



# Do investors benefit from investing in stocks of green bond issuers?

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## ABSTRACT

We investigate the environmental and financial performance of portfolios comprising stocks from worldwide green bond issuers compared to matched non-green but otherwise similar portfolios. Portfolios formed by stocks of green bond issuing companies show superior environmental performance, notably reflected in reduced CO<sub>2</sub> emissions over the medium to long term. Furthermore, these portfolios exhibit financial performance, as measured by the five-factor model of Fama and French (2015), at least comparable to their non-green counterparts, even outperforming them over a 12-month investment horizon. Overall, investing in stocks of green bond issuers seemingly offers competitive risk-adjusted returns.

## 1. Introduction

Green bonds are a key financial instrument of green finance, aiming to mobilize capital towards more sustainable investments. As such, they can play a major role in supporting the transition to a low-carbon economy, in line with the objectives of the 2015 Paris Agreement, namely by “making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development”.<sup>1</sup> The first green bonds date back to 2007, but it wasn't until 2013 that the green bond market began to experience accelerated growth, with issuance increasing from 36.6 billion USD in 2014 to 587.6 billion USD in 2023 (Climate Bond Initiative, 2015, 2024). Originally dominated by supranational and agency issuers (Fender et al., 2019), the landscape of the green bond market has since evolved to embrace a more diversified range of issuers, with corporate green bond issuers representing 57% of the green bond volume in 2023 (Climate Bond Initiative, 2024). Despite still being a small niche compared to the conventional bond market, the potential for further growth remains promising, considering the prevalence of climate-related issues within the policy agenda (Fatica and Panzica, 2021). The rise in corporate green bond issuance reflects a growing emphasis on environmentally responsible business practices, which can be interpreted through the lens of two prominent management frameworks. Drawing on instrumental stakeholder theory (Donaldson and Preston, 1995; Jones, 1995) companies can achieve a competitive advantage by integrating stakeholder expectations,

including those related to environmental responsibility. Moreover, the natural-resource-based view (Hart, 1995) implies that developing strong organizational capabilities in pollution prevention, product stewardship, and sustainable management can also be a source of competitive advantage. Ultimately, these theories support Porter and Van Der Linde (1995)'s win-win argument (Endrikat et al., 2014) that improved environmental performance translates into better financial performance.

The expansion of the green bond market has prompted a flourishing body of research focusing on these financial instruments. A stream of the literature highlights their limited correlation with other asset classes such as equities and commodities (e.g., Reboredo et al., 2020; Nguyen et al., 2021; Jiang et al., 2022), making it an appealing asset class for investors seeking risk diversification. Another line of research explores the pricing differentials between green bonds and other bonds, finding evidence of a greenium (Zerbib, 2019; Dorfleitner et al., 2022; Baker et al., 2022). This suggests that investors are willing to trade off financial performance for greenness attributes, while green bond issuers benefit from lower financing costs. Furthermore, some studies focus on the impact of green bond issuance, showing positive short-term stock price reactions (Tang and Zhang, 2020; Flammer, 2021; Fan et al., 2023) and improvements in environmental performance (Flammer, 2021; Fatica and Panzica, 2021; ElBannan and Löffler, 2024). Overall, the empirical evidence is in line with the argument that investors value the green attributes of these types of bonds, which serve to signal the firm's commitment to sustainability (Flammer, 2021; Sangiorgi and Schopohl,

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<sup>1</sup> [https://unfccc.int/files/meetings/paris\\_nov\\_2015/application/pdf/paris\\_agreement\\_english\\_.pdf](https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf).

2023).

Although the short-term effects of green bond issuance on stock prices have been established, there is limited knowledge of the longer-term financial performance implications for investors holding portfolios of stocks of green bond issuing companies. Even assuming the value-enhancing features of environmental strategies at the corporate level, in line with instrumental stakeholder theory and the natural-resource-based view, there are arguments supporting the underperformance of environmentally screened portfolios. First, based on efficient markets, all value-relevant information relating to environmental performance should already be incorporated in stock prices. Second, according to modern portfolio theory, any additional screens used to form portfolios will restrict the investment universe and, consequently, reduce risk-adjusted returns. Third, recent studies provide theoretical frameworks to explain the effects of investors' preferences for greenness on asset prices. Specifically, Pástor et al. (2021) predict that in equilibrium green assets will provide lower expected returns due to investors' preferences for these assets as well as their climate risk hedging benefits. However, there are also arguments to support the outperformance of green portfolios. In line with the mispricing argument, enhanced environmental performance can generate abnormal returns if its effects are not unanticipated by the market (Edmans, 2011; Derwall et al., 2011). Additionally, the model of Pástor et al. (2021) acknowledges potential outperformance opportunities of green securities in times when there are unexpected shifts towards greenness. Empirically, while some evidence suggests the existence of a carbon premium (Bolton and Kacperzyk, 2021, 2023; Hsu et al., 2023), there are also studies showing outperformance of green portfolios (Bauer et al., 2022; Pástor et al., 2022; Ardia et al., 2023).

To our knowledge, this is the first paper to explore the impact of investing in stocks of companies that issue green bonds, thereby contributing to the debate in the climate finance literature regarding the potential trade-off between portfolio greenness and financial performance. We assume the perspective of an investor who rebalances their portfolios in response to companies' green bond issuance and holds these stocks for different holding periods. Besides investigating financial performance, another contribution of the paper is to compare the environmental performance of companies issuing green bonds versus non-green bond issuers. Our findings indicate that investors do not face disadvantages when investing in stocks of green bond issuers. Stock portfolios of green bond issuers show significantly higher environmental scores than their matched non-green bond counterparts, with stocks of green bond issuers exhibiting a pronounced CO2 mitigation in the medium to long-term. Furthermore, green portfolios exhibit financial performance comparable to matched non-green portfolios. Holding an equal-weighted portfolio of green bond issuers' stocks for 12 months even delivers statistically superior performance compared to a portfolio of stocks of non-green bond issuers. Overall, our findings contribute to the research on sustainable investments and highlight the potential of green instruments as a tool for addressing climate change.

The remainder of the paper is organized as follows. Sections 2 and 3 present the methods and data used in this research, respectively. Section 4 presents and discusses the empirical results, and Section 5 concludes.

## 2. Methods and data

### 2.1. Portfolio formation

To explore the potential benefits of investing in stocks of firms issuing green bonds, we form both equal- and value-weighted portfolios comprising stocks of such firms. We use two approaches: (1) including only stocks of first-time green bond issuers in the portfolio (first-time issuers), in line with the argument that the reaction to the issuance of green bonds is stronger for first time-issuers (Tang and Zhang, 2020; Flammer, 2021), and (2) including stocks of firms each time they issue a green bond (all issuers), aiming to capture potential long-term benefits

beyond the initial green bond issue. Portfolio performance is evaluated for holding periods of 6, 12, and 36 months, respectively, after issuance.

We compare the performance of the portfolio consisting of stocks from companies that issued green bonds (GB issuers) with that of a portfolio of companies possessing similar characteristics but that did not issue green bonds (non-GB issuers). This analysis provides insights into the performance effects associated with portfolios of stocks of companies issuing green bonds. To isolate the performance attributable to the green bond signaling effect and avoid any potential confounding factors, we apply a matching procedure that identifies non-issuing companies with characteristics closely resembling green bond issuers. Specifically, we implement a recursive process whereby each month GB issuers are identified and then matched with a non-GB issuer considering country, industry, size, and leverage using the nearest neighbor matching, thereby selecting the most similar non-GB issuer for each GB issuer.

### 2.2. Financial performance

To assess portfolio performance, we use the Fama and French (2015) five-factor model, which incorporates the market factor along with the size, value, investment, and profitability risk factors, as follows:

$$r_{pt} = \alpha_p + b_p Mkt_t + s_p SMB_t + h_p HML_t + r_p RMW_t + c_p CMA_t + e_{pt} \quad (1)$$

where  $r_{pt}$  is the excess return (over the risk-free rate) of portfolio  $p$  in month  $t$ ,  $Mkt_t$  is the excess returns of the market portfolio in month  $t$ . The remaining independent variables are the differences between: the returns on diversified portfolios of small and large stocks ( $SMB_t$ ); high and low book-to-market stocks ( $HML_t$ ); stocks with robust and weak profitability ( $RMW_t$ ); and stocks of low and high investment firms - conservative minus aggressive ( $CMA_t$ ). In this model,  $\alpha_p$  is the estimated abnormal performance of portfolio  $p$ , and  $b_p$ ,  $s_p$ ,  $h_p$ ,  $r_p$ , and  $c_p$  represent the estimated coefficients associated with the different risk factors. Finally,  $e_{pt}$  represents the zero-mean residuals.

In addition to evaluating the performance of portfolios of stocks of GB issuers and those of non-GB issuers, we also evaluate the performance of a difference portfolio. This portfolio corresponds to a zero-investment strategy consisting of taking a long position in the stock portfolio of GB issuers and simultaneously a short position in the stock portfolio of non-GB issuers. This approach allows us to ascertain whether differences in performance between both types of portfolios are statistically significant.

### 2.3. Data

To identify publicly traded companies issuing green bonds, we retrieved the global list of green bond issuances from 2015 to 2020 through Bloomberg. This data included key information such as issuance and redemption dates, issuer ISIN code, industry, and country. Financial data on green bond issuers, such as monthly total return series and market values in US dollars, were collected from Refinitiv Eikon Datastream. We also retrieved non-financial data, including Environmental scores, CO2 emissions in tons, and ratios of CO2 emissions to revenues and total assets. After identifying 1070 green bonds issued by 464 different firms, the final dataset consists of 464 stocks of green-bond issuers and a matched sample of non-green bond issuers. The risk factors for developed markets and the risk-free rate are obtained from Professor Kenneth French's website.

## 3. Empirical analysis

### 3.1. Environmental performance

Table 1 presents the environmental performance of the portfolios formed of stocks of GB versus non-GB issuers using different environmental metrics.

**Table 1**  
Environmental performance.

	GB issuers			Matched non-GB issuers			T-test equality of means				
	ENV	CO2/TA	CO2/Rev.	ENV	CO2/TA	CO2/Rev.	ENV	CO2/TA	CO2/Rev.		
Panel A. Equal-weighted portfolios											
First-time issuers											
6-month	67.1	0.187	570.9	54.8	0.163	699.7	7.861	***	0.326	-0.847	
12-month	67.1	0.185	569.3	54.0	0.162	897.0	9.971	***	1.476	-2.532	
36-month	67.0	0.173	566.8	53.4	0.210	1451.3	10.995	***	-1.992	**	-7.447
All issuers											
6-month	66.8	0.186	568.8	54.7	0.161	703.5	7.858	***	1.023	-0.887	
12-month	66.9	0.184	567.3	53.9	0.160	898.5	9.992	***	1.589	-2.562	
36-month	67.0	0.172	565.7	53.3	0.209	1455.7	11.123	***	-1.926	*	-7.426
Panel B. Value-weighted portfolios											
First-time issuers											
6-month	74.1	0.120	401.8	63.8	0.099	458.6	5.628	***	0.241	-0.484	
12-month	73.7	0.104	368.8	64.3	0.095	546.1	5.495	***	1.042	-2.126	
36-month	71.6	0.091	341.5	65.7	0.096	580.1	0.000	***	-1.187	-6.848	
All issuers											
6-month	74.0	0.120	401.6	63.7	0.098	460.6	5.684	***	1.269	-0.502	
12-month	73.7	0.103	368.5	64.1	0.092	541.1	5.597	***	1.421	-2.084	
36-month	71.5	0.091	341.3	65.5	0.093	573.7	3.579	***	-0.611	-6.706	

This table presents environmental metrics of stock portfolios of GB and matched non-GB issuers (first-time issuers and all issuers) considering holding periods of 6, 12 and 36 months, and *t*-tests for the difference in means. The environmental metrics are Refinitiv's Environmental score (ENV), CO2 to total assets (CO2/TA), and CO2 Emissions to Revenues (CO2/Rev). ENV scores are from March 2015-December 2020, while CO2 ratios are from November 2015-December 2020. \*, \*\*, and \*\*\* indicate statistical significance at 10%, 5% and 1% levels, respectively.

Portfolios containing stocks of GB issuers hold significantly higher ENV scores compared to their matched non-GB counterparts, consistent with green bond issuance being a potential driver of improved environmental practices, as documented by [Flammer \(2021\)](#). We also observe that portfolios comprised of stocks from GB issuers have significantly lower CO2/Rev ratios compared to those of non-GB issuers. This difference becomes even more pronounced with longer holding periods, suggesting that the positive impact of green bond issuance on CO2 emissions takes time to materialize. The evidence for CO2/TA is somewhat consistent with this. While the differences in this indicator are mostly non-significant, it is noteworthy that a more substantial reduction in the CO2/TA ratio is observed for stock portfolios of GB issuers compared to non-GB issuers for longer holding periods (36 months). This suggests that stock portfolios of GB issuers are reducing their CO2/TA ratio to a greater extent than portfolios of non-GB issuers.

### 3.2. Financial performance

In this section, we evaluate the financial performance of stock portfolios comprising companies that issued green bonds compared to those of non-GB issuers. [Table 2](#) reports the estimated abnormal returns (alpha) from the [Fama and French \(2015\)](#) five-factor model for portfolios of stocks of GB issuers and matched non-GB issuers, held for 6, 12, and 36 months following green bond issuance.

Focusing on equal-weighted portfolios, the alphas of the portfolios of stocks from GB and non-GB issuers are not significantly different from zero. However, the alpha of the 12-month long-short portfolio is positive and statistically significant, indicating that a 12-month investment strategy focused on stocks of GB issuers outperforms a stock portfolio of non-GB issuers. As for the value-weighted portfolios, although several stock portfolios of non-GB issuers yield statistically significant alphas, none of the alphas of the long-short portfolios is statistically significant, indicating no performance differential between both types of portfolios.<sup>2</sup> These findings suggest that investors can invest in stocks of firms that issue green bonds without penalizing their financial performance.

<sup>2</sup> The results are robust to using a six-factor model including a momentum factor.

**Table 2**  
Portfolio financial performance.

	GB issuers		Matched non-GB issuers		Long-short portfolio
	alpha	R <sup>2</sup> Adj.	alpha	R <sup>2</sup> Adj.	
Panel A. Equal-weighted portfolios					
First-time issuers					
6-month	-0.039	78.6%	-0.354	71.4%	0.314
12-month	0.039	82.5%	-0.358	74.4%	0.397*
36-month	0.075	83.9%	-0.214	74.0%	0.289
All issuers					
6-month	0.012	78.3%	-0.389	71.4%	0.401
12-month	0.084	81.6%	-0.400	74.3%	0.485
36-month	0.111	83.4%	-0.220	73.2%	0.330*
Panel B. Value-weighted portfolios					
First-time issuers					
6-month	0.111	74.1%	0.453	63.7%	-0.342
12-month	0.240	75.5%	0.589**	71.1%	-0.350
36-month	0.267	77.0%	0.460*	75.9%	-0.193
All issuers					
6-month	0.112	74.1%	0.395	63.9%	-0.283
12-month	0.239	75.5%	0.526***	70.2%	-0.287
36-month	0.259	77.3%	0.463*	74.0%	-0.204

This table presents the five-factor model alphas of stock portfolios of GB issuers, matched non-GB issuers, and long-short portfolios over the period March 2015-December 2020 (for first-time and all issuers), considering holding periods of 6, 12 and 36 months. The model is estimated by OLS with heteroskedasticity and autocorrelation-adjusted standard errors ([Newey and West, 1987](#)). R<sup>2</sup> Adj. is the adjusted coefficient of determination. \*, \*\*, and \*\*\* indicate statistical significance at 10%, 5% and 1% levels, respectively.

## 4. Conclusions

We investigate the environmental and financial implications of investing in stocks of companies that issue green bonds by forming portfolios of such stocks and comparing their performance to portfolios of stocks of non-green bond issuers. Based on different environmental metrics, we observe that stock portfolios of green bond issuers exhibit better environmental performance relative to their non-green bond counterparts. Specifically, they show a more pronounced CO2 emissions reduction over the medium to long-term. Regarding financial performance, stock portfolios of green bond issuers perform at least as well as those of non-green bond issuers. Holding an equal-weighted portfolio of

stocks of green bond issuing companies over a 12-month period even outperforms a portfolio of non-green bond issuers. Our findings align with studies indicating either outperformance or neutral risk-adjusted performance of green portfolios (e.g., Bauer et al., 2022; Pástor et al., 2022; Ardia et al., 2023) and can be interpreted in light Pástor et al. (2021)'s theoretical framework. Although their equilibrium model predicts lower expected returns for green assets, it also recognizes that these investments may outperform during periods of unexpected increases in demand for greenness. Recent heightened investor interest in environmental issues supports this viewpoint.

Given the urgency of climate change and the pressure to transition to a low-carbon economy, these results offer important insights for investors, companies, and policymakers. However, we acknowledge some limitations that can guide future research directions. Considering that the period of analysis includes the exogenous shock of the Covid pandemic, future research can expand the sample period to explore the impact of the energy crisis that emerged around the Russian invasion of Ukraine. As Bauer et al. (2022) highlight, the increased demand in two particularly high-emitting industries - fossil fuels and defense - along with potential shifts in investors' preferences for green assets might have impacted the performance of green portfolios. Additionally, in light of recent evidence showing the influence of unexpected changes in investors' concerns for climate change on green and brown portfolio performance (Ardia et al., 2023), an interesting avenue for future research would be to incorporate a time-varying climate uncertainty measure into the performance evaluation model.

#### Data availability

Data will be made available on request.

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