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Mutarindwa, Samuel; Schäfer, Dorothea; Stephan, Andreas

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ORIGINAL PAPER



Certification against greenwashing in nascent bond markets: lessons from African ESG bonds

Samuel Mutarindwa¹ · Dorothea Schäfer^{2,3,5} · Andreas Stephan⁴

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Abstract

Africa is one of the most vulnerable continents to climate change. Climate and sustainability-linked bonds can provide funding to African governments and corporations for projects that help to mitigate climate change, combat biodiversity loss, and foster sustainable development. However, less than 0.3% of the global environmental, social, governance (ESG) bond issuance volume is devoted to projects in Africa. Based on the entire universe of 107 African ESG bonds from 42 governmental and corporate issuers over the period 2010–2023, this paper establishes that ESG bonds provide benefits to both issuers and investors in terms of lower spreads and volatility. Our econometric results highlight that greenwashing is a valid concern for investors in African ESG bonds and certification of ESG bonds makes a difference visà-vis the self-labeling of green bonds. Non-certified ESG bonds do not offer similar benefits compared to certified ones. Green macro-financial policy and suitable regulation to prevent greenwashing can foster African ESG-bond markets.

Keywords Africa · Sustainable development · ESG bonds · Greenium

Mathematics Subject Classification $G12 \cdot G28 \cdot K32 \cdot Q56$

Andreas Stephan andreas.stephan@lnu.se

> Samuel Mutarindwa smutarinda@gmail.com

Dorothea Schäfer dschaefer@diw.de

- ¹ University of Rwanda, Kigali, Rwanda
- ² DIW Berlin, Berlin, Germany
- ³ Jönköping University, Jönköping, Sweden
- ⁴ Linnaeus University, Växjö, Sweden
- ⁵ IAW, Universität Bremen, Bremen, Germany

1 Introduction

Africa is one of the most vulnerable continents concerning climate change. Although Africa emits little greenhouse gas compared to the developed parts of the world, the continent already experiences rising temperatures and sea levels as well as heavy rainfalls above global averages. This has led to natural disasters that threaten agriculture and infrastructures, cause environmental damage and biodiversity loss, and increase mortality and starvation (Taghizadeh-Hesary et al., 2022; Tyson, 2021).

Climate or, more broadly, green bonds are financial securities that are issued with the goal that the proceeds are used to finance climate initiatives and include projects related to renewable energy and energy efficiency, biodiversity and forestry, as well as clean transportation (Chiesa & Barua, 2019; Flammer, 2021; Baker et al., 2018).¹ Previous studies on green bond markets and climate financing in Africa provide general evidence and trends (Afful-Koomson, 2015; Ngwenya & Simatele, 2020; Taghizadeh-Hesary et al., 2021; Tyson, 2021), but none of these studies examine the pricing of the broader class of ESG bonds in Africa.

There is global consensus that much more financial resources from the private sector will have to be mobilized to mitigate climate change. The markets for environmental, social, and governance bonds and the commitments from long-horizon asset owners to ESG integration as an investment strategy continue to grow (Pedersen et al., 2021). From a macro-policy perspective focusing on emerging markets, it is vital to know why climate bonds are attractive instruments for investors and how they could help mobilize urgently needed investments in climate protection initiatives.

This paper addresses this gap and complements recent international studies on green bond pricing (Baker et al., 2018; Bertelli et al., 2021; Wang et al., 2020; Zerbib, 2019). We contribute to this very young, rapidly growing, but still inconclusive literature by taking not only green but the broader class of ESG bonds into account. Using Thomson Reuters Refinitiv and Datastream databases, we shed light on the nascent ESG bond markets in African countries and provide novel empirical evidence on the pricing of African ESG bonds.

Between 2003 and 2013, the Green Climate Fund (GCF) committed USD 3.5 billion to 492 climate projects in Africa (Afful-Koomson, 2015; Duru & Nyong, 2016). About 97% of these funds stemmed from multilateral sources—particularly the African Development Bank (AfDB). The remaining funds were sourced as concessional loans to support climate-related projects. Given limited and shrinking government budgets, other stakeholders will have to complement governments in financing these green investments. Most African economies are bank-based (Allen et al., 2011; Beck & Cull, 2013; Mutarindwa et al., 2020, 2021), which means banks are the main providers of finance to the public and private sectors and could be a potential source of financing green investments for climate change mitigation. Despite that, financial institutions have not been active in financing greener investments in Africa. Ng

¹ Ntsama et al. (2021) provide a typology of green bonds. Demary and Neligan (2018) emphasize that these bonds are more transparent compared to conventional bonds in the way their proceeds are used.

and Tao (2016) show that green energy investments are in most cases undertaken by new, young firms with higher opacity having no strong track records and public information, and which financial institutions perceive as less credit-worthy compared to established conventional energy projects. Such information asymmetries may lower the chances for such firms to access necessary financing from conventional financial institutions.

In such economies, alternative financing through financial markets could be a solution to these financing challenges. However, such markets are nonexistent in most African countries. Only a few African economies have developed financial markets that provide sufficient alternative financing for green projects. Given the difficulties of mobilizing capital from conventional banks and the public sector, the current study analyzes a broad class of African ESG bonds, which encompasses climate bonds but also sustainability-linked bonds and even self-labeled green bonds. An ESG bond is defined as having financial and/or structural characteristics that are aligned with at least one of the three ESG pillars. Therefore, this definition includes project-based types of bonds, such as green and social bonds, and target-based types of bonds, such as sustainability-linked bonds (SLBs).²

For investors, ESG bonds may hedge against different types of risk including geopolitical, economic, and climate-policy risks (Chopra & Mehta, 2023; Dong et al., 2022; Kanamura, 2021). Furthermore, green and social bonds tend to be sold at a premium relative to their conventional counterparts (see, for instance, Caramichael & Rapp, 2022; Löffler et al., 2021). This premium implies that the bond yield is lower than for comparable bonds, which is an advantage for issuers, providing them with a lower cost of capital.

The findings of Gao and Schmittmann (2022) indicate that strong supervision and regulations, like disclosure and reporting requirements, are needed to make ESG bond markets work. In particular, in nascent bond markets "greenwashing" seems to be a valid concern for investors. Despite that, the greenwashing risk is rarely highlighted in quantitative investigations revolving around the green bond issuing activity. Petreski et al. (2023), for example, differentiate between occasional and repeated issuing of green bonds. They find it is repeated issuance that builds a reputation that works against investors' suspicion of greenwashing and, consequently, lowers the issuer's cost of capital. The African ESG bond market is in its early stages. If investors' request for being protected against greenwashing risk is substantial, ESG-bond certification should make a difference in pricing vis-à-vis the self-labeling of green bonds. Following this hypothesis, we study quantitatively whether African ESG certified bonds are priced differently than self-labeled green bonds vis-à-vis conventional African (brown) bonds.

² Berrada et al. (2022, p. 7) use the International Capital Market Association (ICMA) definition of SLBs as any type of debt instrument for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined sustainability/ESG objectives. Green bonds are some of the commonly used SLB debt instruments.

The remainder of this paper is organized as follows. Section 2 describes the background and presents related studies. Section 3 explains the econometric methodology. Section 4 provides a description of results. Section 5 concludes.

2 Background and related studies

At the global scale, since the first green bond issuance in 2007 by the European Investment Bank, there has been huge growth in the issuance of green bonds reaching USD 2 trillion, which is driven by the enhanced need of investors for greener assets (Tyson, 2021). In contrast, Marbuah (2020) notes that the green bond market in Africa is relatively small and new compared to the rest of the world. Although the African Development Bank (AfDB) has been pivotal in issuing climate bonds for African projects (Ngwenya & Simatele, 2020; Afful-Koomson, 2015), only very few African corporate, sovereign, and municipal issuers exist—constituting overall a tiny fraction of all African bond issuances (Duru & Nyong, 2016).

Tolliver et al. (2021) review the developments and trends in green innovations and green finance in the Asian countries of China, Japan, India, and South Korea and how they are linked to sustainable economic growth. Maltais and Nykvist (2020) qualitatively analyze the factors that drive green bond markets and the role of green bonds in improving sustainability. Conducting interviews with nine issuers and nine investors in green bonds in Sweden between 2017 and 2018, the authors find that green bonds are low-risk financial securities for both investors and issuers of these instruments. They also find that the issue of green bonds contributes to sustainability at relatively low costs. This also triggers the demand for sustainable investment.

Research on ESG and, more specifically, on ESG bonds is still nascent but fastgrowing. It can be subdivided into three main fields³: namely, the pricing and the returns/spread of green bonds (which our study leans on), the determinants of the green bond returns/spread, and descriptive studies on the development of the green bonds markets. For the African continent, the latter category is most common.

Piñeiro-Chousa et al. (2021) highlight the fact that studies have empirically assessed the effects of the label "green" from three perspectives: that of the investors' (demand side), the issuers (supply-side), and both supply and demand. A growing number of studies focus on financial returns. Most document higher-than-expected financial performance and lower risks for companies that issue green bonds compared to conventional bonds (Krueger et al., 2020; Hartzmark & Sussman, 2019).

Flammer (2021) presents three main reasons for green bond issuance; i.e., signaling, greenwashing and cost-of-capital savings on the issuer's side. In the first argument, corporate bond issuance acts as a signal for a company's commitment to environmental protection and environmentally friendly investors are more likely

³ See MacAskill et al. (2021) for an extensive review of the literature on green bond premium determinants.

to respond to such issuances. When greenwashing is the motive, bond issuers make misleading claims about the company's contribution to the environment during the issue process. Finally, green bonds are considered cheap sources of capital if investors are willing to trade financial benefits for social benefits. Similar arguments are expressed in Gilchrist et al. (2021) who also stress that investments in green projects provide an insurance hedging strategy for environmental risks and help build a reputation that increases corporate social capital. Investors in green bonds are not only driven by market returns but also environmental and responsible considerations (Bertelli et al., 2021).

Studies examining green bond returns compared to synthetic conventional bonds are mainly focused on whether green bond issuers gain a premium or so-called "greenium"⁴ compared to their conventional peers in both primary and secondary markets. Ehlers and Packer (2017) find that there is a green premium compared to conventional bonds in the primary market but this difference changes over time with similar performance in the secondary market. Zerbib (2019) compares the pricing of green and conventional bonds by matching every green bond with two conventional bonds on the secondary market between 2013 and 2017. He studies the two bond variants using their features, for example, coupon, collateral, currency, ratings, bond seniority, and character. Findings from this latter study show a significant greenium of green bonds when compared to matched conventional bonds. Taghizadeh-Hesary et al. (2021) comparatively assess the effects of green bond characteristics on financing. Using data from the Bloomberg and Climate Bonds initiative, they assess the returns of green bonds in Asian and Pacific countries and find that green bonds are associated with higher returns but also higher volatility.

Research on the pricing of green bonds is dominated by US studies. For instance, Karpf and Mandel (2018) match a large dataset of 1880 green municipal bonds with 36,000 conventional bonds of the same issuers in the secondary market from 2010 to 2016. Their results show no greenium until the year 2016 when they identify a spread of 23 basis points (bps). Using 2083 municipal green bonds and 643,299 conventional bonds issued in US primary markets between 2010 and 2016, Baker et al. (2018) identify a higher premium associated with green bonds.

Partridge and Medda (2018) also match municipal green bonds with conventional bonds in the US, which were issued at the same time, and find a growing trend of the green premium in both primary and secondary markets. Using a worldwide bond universe that matches green bonds with conventional bonds from 2007 to late 2019, Löffler et al. (2021) find that there is a negative premium associated with green bonds of about 15–20 bps compared to conventional bonds in the primary and secondary market. In a study of 121 Euro-nominated green bonds using propensity score matching, Gianfrate and Peri (2019) determine a greenium of 18 basis points—with a higher greenium for corporate issuers.

Parallel to the increasing evidence from US issuances, there is also a growing literature on green bond pricing in developing and emerging markets. Wang et al. (2020) compare pricing of conventional and green bonds in an emerging economy

⁴ Greenium stands for green bond discount in contrast to premium.

Year	Number	Billion USD	Africa (%)	Africa (%)
2015	309	41	0.32	1.23
2016	275	94	1.45	0.74
2017	524	168	1.34	0.63
2018	683	184	1.02	0.37
2019	1178	347	1.19	0.50
2020	1514	434	0.40	0.33
2021	3026	897	0.79	0.43
2022	2613	766	0.80	0.28
2023q2	1554	522	0.45	0.17

Table 1Global ESG bondissuances and African shares

Source: Eikon Refinitiv ESG bond guide. Notes: Social bonds excluded. 2023 until July (q2). Column (4) shows the African share in the number of global ESG-bond issuances, and column (5) shows the African issuance volume share

(China) by issuer type—namely, first-time, corporate social responsibility (CSR) issuers, and underwriters. They identify a significant green bond premium for new issues from CSR issuers and those held by long-term institutional investors. Chiesa and Barua (2019) investigate the determinants of bond size and the differences among determinants using a 771 green bond issuance sample in the emerging and non-emerging countries for the period 2010–2017. Their findings show that coupon rates, ratings by credit rating agencies, collateral, sector of issuance, and financial health of the issuer all positively affect the size of the green bond issue, and that these findings are more pronounced in emerging economies.

2.1 The development of bond markets and the potential of green bonds in Africa

African bond markets are in a rather infant stage (Allen et al., 2011). Kodongo et al. (2023) note that bond markets in Africa can be considered illiquid, thinly traded, and dominated by government bond issuance. Table 1 shows that for 2022, the share of African bonds in terms of issuance was 0.8% whereas the share in terms of issuance volume was less than 0.3%.⁵ While the number and volume of global ESG bonds have increased since 2015, the share of African ESG bonds is declining both in terms of numbers and issuance volume.

Green bonds are relatively new financial products in the African financial markets. The first green bond issuance occurred in 2010 (Taghizadeh-Hesary et al., 2021) but most African countries have not been active participants in the green bond markets. The African Development Bank (AfDB) has been a key issuer of green bonds in Sub-Saharan Africa. Several African countries, such as Kenya, Morocco, Nigeria, and South Africa, have also started to issue sovereign green bonds for

 $^{^5}$ These figures are confirmed in Tyson (2021) who report that only 1.5% of total global bond issuances are of African origin. Those account for only about 0.3% of the global market capitalization.

climate-related purposes. Marbuah (2020, p. 11) describes the state of the green bond market in Africa and notes that the African green bond market is relatively small. By 2019, green bond issues totaled USD 2 billion from governments, cities/ municipalities and corporate issuers (supranational issues are excluded from this figure). In total, there have been 17 green bond issuances from Egypt, Kenya, Mauritius, Morocco, Nigeria, Seychelles and South Africa.

Government and multilateral development banks are dominant issuers of green bonds in Africa. In particular, the AfDB remains pivotal. The AfDB has been one of the most important issuers in Africa with about USD 500 million green bond issuances since 2010 (Duru & Nyong, 2016). Most buyers are domestic investors who acquire the bonds through private placements or public offerings on domestic exchange markets. International investors are very reluctant to invest in these bonds because of higher perceived risks relative to other developing and emerging economies (Tyson, 2021). Short maturities also characterize these markets. Banga (2019) notes that despite the fast-growing market for green bonds in developed countries, only a few African investors and governments have non-conventional green bonds. However, the funds raised through green bond issuance in Africa exceed the ones from other climate fund sources. About USD 3.4 billion has been raised from the Climate Funds Initiative from 2002 to 2014 (Duru & Nyong, 2016).

2.2 Pricing of green bonds

Financial industry reports pioneered the assessment of pricing of green bonds vis-àvis their conventional bond peers. The Barclays study by Bakshi and Preclaw (2015) uses option-adjusted spreads to measure pricing differences between conventional and green bonds. The study employs credit rating, spread duration, and time since issuance as proxies for credit risk, liquidity premium, and investment lengths. The results reveal a 17-bps premium for green bonds. In contrast, the later Bloomberg study of Shurey (2017) reveals a negative premium, whereas the CBI study of Harrison (2017) identifies an even higher premium for green bonds.

Subsequent academic literature has also attempted to assess pricing differences between green and conventional bonds, and most of them use matching methods and regressions. These studies range from global to country to sub-regional. Hachenberg and Schiereck (2018) conduct a global study analyzing 63 matched pairs of bonds, over a period of 6 months between 2015 and 2016 in the secondary market. They examine the spread between green and similar conventional bonds and identify a negative premium of 1-18 bps.

Bachelet et al. (2019) compare, on a global scale, green and brown bonds issued in the secondary market during the period 2013–2017. Results from propensity score matching combined with regressions reveal both positive and negative premia for different investors. Specifically, institutional investors obtained negative premia whereas private issuers received positive premia compared to their traditional bonds' correspondents. Analyzing differences in prices of green and brown bonds in the global secondary market from 2015 to 2016, Nanayakkara and Colombage (2019) assess whether investors are willing to pay a premium on green bonds vis-à-vis conventional bonds. They conclude from their panel regressions that green bonds were traded at a higher spread of 62.7 bps. Fatica et al. (2019) perform panel data regressions and find that, compared to conventional bonds, green bonds enjoy a premium, particularly those that were issued by corporate and supranational organizations. Bertelli et al. (2021) argue that the literature on the pricing and determinants of a green premium vis-à-vis conventional bonds is fast growing but remains inconclusive.

Tang and Zhang (2020) match a pair of green and conventional bonds in a worldwide sample from 2007 and 2017. They use matching, difference-in-difference, and regression models and employ control variables to examine yield spread between the green and conventional bonds. They find that green bonds are issued at a yield discount of 6 bps lower than conventional bonds from the same issuers. A worldwide study of bonds from 2007 to 2019 in primary and secondary markets, which also matches conventional and green bonds, shows a greenium of 15–20 bps (Löffler et al., 2021). The results also show that green bonds with large issue amounts enjoy a higher greenium. Gianfrate and Peri (2019) use a PSM approach matching 121 senior green bonds from 2013 to 2017. Their results show that issuers gained a greenium of 18 bps. The greenium was as large as 21 bps for corporate issuers. Noncorporate issuers, such as government entities and municipalities, gained more in the secondary market.

Specific country studies on the pricing of green bonds are also emerging. Zerbib (2019) uses a sample of 110 British green bonds from the secondary market for the period 2013–2017. Using matching and a two-step regression approach, the study compares the yield spreads between conventional and green bonds. The results show a negative premium of 2 bps. Greater premia emerge for financial firms and low-rated bonds. The results also indicate that sector issuer and ratings drive premium. Wulandari et al. (2018) assess the credit spread (difference between green bond yield and government bond yield) of 64 bonds in the UK's secondary market during the period 2013–2016. Their fixed effects regression revealed a negative premium of 69.2 bps.

In another study with primary market data, Karpf and Mandel (2018) examine US municipal green bonds in the secondary market. Using a sample of 1880 municipal green bonds matched with 36,000 conventional bonds from the same issuers from 2010 to 2016, they examine the yield curve of green bonds and find a greenium of 7.8 bps. Larcker and Watts (2019) study differences in prices between conventional bonds and municipal green bonds in the US primary market from 2013 to 2018. They find a very small green bond market yield difference of 0.45 bps and no difference at issue price of the matched sample. In a study of the US primary and secondary market, Partridge and Medda (2020) analyze matched pairs of green and conventional bonds from 2014 to 2018. The matched pairs were similar in terms of issuance date, same issuer, maturity, coupon, and use of proceeds. The results reveal a significant premium of 5 bps in the secondary market and significant differences in greenium in the primary market matches. Ostlund (2015) examines the yield spread between conventional and green bonds of the same issuers in Sweden and find no evidence of a greenium. Instead, green bonds were traded at a discount compared to their brown peers. Bour (2019) uses

yield spread to assess whether there is a greenium between green and similar conventional bonds. Results from this study show a green bond yield discount of 23.2 bps and that bond ratings, issue currencies, and issuer sectors led to variations in green premiums.

2.3 Certified bonds and other green bonds

Greenwashing is a prevalent risk for investors. Immature markets may be particularly prone to fall victim to greenwashing activities. Credibility is likely to determine the bond premia in such markets. Formal certification is the most common way of gaining credibility, and thus, it might make a difference that is neglected if simply conventional versus green bonds are evaluated. In a global study, covering the period 2010–2017, Hyun et al. (2020) use liquidity-adjusted yields to investigate the pricing differences between green and conventional bonds in the secondary market. They find neither a significant yield premium nor a discount on green bonds in general. However, there were pricing differences on bonds depending on external reviewer certification. It increased the green bond premium by 6 bps and those certified by the Climate Bonds Initiative (CBI) had a 15-bps discount.

Kapraun et al. (2021) use a sample of 1500 green bonds issued worldwide to compare the yield differences between green and conventional bonds. They detect a significant greenium of between 20 and 30 bps for green bonds. Moreover, their research indicates that green certifications increase the greenium.

Baker et al. (2018) examine the after-tax yields of US municipal green and conventional bonds in the primary market between 2010 and 2016. They identify a greenium discount of 6 bps. The premium increased with external certification.

Using Chinese primary market data, Wang et al. (2020) use credit spreads to study pricing differences between green and conventional bonds. By applying matching techniques, they identify a green bond premium. They specifically discover a greater premium for issuers who have a strong social reputation and lower ownership concentration of institutional investors. The evidence provided by these very few studies differentiating among green bonds also suggests that ESG bonds are more likely to display a greenium than self-labeled green bonds.

Flammer (2021) examines how stock markets react to green bond issuance. Here, the results show that stock markets significantly respond to green bond issuance with abnormal returns of 0.49%—particularly those that are certified by independent agencies.

Fatica et al. (2021) assess the pricing of green bonds on the primary market. Specifically, they assess the determinants of green bond yields in new issuances. Using a worldwide sample of green bonds from 2007 to 2018, results from this study show that there are green bond yield heterogeneities (premium) among issuers from supranational organizations and corporate issuers (particularly those from developed compared to emerging markets) giving higher premiums. They also find that green bonds that are externally reviewed and those issued by return

issuers gain a premium compared to first-time issuers. Their study suggests that simply labeling bonds as green is inadequate to raise funds at lower costs.

3 Methodology

3.1 Data sources

Data for this study has been obtained from the Thomson Reuters Refinitiv and Datastream databases. The data contains 107 ESG bonds of 42 African issuers and about 2150 conventional bonds from the same issuers. This allows us to directly compare ESG and conventional bonds, as the characteristics of the issuer, like default risk, will be the same for the two bond types.

We excluded social bonds from the sample because many of them were issued in response to the COVID pandemic. The group of ESG bonds includes CBI-certified climate bonds, CBI-aligned climate bonds as well as sustainability and sustainability-linked bonds. There are also a few self-labeled green bonds in the group of ESG bonds. *Yield* and *option-adjusted spread* are our main variables of interest and available as time series for the period 2015q1 to 2023q2, which makes 35 quarters in total.

3.2 Estimation approach

Previous research has used propensity score matching (PSM) or coarsed exact matching (CEM) to create a comparison group comprising conventional bonds that are most similar to green bonds. In contrast, in this paper, we base the analysis on quantile treatment effect regressions estimated using recentered influence functions (RIFs) (Firpo et al., 2009; Rios Avila, 2019). This approach has several advantages for our empirical analysis compared to a traditional OLS-based treatment effect analysis. First, quantile regressions are more robust and less affected by outliers than OLS, which is an advantage considering that the yield of African bonds is very volatile with the occurrence of extreme observations. Second, RIF regression allows us to study the effects of variables at different quantiles of the yield distribution and not only at the conditional mean. Also, RIF-based regressions allow for an analysis of other statistics, for example, the standard deviation of yields, which is interpreted as volatility of the bond yield. Third, in contrast to traditional conditional quantile regression, RIF quantile regression easily enables the inclusion of multiple fixed effects in the regression models, which is more difficult in the traditional models. Fourth, RIF quantile regression is easy to use and fast in computation. Fifth, RIF regressions can be used to obtain treatment effects related to a distributional statistic, such as the median, by applying inverse probability weights in the estimation (Firpo et al., 2018; Rios-Avila, 2020), which is utilized in our study.

The estimation equation can be written as follows:

$$y_{it} = \alpha + \beta_1 ESG \text{ bond type}_i + \beta_2 X_{it} + \lambda_t + \mu_i + \epsilon_{it}, \tag{1}$$

where y_{it} denotes either yield (YTW) or spread (OAS) for bond *i* in period *t*. ESG bond type is a categorical variable that describes whether a bond is an ESG bond or not, and if it is, which category it belongs to, for example, a CBI-certified or sustainability-linked bond. This is our main variable of interest and is represented in the model by the inclusion of dummy variables—one for each category. Therefore, the analysis resembles a treatment effect analysis where ESG bond type affects the bond's yield and volatility. X contains continuous control variables, which are coupon rate, time to redemption, and issuance volume. λ_t are fixed period (quarter) effects, while μ_i summarizes several fixed effects: issuer fixed effects, seniority rank and currency fixed effects as well as coupon-class fixed effects.

In our analysis, we interpret the results of the categorical variable *ESG bond type* showing the difference to the weighted average of all categories including the non-ESG bonds.⁶ Instead of using matching approaches as previous studies have done (see Sect. 2.2), the main identification strategy of this paper is based on using only bonds of the same issuer, which implies comparing ESG and conventional bonds of the same issuer. This is meaningful, as one of the major determinants of a bond yield can be the default risk, and this is related to the issuer. However, other features of bonds may affect the yield, such as seniority rank and time to redemption, as well as the coupon rate. These are essential control variables specified in the regression models.

In the second set of estimations, the RIF regressions replace the original dependent variables with their numerical RIF values. This allows us to model the influence of independent variables on the distribution of a function of the dependent variable represented by its RIF (Firpo et al., 2009). In our analysis, we specify the q50 (median), q5, and q95 quantiles computed as RIFs of the dependent variables, and we include the volatility (standard deviation) of the dependent variable. It is worth noting that RIF regressions also have limitations. RIF regressions are linear approximations of non-linear functions. Furthermore, RIF regression estimates provide average marginal effects, corresponding to infinitesimal small-scale shifts of the respective explanatory variable. Finally, using RIF as a dependent variable implies an unconditional regression interpretation of estimation results, whereas traditional regression models provide conditional estimation (Firpo et al., 2018). Despite these limitations, RIF regression has also several advantages as mentioned above. It is fast to compute and does not have any computational difficulties even if high-dimensional fixed effects are included. Furthermore, the RIF quantile regression results are robust and not affected by single outliers.

⁶ The dummy variables have been transformed so that the weighted average over all categories becomes the reference (see Haisken-DeNew & Schmidt, 1997; Rios-Avila & de New, 2022).

Variable	Description
Yield to worst (YTW)	Defined as the interest rate that will make present value of the bond's cashflows equal to its price plus accrued interest at the earliest redemption date. YTW is the lower bond of the yield that an investor will earn on the bond
Option-adjusted spread (OAS)	Spread to benchmark rate including adjustments if the bond is callable
Bond proceeds	Describes the purpose of the bond proceeds
Coupon rate	Yearly coupon rate of bond issue expressed in percentage points
Coupon type	Coupon type is a dummy variable equal to 0 if the issue has fixed type of coupon and 1 for floating rates
Domicile of issuer	Defined as the domestic country of the issuer of the bond
ESG bond type	Categorical variable describing the type of ESG bond, for definitions, see Table $\frac{3}{2}$
Issuance amount and currency	Issuance amount in USD and the issuance currency of the bond
Time to redemption	Measured in days as the difference of current date and redemption date, expressed in years
Seniority rank	Normalized payment rank of the bond where 1 equals Secured, 2 equals Senior unsecured, 3 equals Unsecured
Sector of issuer	Defined as the sector of business of the issuer of the bond

 Table 2
 Variables description

Sources: Thomson Reuters Refinitiv + Datastream database

Table 3African ESG-bondclassifications	ESG-bond type	Freq	Percent
	CBI certified green bond	24	22.4
	CBI aligned green bond	48	44.9
	Self-labeled green bond	16	15.0
	Sustainability bond	10	9.3
	Sustainability linked bond	9	8.4
	Total	107	100
	Description sub-categories of	107 issued African	ESG bonds.

Description sub-categories of 107 issued African ESG bonds. Source: Eikon Refinitiv ESG bond guide *CBI* climate bond initiative

3.3 Definition and measurement of variables

Table 2 contains the definitions of the variables we employ in the analysis. The two dependent variables of our analysis are yield to worst (YTW) and option-adjusted spread (OAS). While *YTW* is a conservative measure of the lowest yield an investor will earn (until the earliest possible redemption date), *OAS* gives the spread of the bond yield relative to a benchmark rate, typically the risk-free rate, considering embedded options of the bond (e.g., being callable and the interest rate sensitivity of the respective bond). OAS should be directly comparable between different bonds

 Table 4
 African ESG-bond
 ESG-bond issuer type Freq Percent issuer type 72 67.3 Corporate Govt/treasury/central bank 7 6.5 Other gov/supranational organizations 26 24.3 Cities/municipalities 1.9 2 Total 107 100

Description of issuer types. Source: Eikon Refinitiv ESG bond guide

 Table 5
 African ESG-bond issuance amount by issuer sector (mill USD)

TRBC sector	Ν	Mean	Sum	Min	Max
Banks (NEC)	41	158	6480	6.7	842
Business support services	3	276	828	28	400
Commercial REITs	8	25	199	8	55
Corporate banks	7	43	301	3.7	111
Corporate financial services	10	409	4088	325	475
Diversified REITs	3	26	77	22	28
Electric Utilities	2	500	1000	500	500
Government and government Finance	2	750	1500	750	750
Government administration	1	250	250	250	250
Heavy machinery	2	30	61	17	43
Investment holdings	4	518	2070	50	535
Investment management and fund operator	1	174	174	174	174
Public finance activities	7	187	1307	14	561
Renewable IPPs	4	382	1526	363	400
Solar electric utilities	6	421	2528	350	500
Water supply and irrigation systems	2	32	64	32	32
Wind electric utilities	4	875	3500	750	1000
Total	107	243	25,954	4	1000

TRBC sector. Source: Eikon Refinitiv ESG bond guide

and also proportional to the level of risk that the bond has relative to the risk-free rate. The higher the OAS, the higher the risk of the respective bond.

4 Results

4.1 Descriptive results

Table 3 reports the various types of the sample of 107 African bonds. According to the Thomson Reuters Refinitiv ESG bond guide, this sample constitutes the

Year	N	Mean	Sum	Min	Max
2010	9	31	277	6.7	70
2013	1	500	500	500	500
2014	3	92	276	81	98
2015	1	500	500	500	500
2016	4	304	1218	96	500
2017	7	290	2033	14	500
2018	7	97	679	3.7	500
2019	14	225	3152	18	535
2020	6	421	2524	174	750
2021	28	362	10,146	6.9	1000
2022	21	159	3341	8	750
2023a	6	218	1308	51	400
Total	107	243	25,954	3.7	1000

a Until Q2 2023. Source: Eikon Refinitiv ESG bond guide

Domicile	Ν	Mean	Sum	Min	Max
Benin	2	561	1123	561	561.4
Egypt	2	750	1500	750	750
Ivory Coast/Cote d'Ivoire	23	136	3128	6.7	500
Maldives	1	250	250	250	250
Mauritius	32	485	15,512	325	1000
Morocco	1	14	14	14	14
Namibia	2	8.1	16	3.7	13
Nigeria	5	55	277	13.8	174
Seychelles	1	15	15	15	15
South Africa	34	51	1736	6.9	300
Togo	4	596	2384	350	842
Total	107	243	25,954	3.65	1000

Source: Eikon Refinitiv ESG bond guide

entire universe of existing ESG bonds for Africa. About 23% of those bonds are CBI-certified and almost 45% are CBI-aligned. Sustainability and sustainability-linked bonds constitute only about 18% of all ESG bonds, and the group of self-labeled green bonds is 15% of ESG bonds.

Table 4 shows the various issuer types of African ESG bonds. Most bonds are issued by corporations (about two-thirds), whereas the AfDB, as a supranational organization, has issued 26 ESG bonds in total. The remaining ESG bonds have been issued by governments (e.g., Egypt, Nigeria) or by municipalities.

The ESG-bond issuer sector and also the issued amounts are reported in Table 5. Most of the bonds are issued by banks or corporate financial services including

 Table 6
 African ESG-bond

issuance amount by issuance year (mill USD)

 Table 7
 African ESG-bond

 issuance amount by domicile of

issuer (mill USD)

Table 8African ESG bonds'use of proceeds

Table 9African ESG-bondissuance amount (in mill USDby issuance currency)

Use of proceeds	Freq	Percent
Access to essential services	6	5.6
Alternative energy	1	0.9
Aquatic biodiversity conservation	6	5.6
Clean transport	14	13.1
Climate change adaptation	11	10.3
Commercial paper backup	1	0.9
Eligible green projects	14	13.1
Energy efficiency	34	31.8
General purpose	4	3.7
Green construction/buildings	2	1.9
Land preservation	1	0.9
Renewable energy projects	9	8.4
Sustainable development projects	1	0.9
not available	3	2.8
Total	107	100.0

Description of the purpose of 107 issued African ESG bonds. Source: Eikon Refinitiv ESG bond guide

Issuance currency	N	Mean	Sum	Min	Max
Australian dollar	6	46	277	8	96
Brazilian real	2	7.2	14	6.7	7.7
Euro	4	702	2807	561	842
Moroccan dirham	1	14	14	14	14
Namibian dollar	2	8.1	16	3.7	13
New Zealand dollar	3	44	133	30	70
Nigerian naira	3	18	53	14	19
Norwegian krone	1	199	199	199	199
South African rand	32	39	1236	7	111
Swedish krona	7	129	904	98	196
Swiss franc	1	174	174	174	174
U.S. dollar	45	447	20,127	15	1000
Total	107	243	25,954	3.7	1000

Source: Eikon Refinitiv ESG bond guide

investment holdings, where the second most frequent ESG-bond issuer sector is the renewable energy and utilities sector.

The development of ESG-bond issuance in Africa is shown in Table 6. One can note an increasing trend in issuance frequency and issuance volume (for the year 2023 the figures include only the first and second quarters). The domicile of ESG-bond issuers is shown in Table 7. The three most frequent domiciles of ESG-bond issuers are South Africa, Mauritius and Ivory Coast. The latter can be explained by

	n	Mean	sd	p5	p50	p95
Non-ESG bond						
Yield (%)	18,085	9.71	5.31	1.07	9.03	19.5
OAS (bps)	3,924	340.1	367.9	-19.6	216.4	1126.7
Coupon rate (%)	18,085	7.47	4.98	0	7.61	15.6
Issuance in USD (log)	18,085	15.3	2.76	10.8	15.5	20.2
Time to redemption	18,085	3.17	3.33	0.19	2.36	8.10
CBI aligned green bond						
Yield (%)	468	5.58	4.38	0.38	5.07	12.0
OAS (bps)	270	323.0	265.9	6.08	306.3	785.3
Coupon rate (%)	468	4.35	3.23	0.25	4.88	10.2
Issuance in USD (log)	468	16.4	2.28	11.7	16.9	19.5
Time to redemption	468	3.44	2.20	0.64	3.31	7.75
CBI certified green bond						
Yield (%)	235	7.11	3.44	3.27	5.80	14.7
OAS (bps)	104	472.2	275.0	208.8	357.2	1097.8
Coupon rate (%)	235	6.40	2.51	3.58	5.65	13.5
Issuance in USD (log)	235	16.2	1.53	13.1	16.8	17.5
Time to redemption	235	2.58	1.18	0.77	2.63	4.35
Self-labeled green bond						
Yield (%)	73	8.33	2.60	3.74	8.66	12.2
OAS (bps)	42	405.6	188.6	99.1	402.7	693.4
Coupon rate (%)	73	7.90	3.76	4.25	6.25	14.5
Issuance in USD (log)	73	14.6	1.84	11.9	14.3	16.6
Time to redemption	73	3.91	1.47	2.16	3.69	6.12
Sustainability bond						
Yield (%)	46	6.60	2.73	2.21	6.48	10.3
OAS (bps)	27	373.6	185.2	187.5	314.9	740.3
Coupon rate (%)	46	4.95	2.53	2.75	4.95	9.41
Issuance in USD (log)	46	15.8	2.84	13.6	13.8	19.6
Time to redemption	46	7.70	2.12	3.35	8.40	9.79
Sustainability linked bond						
Yield (%)	32	8.66	1.68	5.87	8.95	11.0
OAS (bps)	1	248.4	-	248.4	248.4	248.4
Coupon rate (%)	32	10.1	0.22	9.88	9.96	10.3
Issuance in USD (log)	32	13.2	0.39	12.7	13.1	13.8
Time to redemption	32	2.43	0.94	0.95	2.43	4.03
Total						
Yield (%)	18,939	9.56	5.30	0.99	8.95	19.4
OAS (bps)	4,368	343.0	358.8	- 14.2	236.7	1103
Coupon rate (%)	18,939	7.37	4.93	0	7.38	15.6
Issuance in USD (log)	18,939	15.3	2.74	10.8	15.6	20.1

 Table 10 Descriptive statistics of yields and option-adjusted spreads of African ESG and non-ESG bonds (bond-quarter observations)

Table TO (continued)						
	n	Mean	sd	p5	p50	p95
Time to redemption	18,939	3.18	3.29	0.19	2.41	8.13

Table 10	(continued)
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the presence of the AfDB, whereas the first is an indication that fixed-income markets in South Africa are, by far, more developed compared to most other countries in Africa

Table 8 reports results on the usage of proceeds from the 107 ESG-bond issuances in Africa. A big part of the proceeds go to energy efficiency, green projects and clean transport. Some portion of the proceeds (8%) also go to renewable energy projects. This shows the commitment of issuers to mitigate climate change. Furthermore, a few bonds are used for biodiversity conservation.

Table 9 reports the currency of issuance of the green bonds. In many of the issuances, foreign bookmakers or managers are involved. Green bonds' issuance in Africa is dominated by a few currencies. A large portion of the issuance is in US dollar (in total 20,127 million USD) followed by the Euro (2,807 million USD), South African Rand, and Swedish Krona. Issuances in local currencies are on average much smaller-for instance, in the Namibian dollar or Moroccan Dirham. This shows that one of the purposes of issuing ESG bonds is to attract foreign investors who aim to increase the share of green assets in their total assets.

Table 10 reports summary statistics based on a quarterly time series of the 2 dependent (yield (YTW) and spread (OAS)) and the 3 main independent variables (coupon rate, issuance volume and time to redemption) by ESG-bond type. Concerning yield, CBI-aligned bonds have the lowest average yield and a lower OAS, even lower compared to CBI-certified bonds. Similarly, sustainability bonds have a lower yield but higher OAS compared to sustainability-linked bonds. These ESG bonds have, in general, lower yields and lower spreads compared to non-ESG bonds.

4.2 Regression results

Table 11 (dependent variable YTW) and Table 12 (dependent variable OAS) display the regression model results. The first columns show the results for OLS estimations, including several fixed effects (issuer, quarter, rank seniority, coupon class, and currency) whereas the remaining columns show the results of RIF quantile regression estimations using various RIF functions. Column (2) displays the results for the median (RIF(p50)), column (3) shows the results for the 5% percentile, and column (4) produces the results for the 95% percentile. Column (5) reports the results for the standard deviation of the dependent variable, which is interpreted as volatility. The reference category for all models is the weighted average of all bonds.⁷ The estimations in Table 11 are based on quarterly time-series of 2261 bonds over the period 2015q1–2023q2 and 18,939 bond-quarter observations in total. Table 12 is based

⁷ See Rios Avila (2019).

vith multiple fixed effects					1
Dep variable: yield (%)	(1) OLS	(2) RIF(p50)	(3) RIF(p5)	(4) RIF(p95)	(5) RIF(std)
Conventional non-ESG bond	0.216 (0.80)	1.424^{***} (8.76)	- 0.291 (- 0.56)	3.478^{***} (3.74)	0.897 (1.34)
Self-labeled green bond	-0.0663 (-0.32)	- 0.224 (- 0.39)	0.994(0.71)	-0.176 (-0.08)	- 0.936 (- 1.49)
CBI certified green bond	$-1.422^{***}(-11.91)$	$-2.024^{***}(-9.18)$	0.273 (0.69)	-1.636(-0.95)	- 0.792*** (- 3.77)
CBI aligned green bond	0.363(0.77)	- 0.417 (- 1.63)	- 0.407 (- 0.46)	- 2.308** (- 2.02)	- 0.803 (- 0.68)
Sustainability bond	0.173(0.62)	- 0.357 (- 0.53)	2.615* (1.78)	$-5.816^{***}(-8.64)$	$-2.010^{***}(-3.77)$
Sustainability linked bond	$-0.480^{**}(-2.16)$	- 0.562 (- 0.79)	0.0360(0.04)	- 3.428** (- 2.10)	$-0.650^{***}(-3.04)$
Coupon rate (%)	0.129^{***} (4.34)	0.0767^{***} (2.92)	$-0.151^{**}(-2.31)$	- 0.269** (- 2.13)	$0.0569^{**}(2.11)$
ssuance in USD (log)	$0.147^{***}(3.84)$	$0.119^{***}(2.74)$	0.0172(0.15)	0.0542(0.48)	- 0.0210 (- 0.61)
Time to redemption	0.0829^{***} (4.08)	$0.0614^{**}(2.53)$	$0.249^{***}(3.51)$	$-0.166^{***}(-2.75)$	$-0.112^{***}(-6.30)$
Observations (bond-year)	18,939	18,939	18,939	18,939	18,939
Adjusted R^2	0.816	0.633	0.509	0.320	0.461
Vo of bonds	2261	2261	2261	2261	2261
Sample RIF mean	Ι	7.816	0.765	15.99	5.247
Dependent variable is yield to w he YTW median, while RIF(p5)	vorst (YTW) and derived RIF and RIF(p95) are regressions	measures. YTW winsorized on the 5% and the 95% per-	1 at 2.5 and 97.5% for mod centiles of the YTW. RIF(st	els (1) and (5). RIF(p50) is d) is a regression on the stan	a quantile regression on idard deviation of YTW.

Table 11 Panel regression results on risk and return of African bonds, dependent variables yield to worst (YTW) and several RIF functions of YTW, regression models

Cluster robust (bond-level) t statistics in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01. Fixed effects included (absorbed): issuer (df = 41), period (df = 35), rank seniority (df = 5), coupon class (df = 3), and issuance currency (df = 21). The estimations have been carried out with the user-written Stata command rithdreg, see Rios-

Avila (2020)

Dep variable: OAS (bps)	(1) OLS	(2) RIF(p50)	(3) RIF(p5)	(4) RIF(p95)	(5) RIF(std)
Conventional non-ESG bond	43.16*** (3.49)	- 9.247 (- 0.30)	22.15 (0.73)	267.6*** (8.09)	40.50*** (4.09)
Self-labeled green bond	-223.4^{***} (-6.47)	- 77.51 (- 1.07)	14.59(0.13)	-776.9***(-6.03)	$-174.6^{***}(-4.86)$
CBI certified green bond	- 68.44*** (- 3.23)	- 278.5*** (- 8.55)	$61.45^{**}(2.58)$	-510.9***(-6.41)	- 195.1*** (- 11.62)
CBI aligned green bond	- 1.790 (- 0.12)	167.4^{***} (4.30)	- 76.97* (- 1.87)	58.90 (1.26)	52.55*** (4.27)
Sustainability bond	- 13.24 (- 0.48)	- 157.3*** (- 3.65)	96.69^{***} (5.14)	- 202.8*** (- 3.22)	- 81.50*** (- 3.14)
Sustainability linked bond	- 165.5** (-2.12)	$-394.1^{**}(-2.11)$	66.70*** (4.68)	- 708.3*** (- 7.29)	- 207.1*** (- 9.59)
Coupon rate (%)	36.07^{***} (3.13)	18.53 (1.19)	13.43*(1.93)	72.97*** (3.22)	20.91^{***} (3.89)
Issuance in USD (log)	- 13.86** (- 2.46)	- 27.67*** (- 2.77)	- 15.91** (- 2.13)	4.722 (0.42)	10.80^{***} (3.23)
Time to redemption	2.267 (1.12)	1.901 (0.62)	- 6.463** (- 2.11)	- 3.232 (- 0.81)	2.149 (1.61)
	(61.59)	(40.36)	(-0.70)	(90.97)	(88.44)
Observations	4368	4368	4368	4368	4368
Adjusted R ²	0.755	0.677	0.434	0.260	0.424
No of bonds	284	284	284	284	284
Sample RIF mean	I	244.9	- 3.525	962.2	336.6

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Rios-Avila (2020)

rank seniority (df = 1), coupon class (df = 1), and issuance currency (df = 16). The estimations have been carried out with the user-written Stata command rithdreg, see

Outcome variable: yield					
	(1)	(2)	(3)		
Treatment effect at lower quartile	- 0.843*** (- 7.41)	- 0.664*** (- 6.88)	- 0.336** (- 2.19)		
Treatment effect at the median	- 1.341** (- 2.04)	0.248 (1.00)	0.447** (2.42)		
Treatment effect at upper quartile	- 3.159*** (- 4.62)	3.070 (1.51)	0.325 (0.22)		
Observations	18,939	18,939	18,939		

 Table 13
 Robustness test: quantile treatment effect (QTE) of ESG bond type on yield

Normal-bootstrap (with 999 replications) *t* statistics in parentheses *p < 0.10, **p < 0.05, ***p < 0.01. Treatment definitions: column (1) CBI *certified*, column (2) CBI certified or aligned, column (3) ESG bond (all types). Same control variables as in Tables 11 and 12. Fixed effects included (absorbed): issuer (df = 41), period (df = 35), rank seniority (df = 4), coupon class (df = 2), and issuance currency (df = 21). The estimations have been carried out with the user-written Stata command rqr, see Borgen et al. (2021a)

on a significantly lower number of bonds and only 4368 bond-quarter observations in total. The reason is that OAS is only available for a smaller fraction of bonds and also more often in later quarters whereas it is missing for earlier quarters.

Table 11 highlights that CBI-certified bonds have a significantly lower yield both in terms of mean but also in terms of median compared to non-ESG bonds. The estimate indicates a difference of more than 200 bps to the average yield of all bonds. CBI-certified bonds also have lower yield volatility compared to their non-ESG counterparts. In contrast, self-labeled green bonds are not significantly different from non-ESG bonds in all tested models. This implies that the risk of greenwashing exists and that certification is an instrument to mitigate this risk. Therefore it plays an important role in creating benefits for both issuers and investors. Sustainable and, in particular, sustainability-linked bonds have lower yields and lower volatility compared to conventional bonds. However, overall the differences are smaller compared to CBI-certified and CBI-aligned bonds. Interestingly, the results are significant for the upper tail of the yields, whereas there is less difference at lower tails. This means the effects are strongest for high-yield bonds, and thus, benefits occur for issuers of bonds with high yields. The control variables have expected signs. Higher coupon rates are correlated with higher yields, whereas a longer time to redemption implies also higher yield (term structure). The issuance volume is also positively related to the yield, at least for the mean and median.

Table 12 shows the estimation results for OAS, i.e., the spread over the benchmark rate. The lower the OAS, the lower the risk premium of the bond. Overall, the results of Table 12 confirm the results of Table 11 with a few subtle differences. CBI-certified bonds have a significantly lower OAS both at the mean and the median (again, more than 200 bps) as well as lower volatility (column (5)), whereas CBIaligned bonds have a higher OAS and also higher volatility than conventional bonds. The two types of sustainability bonds have similar benefits as CBI-aligned bonds, whereas self-labeled green bonds appear to have significantly lower OAS volatility and also significantly lower OAS at the mean in comparison to their conventional counterparts. In contrast to Table 12, we also find that CBI-certified and the two types of sustainability bonds have a positive impact on the lower 5% tail OAS, whereas the impact on the 95% upper tail is negative. Overall, this means a reduced downside risk of the spread, and therefore, those bonds are less risky than their non-ESG counterparts.

As a robustness check, we use quantile treatment effects (QTE) to estimate whether ESG bonds have different yields compared to conventional bonds. In the previous estimations using unconditional quantile regressions, we estimated the differences in bond yields for the entire population of specific bond types. Using QTE, we interpret the certification of a green bond as a binary treatment, and quantile regressions enable us to obtain the treatment effect at various quantiles of the outcome variable bond yield (see, Firgo, 2007; Borgen et al., 2021a, 2021b, 2022). Table 13 reports the estimated QTEs. In column (1), the QTEs of CBI-certification in comparison to all other bonds are reported, whereas in column (2) both types of CBI bond (aligned and certified) are considered as treatment. Column (3) includes all ESG bond types as treatment. The results are in line with our previous findings. A negative and highly significant QTE of CBI certification is found at all quartiles (25, 50, 75%), and it can the noted that the effect of CBI certification increases at higher quartiles of bond yields. This contrasts with the results reported in column (2) when both CBI bond types (aligned and certified) are considered as treatment. In column (2) QTE is only significant at the lower quartile but not at the median or the upper quartile. In column (3), the treatment effect of all ESG bond types is tested. Although there is a negative treatment at the lower quartile, we find a positively significant QTE at the median and no significant QTE at the upper quartile. Taken together, the results from these robustness tests imply that it is the bond certification that matters most for the difference in terms of bond yield, thus confirming the previous results.

5 Conclusions

Considering the size of the African continent as well as the great potential to launch projects for renewable energy generation and to preserve biodiversity, there exist surprisingly few issuers of ESG bonds in Africa. The share of African ESG bonds in the global ESG-bond issuance volume is less than 0.3%. The African Development Bank and a few private banks do issue ESG bonds as well as a few public corporations active in the renewable energy sector. In most cases, there are foreign managers and bookmakers involved, and ESG bonds are often denoted in a non-domestic currency to attract international investors. Also, a handful of sovereign ESG bonds have been issued in Africa so far—here, Egypt and Nigeria are most active.

The econometric analysis using quantile treatment regression models estimated with the RIF approach shows that, in particular, CBI-certified bonds have significantly lower yields, lower option-adjusted spreads, and even lower yield volatility compared to their non-ESG counterparts. The estimates imply a significant and robust greenium of African CBI-certified bonds of more than 200 bps. We also find significant differences regarding the spread and volatility of sustainability-linked bonds, whereas self-labeled green bonds are not significantly different from non-ESG bonds. This confirms that the greenwashing risk exists. Receiving a certification reduces information asymmetry and signals better bond quality. Thus, certification of bonds is beneficial both for issuers and investors. This shows that green macro policy and financial regulation that reduce information asymmetry and greenwashing risks should have a positive effect on the development of the African ESG bond market. Overall, the findings of this study support the view that the potential for issuing ESG bonds for Africa is huge and not at all exploited yet.

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Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest. No funding has been received for this project and there are no competing interests.

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