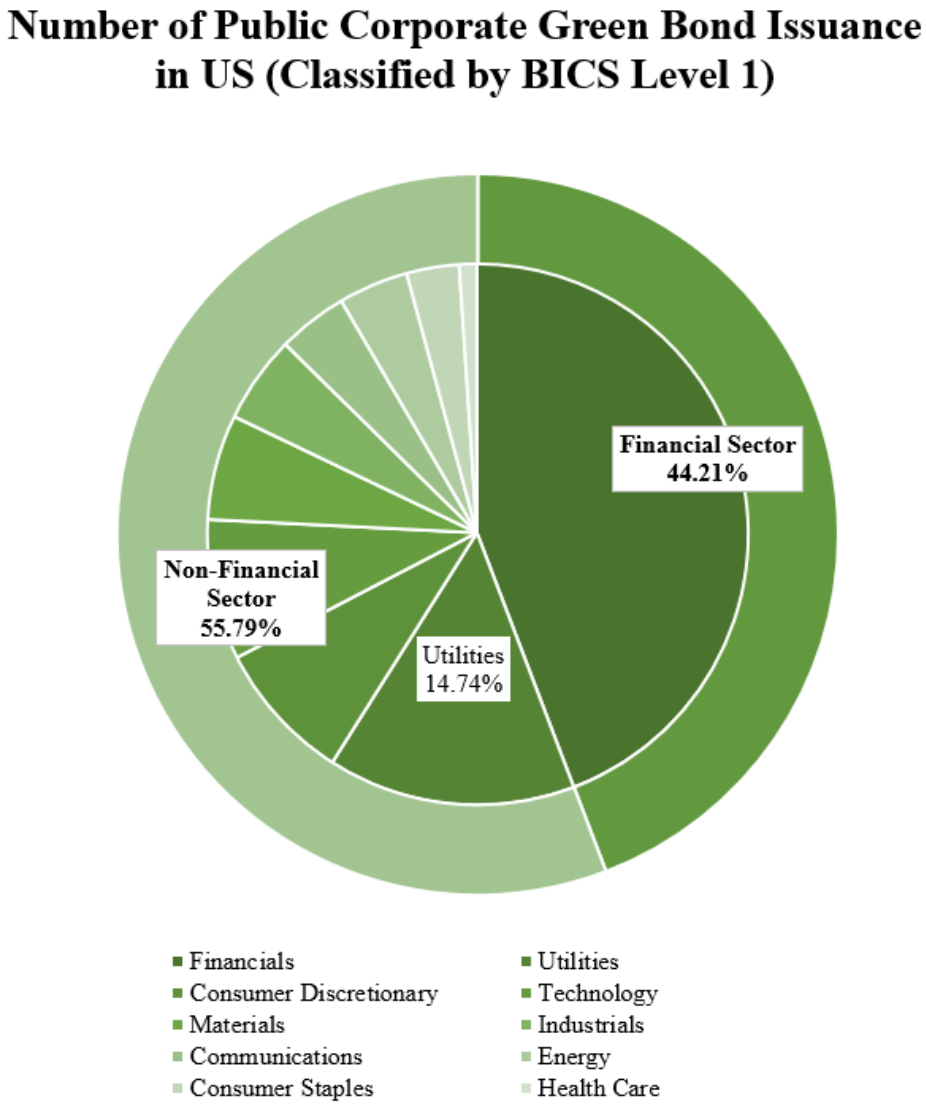

**Figure 4. Amount of Public CGBs in US**

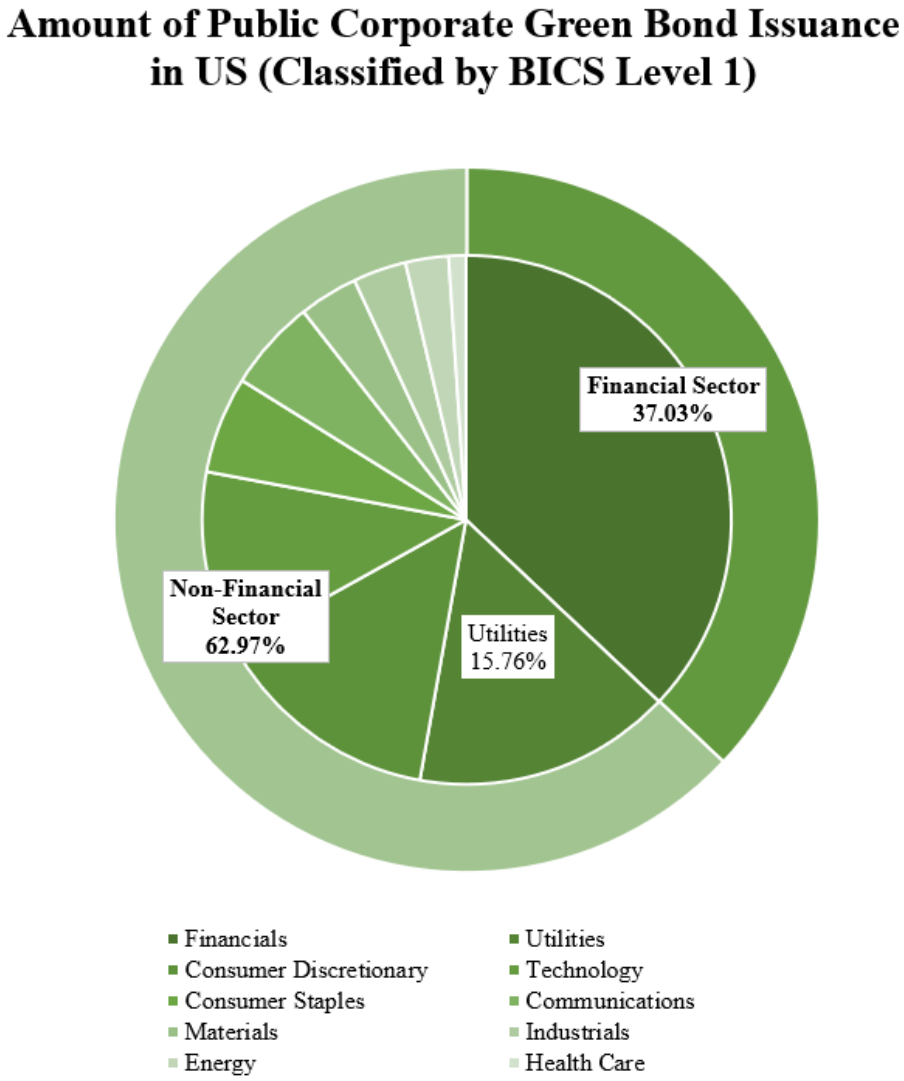

**Table 1. Corporate Green Bonds in the U.S.**

This table reports the characteristics of the corporate green bonds in the U.S. by looking at the number of bonds (# Bonds) and the total issuance amount ($ Amount (in billion)) from 2013-2022. Table 1a reports the features of the CGBs over time on an annual basis. Table 1b reports the features of the CGBs over issuers based on three classifications.

a. Corporate Green Bonds over Time in the U.S.

| Year | # Bonds | $ Amount (in billion) |
|---|---|---|
| 2013 | 3 | 2.50 |
| 2014 | 9 | 2.11 |
| 2015 | 144 | 8.09 |
| 2016 | 14 | 5.44 |
| 2017 | 9 | 4.73 |
| 2018 | 12 | 8.13 |
| 2019 | 44 | 24.61 |
| 2020 | 57 | 31.90 |
| 2021 | 84 | 52.82 |
| 2022 | 60 | 31.25 |
| Total | 436 | 171.57 |

b. Corporate Green Bonds over Issuers in the U.S.

| | # Of Obs | $ Amount (in billion) |
|---|---|---|
| Private Issuance vs. Public Issuance | | |
| Private Issuance | 341 | 100.01 |
| Public Issuance | 95 | 71.56 |
| Total | 436 | 171.57 |
| Green Bond Issuer-Days (Public) | | |
| First-Time Issues (Unique Issuers) | 49 | 42.88 |
| Seasoned Issues | 32 | 28.68 |
| Total | 81 | 71.56 |

**Table 2. Summary Statistics**

Table 2 is the summary statistics of the public corporate green bonds and their two distinct matched sample groups based on bonds and issuers. Table 2a provides an overview of public corporate green bonds. The first five rows are the bond-level data that collected for each unique green bond, while the rest are the firm-level data that collected for each unique issuer. To make the consistency, I repeatedly report the firm-level data based on each unique bond. Table 2b summarizes one-on-one CGBs-based matching results based on unique issuance days, encompassing bond-level data, firm-level data, and ESG environmental scores. Table 2c highlights one-on-one CGIs-based matching, focused on first-time unique issuers and including firm-level data and ESG scores but excludes issuers who do not release their fiscal year fundamental annual report by December 31.

a. Public Corporate Green Bonds in the U.S.

| | Mean | Standard Deviation | Minimum | 1% | Median | 99% | Maximum | No. of Observations |
|---|---|---|---|---|---|---|---|---|
| Investment Grade (1/0) | 0.674 | 0.471 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | 95 |
| Bond Size ($US in Billion) | 0.753 | 0.494 | 0.011 | 0.011 | 0.650 | 2.500 | 2.500 | 95 |
| Maturity Length (Year) | 8.905 | 5.651 | 2.984 | 2.984 | 7.208 | 30.038 | 30.038 | 95 |
| Coupon Rate (%) | 4.906 | 3.456 | 0.000 | 0.000 | 4.500 | 19.850 | 19.850 | 95 |
| Firm $Size_t$ ($US in Billion) | 512.940 | 916.370 | 0.937 | 0.937 | 34.603 | 3743.567 | 3743.567 | 95 |
| Ln(Firm $Size_t$) | 11.129 | 2.248 | 6.842 | 6.842 | 10.452 | 15.136 | 15.136 | 95 |
| Firm $Age_t$ | 51.789 | 39.052 | 4.000 | 4.000 | 39.000 | 174.000 | 174.000 | 95 |
| Firm $Leverage_t$ | 0.379 | 0.141 | 0.034 | 0.034 | 0.379 | 0.633 | 0.633 | 95 |
| $ROA_t$ (%) | 2.130 | 7.345 | -32.731 | -32.731 | 1.792 | 17.726 | 17.726 | 95 |
| Tobin's $Q_t$ | 2.257 | 2.124 | 0.922 | 0.922 | 1.438 | 12.574 | 12.574 | 95 |
| Revenue $Growth_t$ (%) | 9.340 | 21.873 | -25.798 | -25.798 | 6.058 | 147.154 | 147.154 | 95 |
| BESG E $Score_t$ | 3.609 | 1.688 | 0.000 | 0.000 | 3.950 | 7.190 | 7.190 | 69 |
| E Disclosure $Score_t$ | 44.568 | 20.125 | 0.000 | 0.000 | 43.416 | 84.929 | 84.929 | 74 |

b. Matched Samples - Corporate Green Bonds (CGBs)

| | No. of Observations | | Mean | | Diff. in Means | |
|---|---|---|---|---|---|---|
| | GBs | Matched NGBs | GBs | Matched NGBs | Actual Diff. | p-value |
| Investment Grade (1/0) | 80 | 80 | 0.650 | 0.638 | 0.013 | 0.8699 |
| Bond Size ($US in Billion) | 80 | 80 | 0.754 | 0.756 | -0.002 | 0.9826 |
| Maturity Length (Year) | 80 | 80 | 9.168 | 8.867 | 0.301 | 0.7497 |
| Coupon Rate (%) | 80 | 80 | 5.087 | 5.095 | -0.007 | 0.9886 |
| Liquidity [-2,2] (%) | 80 | 80 | 1.272 | 1.064 | 0.208 | 0.4558 |
| Firm $Size_{t-1}$ | 78 | 80 | 11.312 | 10.247 | 1.065*** | 0.0028 |
| Firm $Age_{t-1}$ | 78 | 80 | 52.769 | 64.038 | -11.268 | 0.1397 |
| Firm $Leverage_{t-1}$ | 78 | 80 | 0.354 | 0.414 | -0.060 | 0.1086 |
| $ROA_{t-1}$ (%) | 78 | 80 | 3.207 | 3.706 | -0.499 | 0.7409 |
| Tobin's $Q_{t-1}$ | 78 | 80 | 1.950 | 2.897 | -0.946** | 0.0287 |
| BESG E $Score_{t-1}$ | 72 | 57 | 3.328 | 3.089 | 0.239 | 0.4917 |
| E Disclosure $Score_{t-1}$ | 77 | 77 | 43.719 | 36.847 | 6.872** | 0.0367 |

c. Matched Samples - Corporate Green Issuers (CGIs)

| | No. of Observations | | Mean | | Diff. in Means | |
|---|---|---|---|---|---|---|
| | GIs | Matched NGIs | GIs | Matched NGIs | Actual Diff. | p-value |
| Firm Size$_{t-1}$ | 40 | 40 | 10.299 | 9.812 | 0.487 | 0.3199 |
| Firm Age$_{t-1}$ | 40 | 40 | 61.150 | 60.800 | 0.350 | 0.9726 |
| Firm Leverage$_{t-1}$ | 40 | 40 | 0.375 | 0.364 | 0.011 | 0.7799 |
| ROA$_{t-1}$ (%) | 40 | 40 | 2.110 | 3.384 | -1.273 | 0.4162 |
| Tobin's Q$_{t-1}$ | 40 | 40 | 2.246 | 1.816 | 0.430 | 0.3947 |
| Revenue Growth$_{t-1}$ (%) | 40 | 40 | 4.238 | 4.704 | -0.466 | 0.9038 |
| BESG E Score$_{t-1}$ | 34 | 32 | 3.004 | 2.810 | 0.194 | 0.3965 |
| E Disclosure$_{t-1}$ | 37 | 39 | 41.293 | 35.989 | 5.304 | 0.3314 |

**Table 3. Correlation Coefficients**

This table provides the correlation coefficients of all of the variables between each other for all of the regressions we include. Table 3a reports correlation matrix for CGBs-based matched variables. Table 3b reports correlation matrix for CGIs-based matched variables.

a. Matched Samples Correlation Matrix – CGBs

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| (1) CARs [-2, 2] | 1.000 | | | | | | | |
| | (160) | | | | | | | |
| (2) Green (1/0) | -0.124 | 1.000 | | | | | | |
| | (0.119) | | | | | | | |
| | (160) | (160) | | | | | | |
| (3) Investment Grade (1/0) | 0.219*** | 0.013 | 1.000 | | | | | |
| | (0.005) | (0.870) | | | | | | |
| | (160) | (160) | (160) | | | | | |
| (4) Bond Size | 0.068 | -0.002 | 0.115 | 1.000 | | | | |
| | (0.391) | (0.983) | (0.147) | | | | | |
| | (160) | (160) | (160) | (160) | | | | |
| (5) Maturity Length | 0.151* | 0.016 | 0.290*** | 0.017 | 1.000 | | | |
| | (0.056) | (0.844) | (0.000) | (0.834) | | | | |
| | (160) | (160) | (160) | (160) | (160) | | | |
| (6) Coupon Rate (%) | 0.008 | -0.015 | 0.005 | 0.048 | 0.187** | 1.000 | | |
| | (0.924) | (0.850) | (0.947) | (0.545) | (0.018) | | | |
| | (160) | (160) | (160) | (160) | (160) | (160) | | |
| (7) Liquidity [-2, 2] | -0.280*** | 0.059 | -0.413*** | -0.072 | -0.163** | -0.080 | 1.000 | |
| | (0.000) | (0.456) | (0.000) | (0.368) | (0.039) | (0.316) | | |
| | (160) | (160) | (160) | (160) | (160) | (160) | (160) | |
| (8) Ln(Firm Size$_t$) | 0.177** | 0.214*** | 0.212*** | 0.342*** | 0.044 | -0.114 | -0.410*** | 1.000 |
| | (0.026) | (0.007) | (0.007) | (0.000) | (0.585) | (0.152) | (0.000) | |
| | (158) | (158) | (158) | (158) | (158) | (158) | (158) | (158) |

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

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| (9) Firm Age$_t$ | 0.065 | -0.122 | 0.165** | 0.016 | 0.018 | 0.023 | -0.221*** | 0.251*** |
| | (0.420) | (0.127) | (0.038) | (0.838) | (0.823) | (0.775) | (0.005) | (0.001) |
| | (158) | (158) | (158) | (158) | (158) | (158) | (158) | (158) |
| (10) Firm Leverage$_t$ | 0.025 | -0.192** | -0.112 | -0.091 | 0.086 | 0.114 | 0.131 | -0.455*** |
| | (0.757) | (0.016) | (0.159) | (0.256) | (0.285) | (0.155) | (0.100) | (0.000) |
| | (158) | (158) | (158) | (158) | (158) | (158) | (158) | (158) |
| (11) ROA$_t$ (%) | 0.122 | -0.663*** | -0.047 | -0.059 | -0.013 | -0.032 | 0.066 | -0.379*** |
| | (0.126) | (0.000) | (0.561) | (0.459) | (0.875) | (0.690) | (0.411) | (0.000) |
| | (158) | (158) | (158) | (158) | (158) | (158) | (158) | (158) |
| (12) Tobin's Q$_t$ | -0.102 | -0.111 | -0.107 | -0.043 | -0.040 | -0.157** | 0.291*** | -0.484*** |
| | (0.203) | (0.165) | (0.180) | (0.590) | (0.620) | (0.048) | (0.000) | (0.000) |
| | (158) | (158) | (158) | (158) | (158) | (158) | (158) | (158) |
| (13) Revenue Growth$_t$ (%) | -0.007 | -0.125 | -0.099 | -0.129 | -0.061 | 0.052 | 0.184** | -0.202** |
| | (0.928) | (0.117) | (0.216) | (0.106) | (0.449) | (0.516) | (0.021) | (0.011) |
| | (158) | (158) | (158) | (158) | (158) | (158) | (158) | (158) |
| (14) BESG E Score$_t$ | 0.170* | 0.084 | 0.271*** | 0.141 | 0.276*** | 0.138 | -0.164* | 0.002 |
| | (0.080) | (0.390) | (0.005) | (0.148) | (0.004) | (0.158) | (0.092) | (0.988) |
| | (107) | (107) | (107) | (107) | (107) | (107) | (107) | (107) |
| (15) E Disclosure$_t$ | 0.221** | 0.176** | 0.263*** | 0.302*** | 0.044 | 0.084 | -0.284*** | 0.467*** |
| | (0.013) | (0.049) | (0.003) | (0.001) | (0.623) | (0.351) | (0.001) | (0.000) |
| | (126) | (126) | (126) | (126) | (126) | (126) | (126) | (126) |
| (16) Industries (1/0) | -0.144* | 0.000 | 0.084 | 0.154* | 0.202** | 0.344*** | 0.238*** | -0.346*** |
| | (0.069) | (1.000) | (0.292) | (0.052) | (0.010) | (0.000) | (0.002) | (0.000) |
| | (160) | (160) | (160) | (160) | (160) | (160) | (160) | (158) |

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

| Variables | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|---|---|
| (9) Firm Age$_t$ | 1.000 | | | | | | | |
| | (158) | | | | | | | |
| (10) Firm Leverage$_t$ | -0.268*** | 1.000 | | | | | | |
| | (0.001) | | | | | | | |
| | (158) | (158) | | | | | | |
| (11) ROA$_t$ (%) | -0.016 | 0.470*** | 1.000 | | | | | |
| | (0.838) | (0.000) | | | | | | |
| | (158) | (158) | (158) | | | | | |
| (12) Tobin's Q$_t$ | -0.162** | 0.419*** | 0.614*** | 1.000 | | | | |
| | (0.042) | (0.000) | (0.000) | | | | | |
| | (158) | (158) | (158) | (158) | | | | |
| (13) Revenue Growth$_t$ (%) | -0.116 | 0.132* | 0.204** | 0.230*** | 1.000 | | | |
| | (0.148) | (0.099) | (0.010) | (0.004) | | | | |
| | (158) | (158) | (158) | (158) | (158) | | | |
| (14) BESG E Score$_t$ | -0.057 | 0.080 | -0.117 | 0.004 | -0.171* | 1.000 | | |
| | (0.561) | (0.410) | (0.229) | (0.965) | (0.079) | | | |
| | (107) | (107) | (107) | (107) | (107) | (107) | | |
| (15) E Disclosure$_t$ | 0.279*** | -0.212** | -0.184** | -0.245*** | -0.140 | 0.463*** | 1.000 | |
| | (0.002) | (0.017) | (0.040) | (0.006) | (0.118) | (0.000) | | |
| | (126) | (126) | (126) | (126) | (126) | (107) | (126) | |
| (16) Industries (1/0) | -0.027 | 0.172** | 0.132* | 0.261*** | 0.155* | 0.328*** | 0.154* | 1.000 |
| | (0.739) | (0.031) | (0.099) | (0.001) | (0.052) | (0.001) | (0.084) | |
| | (158) | (158) | (158) | (158) | (158) | (107) | (126) | (160) |

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

b. Matched Samples Correlation Matrix – CGIs

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| (1) $ROA_{t+1}$ | 1.000 | | | | | | | | |
| | (64) | | | | | | | | |
| (2) Tobin's $Q_{t+1}$ | 0.363*** | 1.000 | | | | | | | |
| | (0.003) | | | | | | | | |
| | (64) | (64) | | | | | | | |
| (3) Green (1/0) | -0.049 | 0.164 | 1.000 | | | | | | |
| | (0.703) | (0.189) | | | | | | | |
| | (64) | (64) | (80) | | | | | | |
| (4) BESG E $Score_t$ (1/0) | -0.152 | -0.002 | 0.000 | 1.000 | | | | | |
| | (0.232) | (0.985) | (1.000) | | | | | | |
| | (64) | (64) | (80) | (80) | (80) | | | | |
| (5) Firm $Size_t$ | -0.002 | -0.372*** | 0.141 | 0.048 | 1.000 | | | | |
| | (0.989) | (0.002) | (0.213) | (0.673) | | | | | |
| | (64) | (64) | (80) | (80) | (80) | | | | |
| (6) Firm $Age_t$ | 0.045 | -0.216* | 0.004 | -0.015 | 0.327*** | 1.000 | | | |
| | (0.724) | (0.082) | (0.973) | (0.893) | (0.003) | | | | |
| | (64) | (64) | (80) | (80) | (80) | (80) | | | |
| (7) Firm $Leverage_t$ | 0.195 | 0.255** | 0.010 | -0.225** | -0.492*** | -0.350*** | 1.000 | | |
| | (0.123) | (0.039) | (0.929) | (0.044) | (0.000) | (0.001) | | | |
| | (64) | (64) | (80) | (80) | (80) | (80) | (80) | | |
| (8) $ROA_t$ (%) | 0.614*** | 0.119 | -0.012 | -0.245** | 0.119 | 0.015 | 0.169 | 1.000 | |
| | (0.000) | (0.348) | (0.920) | (0.030) | (0.301) | (0.899) | (0.139) | | |
| | (64) | (64) | (80) | (80) | (80) | (80) | (80) | (80) | |
| (9) Tobin's $Q_t$ | 0.270** | 0.928*** | 0.172 | 0.011 | -0.428*** | -0.287*** | 0.215* | -0.035 | 1.000 |
| | (0.031) | (0.000) | (0.128) | (0.922) | (0.000) | (0.010) | (0.056) | (0.762) | |
| | (64) | (64) | (80) | (80) | (80) | (80) | (80) | (80) | (80) |

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

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| (10) Revenue Growth$_t$ (%) | 0.169 | 0.205* | -0.040 | 0.045 | -0.339*** | -0.225** | 0.200* | 0.119 | 0.294*** |
| | (0.183) | (0.098) | (0.722) | (0.692) | (0.002) | (0.045) | (0.075) | (0.300) | (0.008) |
| | (64) | (64) | (80) | (80) | (80) | (80) | (80) | (80) | (80) |
| (11) E Disclosure$_t$ | -0.004 | -0.103 | 0.163 | -0.212* | 0.453*** | 0.251** | -0.177 | 0.086 | -0.184 |
| | (0.974) | (0.409) | (0.191) | (0.087) | (0.000) | (0.042) | (0.156) | (0.498) | (0.140) |
| | (64) | (64) | (64) | (64) | (64) | (64) | (64) | (64) | (64) |
| (12) Industries (1/0) | 0.068 | 0.302** | 0.000 | -0.422*** | -0.326*** | -0.114 | 0.379*** | 0.000 | 0.296*** |
| | (0.593) | (0.014) | (1.000) | (0.000) | (0.003) | (0.314) | (0.001) | (0.997) | (0.008) |
| | (64) | (64) | (80) | (80) | (80) | (80) | (80) | (80) | (80) |

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

| Variables | (10) | (11) | (12) |
|---|---|---|---|
| (10) Revenue Growth$_t$ (%) | 1.000 | | |
| | | | |
| | (80) | | |
| (11) E Disclosure$_t$ | -0.280** | 1.000 | |
| | (0.023) | | |
| | (64) | (64) | |
| (12) Industries (1/0) | 0.185 | 0.323*** | 1.000 |
| | (0.101) | (0.008) | |
| | (80) | (64) | (80) |

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

**Table 4. Short-run Stock Reaction to the Announcement of the CGBs Issuance**

This table presents the results of the impact of the CGBs issuance on the CARs based on short-run event study and regressions. Table 4a to 4c display the short-run event study concerning CGBs, examining CARs over different event windows before and after their issuance announcements based on the CAPM. In particular, Table 4a reports the results encompassing all unique issuance day observations. The sample size corresponds to the unique issuer-day observation from Table 1b. Table 4b presents cross-sectional heterogeneity findings for first-time issuances, ESG's environmental financial materiality score, and financial vs. non-financial sectors. Table 4c is the shows the results of the robustness tests we did for the short-run event study, including three panels that discusses Fama-French Carhart Model, filtered samples that only includes the bond that is immune from the other conventional bonds' impact 10 business days prior to the certain green/conventional bond issuance, and the paired difference with matched conventional bond sample. Table 4d and 4e display the results of three types of regressions, which are general regressions, low/high BESG E Score subsampling regressions, and non-financial/financial industries subsampling regressions, with distinct sample base including full-sample group and bond impact immune group, respectively, based on corporate green bonds' matched samples. The numbers in parentheses are t-test value. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

a. General Short-run Event-Study

Estimation Interval: [-250, -50]
General_CAPM

| Event Window | #. Of Obs | CARs (%) | | t value | p value |
|---|---|---|---|---|---|
| [-10, 10] | 80 | -1.8440 | | -1.6239 | 0.1084 |
| [-5, 5] | 80 | -1.3346 | | -1.6379 | 0.1054 |
| [-2, 2] | 80 | -1.2821 | ** | -2.2151 | 0.0296 |

b. Cross-Sectional Heterogeneity

| | #. Of Obs | CARs [-2, 2] | | t value | p value |
|---|---|---|---|---|---|
| Panel A. First-time Issuance vs. Seasoned Issuance | | | | | |
| First-time Issuance | 48 | -2.0700 | ** | -2.3465 | 0.0232 |
| Seasoned Issuance | 32 | -0.1003 | | -0.1864 | 0.8533 |
| Panel B. BESG E Score | | | | | |
| BESG E Score (below median) | 46 | -2.2355 | ** | -2.4361 | 0.0189 |
| BESG E Score (above/equal to median) | 34 | 0.0078 | | 0.0157 | 0.9876 |
| Panel C. Financial vs. Non-Financial Industries | | | | | |
| Non-Financial Industries | 39 | -2.1158 | ** | -2.0742 | 0.0449 |
| Financial Industries | 41 | -0.4890 | | -0.8666 | 0.3913 |

c. Robustness: Short-run Event-Study

| | #. Of Obs | CARs [-2,2] (%) | | t value | p value |
|---|---|---|---|---|---|
| Panel A. Fama-French Carhart | | | | | |
| 1. General | 80 | -0.9928 | * | -1.9471 | 0.0551 |
| 2. First-time Issuance vs. Seasoned Issuance | | | | | |
| First-time Issuance | 48 | -1.8431 | ** | -2.3302 | 0.0241 |
| Seasoned Issuance | 32 | 0.2827 | | 0.7396 | 0.4651 |
| 3. BESG E Score | | | | | |
| BESG E Score (below median) | 46 | -1.7361 | ** | -2.1892 | 0.0338 |
| BESG E Score (above/equal to median) | 34 | 0.0128 | | 0.0255 | 0.9798 |
| 4. Financial vs. Non-Financial Industries | | | | | |
| Non-Financial Industries | 39 | -1.9560 | ** | -2.0818 | 0.0442 |
| Financial Industries | 41 | -0.0766 | | -0.1909 | 0.8496 |
| Panel B. Bond Impact Immune Group | | | | | |
| CAPM | 37 | -2.2571 | ** | -2.1134 | 0.0416 |
| Fama-French Carhart | 37 | -1.9403 | * | -1.9773 | 0.0557 |
| Panel C. Paired Difference with Matched Conventional Bond Sample | | | | | |
| CAPM | 80 | -1.1954 | * | -1.7719 | 0.0803 |
| Fama-French Carhart | 80 | -1.2192 | | -0.7734 | 0.4416 |

d. Full-Sample Group Regressions: The Impact of CGBs on CARs (Matched Samples – CGBs)

| | General Regressions | | | Low BESG E Score$_{t-1}$ | High BESG E Score$_{t-1}$ | Non-Financial Industries | Financial Industries |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| VARIABLES | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] |
| Green (1/0) | **-0.914** | **-0.506** | **-0.244** | **0.150** | **-1.299** | **0.199** | **-0.130** |
| | **(-1.33)** | **(-0.78)** | **(-0.40)** | **(0.18)** | **(-1.34)** | **(0.19)** | **(-0.17)** |
| Bond Size | -0.153 | | 0.299 | 0.069 | -0.190 | 1.405 | 0.469 |
| | (-0.21) | | (0.43) | (0.06) | (-0.20) | (1.22) | (0.43) |
| Coupon Rate (%) | -0.165 | | -0.289** | -0.418** | -0.068 | -0.161 | -0.245 |
| | (-1.23) | | (-2.49) | (-2.27) | (-0.42) | (-0.88) | (-1.46) |
| Maturity Length | 0.066 | | 0.042 | 0.033 | 0.082 | 0.067 | -0.017 |
| | (0.91) | | (0.69) | (0.23) | (1.14) | (0.83) | (-0.15) |
| Investment Grade (1/0) | 1.182 | | -0.120 | -0.974 | 0.632 | 2.608 | 0.344 |
| | (1.19) | | (-0.13) | (-0.78) | (0.45) | (1.30) | (0.31) |
| Liquidity [-2,2] | -0.388 | | -1.432*** | -3.213*** | -0.427 | -1.481*** | 0.533 |
| | (-1.54) | | (-4.06) | (-4.92) | (-0.97) | (-3.16) | (0.57) |
| Firm Size$_{t-1}$ | | -0.006 | -0.302 | -0.748** | 0.214 | -0.444 | -0.214 |
| | | (-0.03) | (-1.34) | (-2.35) | (0.61) | (-0.77) | (-0.83) |
| Firm Leverage$_{t-1}$ | | 0.036 | -0.169 | 0.442 | -1.348 | -1.066 | 2.859 |
| | | (0.02) | (-0.11) | (0.17) | (-0.74) | (-0.49) | (1.32) |
| Revenue Growth$_{t-1}$ (%) | | 4.259** | 4.480** | 5.139** | 1.205 | 11.748** | 2.772 |
| | | (2.04) | (2.26) | (2.08) | (0.28) | (2.46) | (1.23) |
| BESG E Score$_{t-1}$ (1/0) | | -1.483* | -1.354* | | | -0.291 | -1.394 |
| | | (-1.86) | (-1.79) | | | (-0.23) | (-1.15) |
| E Disclosure$_{t-1}$ | | 0.027 | 0.027 | 0.054* | 0.024 | 0.016 | 0.020 |
| | | (1.31) | (1.35) | (1.92) | (0.67) | (0.43) | (0.76) |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | No | No |
| Constant | 0.980 | -0.102 | 6.381 | 12.174** | -1.709 | 3.062 | 5.451 |
| | (0.26) | (-0.03) | (1.58) | (2.42) | (-0.33) | (0.40) | (1.25) |
| R-squared | 0.341 | 0.322 | 0.436 | 0.580 | 0.389 | 0.616 | 0.289 |
| F-test | 2.91*** | 2.68*** | 3.45*** | 3.19*** | 1.37 | 3.27*** | 1.22 |
| Observations | 160 | 154 | 154 | 87 | 67 | 77 | 77 |

e. Bond Impact Immune Sample Group Regressions: The Impact of CGBs on CARs (Matched Samples – CGBs)

| | General Regressions | | | Low BESG E Score$_{t-1}$ | High BESG E Score$_{t-1}$ | Non-Financial Industries | Financial Industries |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| VARIABLES | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] | CARs [-2,2] |
| Green (1/0) | **-1.743** | **-1.111** | **-1.113** | **-1.082** | **-1.178** | **0.031** | **-1.399** |
| | **(-1.34)** | **(-0.96)** | **(-1.19)** | **(-0.78)** | **(-1.10)** | **(0.02)** | **(-1.04)** |
| Bond Size | -3.141 | | 1.836 | 1.546 | 1.646 | 2.058 | -0.085 |
| | (-1.33) | | (0.73) | (0.30) | (0.65) | (0.55) | (-0.02) |
| Coupon Rate (%) | -0.325 | | -0.173 | -0.271 | -0.166 | -0.071 | 0.153 |
| | (-1.26) | | (-0.91) | (-0.53) | (-0.79) | (-0.31) | (0.17) |
| Maturity Length | -0.079 | | -0.154 | -0.520 | -0.285* | -0.124 | -0.455 |
| | (-0.50) | | (-1.33) | (-1.10) | (-2.07) | (-1.02) | (-1.12) |
| Investment Grade (1/0) | 3.491* | | 2.789 | 2.274 | 2.564 | 5.675** | 3.565 |
| | (1.82) | | (1.57) | (0.79) | (1.13) | (2.24) | (0.97) |
| Liquidity [-2,2] | -0.337 | | -2.473*** | -3.676*** | -1.590** | -2.812*** | 1.496 |
| | (-0.95) | | (-4.65) | (-4.13) | (-2.51) | (-4.73) | (1.02) |
| Firm Size$_{t-1}$ | | 0.044 | -1.596*** | -2.405** | 0.159 | -1.506* | -0.998 |
| | | (0.09) | (-2.78) | (-2.56) | (0.21) | (-1.91) | (-1.21) |
| Firm Leverage$_{t-1}$ | | -2.240 | -1.658 | -2.608 | -2.284 | -0.231 | 5.957 |
| | | (-0.84) | (-0.75) | (-0.44) | (-1.04) | (-0.09) | (1.11) |
| Revenue Growth$_{t-1}$ (%) | | 14.807*** | 10.595*** | 7.243 | 16.006** | 10.106 | 16.761*** |
| | | (3.45) | (2.99) | (1.53) | (2.37) | (1.67) | (3.33) |
| BESG E Score$_{t-1}$ (1/0) | | -0.095 | 0.210 | | | -0.590 | 1.066 |
| | | (-0.07) | (0.18) | | | (-0.39) | (0.63) |
| E Disclosure$_{t-1}$ | | 0.057 | 0.057** | 0.065 | -0.030 | -0.000 | 0.030 |
| | | (1.63) | (2.02) | (1.57) | (-0.56) | (-0.01) | (0.72) |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | No | No |
| Constant | -2.530 | -7.545 | 8.761 | 23.883** | 5.002 | 7.303 | 7.013 |
| | (-0.52) | (-1.32) | (1.51) | (2.75) | (0.64) | (0.98) | (0.58) |
| R-squared | 0.418 | 0.451 | 0.683 | 0.799 | 0.855 | 0.802 | 0.829 |
| F-test | 2.55*** | 2.67*** | 4.82*** | 3.96*** | 2.95* | 4.86*** | 3.11** |
| Observations | 74 | 69 | 69 | 41 | 28 | 45 | 24 |

**Table 5. Long-run Stock Reaction to Corporate Green Bond Issuance**

This table reports the BHARs results of CGBs from the long-term event study including all unique issuance day observations. The EW means the equal-weighted BHARs while VW means the value -weighted BHARs. The N means BHARs are calculated without annual rebalancing. This table, overall, involves four different approaches for calculating BHARs in two different periods including one-month and one-quarter.

| Event Window | #. Of Obs | BHARs (%) | t value | p value |
|---|---|---|---|---|
| One-Month_EW_N | 78 | 1.1736 | 0.8632 | 0.3907 |
| One-Month_EW | 78 | 1.1736 | 0.8632 | 0.3907 |
| One-Month_VW_N | 78 | 1.1745 | 0.8638 | 0.3904 |
| One-Month_VW | 78 | 1.3234 | 0.9741 | 0.3331 |
| One-Quarter_EW_N | 78 | 2.5227 | 0.8824 | 0.3803 |
| One-Quarter_EW | 78 | 2.5009 | 0.8765 | 0.3835 |
| One-Quarter_VW_N | 78 | 2.5244 | 0.8830 | 0.3800 |
| One-Quarter_VW | 78 | 2.9259 | 1.0394 | 0.3019 |

**Table 6. Impact of CGBs on ROA (Matched Samples - CGIs)**

This table provides the general regression, low/high BESG E Score subsampling regression, and non-financial/financial subsampling regression results for the impact of CGBs on $ROA_{t+1}$ (Table 6a) and $ROA_t$ (Table 6b) based on corporate green issuers' matched samples. The numbers in parentheses are t-test value. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

a. Impact of CGBs on $ROA_{t+1}$

| | General Regressions | Low BESG E Score$_{t-1}$ | High BESG E Score$_{t-1}$ | Non-Financial Industries | Financial Industries |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| VARIABLES | $ROA_{t+1}$ (%) | $ROA_{t+1}$ (%) | $ROA_{t+1}$ (%) | $ROA_{t+1}$ (%) | $ROA_{t+1}$ (%) |
| Green (1/0) | **-0.315** | **-0.157** | **-5.083**** | **-0.649** | **-0.074** |
| | **(-0.35)** | **(-0.19)** | **(-2.74)** | **(-0.40)** | **(-0.16)** |
| $ROA_{t-1}$ (%) | 0.519*** | 0.516*** | 0.296 | 0.463*** | 0.816*** |
| | (6.95) | (7.63) | (0.86) | (4.23) | (3.89) |
| Firm Size$_{t-1}$ | 0.286 | 0.162 | 4.221* | 0.816 | -0.143 |
| | (0.62) | (0.34) | (2.25) | (0.51) | (-0.59) |
| Firm Leverage$_{t-1}$ | 3.555 | 2.661 | -4.375 | -7.363 | 0.493 |
| | (0.91) | (0.60) | (-0.24) | (-0.70) | (0.23) |
| Revenue Growth$_{t-1}$ (%) | -0.237*** | 0.038 | -0.370** | -0.317*** | 0.006 |
| | (-4.91) | (0.49) | (-2.88) | (-4.30) | (0.14) |
| BESG E Score$_{t-1}$ (1/0) | -1.887 | | | 0.120 | 2.006* |
| | (-1.36) | | | (0.04) | (1.93) |
| E Disclosure$_{t-1}$ | -0.014 | -0.000 | -0.094 | -0.131 | 0.049** |
| | (-0.39) | (-0.00) | (-1.39) | (-1.62) | (2.55) |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes |
| Industry Fixed Effect | Yes | Yes | Yes | No | No |
| Constant | -9.932* | -2.471 | -23.541 | -2.655 | -2.290 |
| | (-1.77) | (-0.46) | (-1.60) | (-0.17) | (-0.56) |
| R-squared | 0.741 | 0.791 | 0.952 | 0.827 | 0.795 |
| F-test | 5.58*** | 4.39*** | 10.65*** | 4.76*** | 4.78*** |
| Observations | 63 | 42 | 21 | 33 | 30 |

b. Impact of CGBs on $ROA_t$

| | General Regressions | Low BESG E Score$_{t-1}$ | High BESG E Score$_{t-1}$ | Non-Financial Industries | Financial Industries |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| VARIABLES | $ROA_t$ (%) | $ROA_t$ (%) | $ROA_t$ (%) | $ROA_t$ (%) | $ROA_t$ (%) |
| Green (1/0) | **-0.180** | **0.003** | **0.615** | **0.198** | **-0.638** |
| | **(-0.19)** | **(0.00)** | **(0.37)** | **(0.14)** | **(-0.99)** |
| $ROA_{t-1}$ (%) | 0.409*** | 0.511*** | 0.091 | 0.349*** | 0.761** |
| | (4.91) | (4.69) | (0.32) | (3.25) | (2.54) |
| Firm Size$_{t-1}$ | 0.486 | -0.154 | 1.705 | 2.151 | -0.152 |
| | (0.99) | (-0.22) | (1.19) | (1.61) | (-0.44) |
| Firm Leverage$_{t-1}$ | 3.823 | -1.174 | 21.832 | -7.859 | -0.896 |
| | (0.90) | (-0.19) | (1.56) | (-0.80) | (-0.29) |
| Revenue Growth$_{t-1}$ (%) | -0.092* | -0.065 | -0.112 | -0.103 | -0.041 |
| | (-1.86) | (-0.62) | (-1.56) | (-1.60) | (-0.69) |
| BESG E Score$_{t-1}$ (1/0) | 0.683 | | | 4.280 | -0.924 |
| | (0.46) | | | (1.63) | (-0.62) |
| E Disclosure$_{t-1}$ | -0.004 | 0.056 | -0.094 | -0.091 | 0.011 |
| | (-0.11) | (0.92) | (-1.37) | (-1.26) | (0.39) |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes |
| Industry Fixed Effect | Yes | Yes | Yes | No | No |
| Constant | -9.176 | -8.660 | -12.330 | -18.162 | 3.081 |
| | (-1.48) | (-0.98) | (-1.18) | (-1.30) | (0.53) |
| R-squared | 0.598 | 0.673 | 0.764 | 0.705 | 0.711 |
| F-test | 3.22*** | 2.57** | 2.82** | 3.39*** | 3.04** |
| Observations | 77 | 46 | 31 | 47 | 30 |

**Table 7. Impact of CGBs on Tobin's Q (Matched Samples - CGIs)**

This table provides the general regression, low/high BESG E Score subsampling regression, and non-financial/financial subsampling regression results for the impact of CGBs on Tobin's $Q_{t+1}$ (Table 6a) and Tobin's $Q_t$ (Table 6b) based on corporate green issuers' matched samples. The numbers in parentheses are t-test value. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

a. Impact of CGBs on Tobin's $Q_{t+1}$

| | General Regressions | Low BESG E Score$_{t-1}$ | High BESG E Score$_{t-1}$ | Non-Financial Industries | Financial Industries |
|---|---|---|---|---|---|
| VARIABLES | (1) Tobin's $Q_{t+1}$ | (2) Tobin's $Q_{t+1}$ | (3) Tobin's $Q_{t+1}$ | (4) Tobin's $Q_{t+1}$ | (5) Tobin's $Q_{t+1}$ |
| Green (1/0) | **0.272**** | **0.293**** | **0.033** | **0.445**** | **-0.243**** |
| | **(2.33)** | **(2.25)** | **(0.20)** | **(2.23)** | **(-2.60)** |
| ROA$_{t-1}$ (%) | 0.601*** | 0.586*** | 1.150*** | 0.598*** | 1.432*** |
| | (19.28) | (19.37) | (5.23) | (13.78) | (9.61) |
| Firm Size$_{t-1}$ | -0.061 | -0.060 | -0.169 | -0.232 | 0.129** |
| | (-1.05) | (-0.80) | (-1.04) | (-1.16) | (2.77) |
| Firm Leverage$_{t-1}$ | 0.641 | 0.605 | -0.185 | 1.193 | 0.589 |
| | (1.28) | (0.87) | (-0.12) | (0.99) | (1.70) |
| Revenue Growth$_{t-1}$ (%) | -0.023*** | 0.014 | 0.008 | -0.029*** | -0.005 |
| | (-3.71) | (1.20) | (0.47) | (-3.14) | (-0.74) |
| BESG E Score$_{t-1}$ (1/0) | -0.073 | | | -0.201 | 0.271* |
| | (-0.42) | | | (-0.56) | (1.89) |
| E Disclosure$_{t-1}$ | 0.002 | 0.003 | 0.008 | 0.004 | 0.002 |
| | (0.38) | (0.45) | (1.57) | (0.41) | (0.69) |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes |
| Industry Fixed Effect | Yes | Yes | Yes | No | No |
| Constant | 0.855 | 2.087** | 1.178 | 3.099 | -2.664*** |
| | (1.18) | (2.49) | (0.94) | (1.58) | (-3.45) |
| R-squared | 0.951 | 0.978 | 0.967 | 0.964 | 0.939 |
| F-test | 37.76*** | 51.47*** | 15.64*** | 27.00*** | 18.99*** |
| Observations | 63 | 42 | 21 | 33 | 30 |

b. Impact of CGBs on Tobin's $Q_t$

| | General Regressions | Low BESG E Score$_{t-1}$ | High BESG E Score$_{t-1}$ | Non-Financial Industries | Financial Industries |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| VARIABLES | Tobin's $Q_t$ | Tobin's $Q_t$ | Tobin's $Q_t$ | Tobin's $Q_t$ | Tobin's $Q_t$ |
| Green (1/0) | **0.311**** | **0.481**** | **-0.016** | **0.430*** | **-0.201*** |
| | **(2.12)** | **(2.18)** | **(-0.13)** | **(1.89)** | **(-1.88)** |
| ROA$_{t-1}$ (%) | 0.486*** | 0.444*** | 1.103*** | 0.503*** | 1.300*** |
| | (11.31) | (8.01) | (9.49) | (8.80) | (7.61) |
| Firm Size$_{t-1}$ | -0.058 | -0.182 | 0.041 | -0.260 | 0.067 |
| | (-0.78) | (-1.49) | (0.41) | (-1.24) | (1.25) |
| Firm Leverage$_{t-1}$ | 1.043 | -0.045 | -1.271 | 2.841* | 0.263 |
| | (1.62) | (-0.04) | (-1.36) | (1.92) | (0.66) |
| Revenue Growth$_{t-1}$ (%) | -0.011 | 0.016 | -0.000 | -0.015 | -0.010 |
| | (-1.50) | (0.88) | (-0.04) | (-1.47) | (-1.31) |
| BESG E Score$_{t-1}$ (1/0) | -0.073 | | | -0.364 | -0.053 |
| | (-0.33) | | | (-0.88) | (-0.32) |
| E Disclosure$_{t-1}$ | -0.004 | 0.004 | -0.003 | 0.002 | 0.005 |
| | (-0.68) | (0.40) | (-0.63) | (0.17) | (1.59) |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes |
| Industry Fixed Effect | Yes | Yes | Yes | No | No |
| Constant | 1.341 | 3.127* | 0.468 | 3.460 | -1.492 |
| | (1.42) | (2.04) | (0.62) | (1.58) | (-1.68) |
| R-squared | 0.906 | 0.933 | 0.952 | 0.915 | 0.917 |
| F-test | 20.88*** | 17.30*** | 17.41*** | 15.38*** | 13.68*** |
| Observations | 77 | 46 | 31 | 47 | 30 |

**Table 8. Robustness: Reverse Causality Tests**

Table 8 reports the reverse causality test results for ROA and Tobin's Q to check if green issuances are or aren't affected by the ROA and Tobin's Q before the issuance year. In particular, Column (1) to (4) show the reverse causality test results under corporate green bonds matched samples, while Column (5) to (6) show the reverse causality test results under corporate green issuers matched samples.

| | Matched Samples - CGBs | | | | Matched Samples - CGIs | |
|---|---|---|---|---|---|---|
| | Full Sample Group | | Bond Impact Immune Group | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VARIABLES | Green (1/0) | Green (1/0) | Green (1/0) | Green (1/0) | Green (1/0) | Green (1/0) |
| $ROA_{t-1}$ (%) | **-0.009** | | **-0.009** | | **-0.008** | |
| | **(-1.38)** | | **(-1.00)** | | **(-0.72)** | |
| Tobin's $Q_{t-1}$ | | **-0.026** | | **0.003** | | **0.050** |
| | | **(-1.12)** | | **(0.09)** | | **(1.25)** |
| Firm $Size_{t-1}$ | 0.053* | 0.050 | -0.028 | -0.039 | 0.075 | 0.099 |
| | (1.76) | (1.61) | (-0.48) | (-0.68) | (1.09) | (1.46) |
| Firm $Leverage_{t-1}$ | -0.126 | -0.085 | -0.652** | -0.684** | 0.701 | 0.927 |
| | (-0.59) | (-0.39) | (-2.15) | (-2.14) | (1.17) | (1.57) |
| Revenue $Growth_{t-1}$ (%) | -0.257 | -0.262 | -0.313 | -0.328 | -0.004 | -0.004 |
| | (-0.92) | (-0.93) | (-0.62) | (-0.63) | (-0.52) | (-0.55) |
| BESG E $Score_{t-1}$ (1/0) | -0.027 | -0.018 | -0.084 | -0.073 | 0.017 | 0.014 |
| | (-0.25) | (-0.16) | (-0.55) | (-0.48) | (0.08) | (0.07) |
| E $Disclosure_{t-1}$ | 0.002 | 0.002 | 0.005 | 0.005 | 0.002 | 0.001 |
| | (0.86) | (0.59) | (1.23) | (1.09) | (0.35) | (0.21) |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | -0.148 | -0.071 | 1.023 | 1.013 | -0.709 | -1.083 |
| | (-0.27) | (-0.13) | (1.54) | (1.50) | (-0.81) | (-1.24) |
| R-squared | 0.129 | 0.124 | 0.181 | 0.165 | 0.081 | 0.098 |
| F-test | 0.83 | 0.80 | 0.72 | 0.64 | 0.20 | 0.25 |
| Observations | 154 | 154 | 69 | 69 | 77 | 77 |