Can Biodiversity Green Bonds Be Issued at Lower Cost?

An Investigation Into the Pricing of Green Biodiversity Bonds

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Abstract

Financial resources play an important role in achieving biodiversity conservation and restoration goals. Among the instruments that can generate financing for biodiversity are green bonds. The green bond market is growing fast. Whereas green bonds and their pricing in general has been studied frequently, we study green bonds that relate to SDG 14: Life Below Water and SDG 15: Life On Land. We deem these bonds 'biodiversity green bonds'. We use the EFData database and SDC Platinum database within the LSEG database. We create three subsets of bonds: a set of biodiversity green bonds, a set of general green bonds without explicit biodiversity ambitions and a set of conventional bonds. Using matching techniques, our preliminary findings indicate that biodiversity green bonds have lower yields spreads of 3.97 to 10.5 basis points when compared to general green bonds, in the primary market. This implies lower cost of issuing a biodiversity green bond instead of a general bond. We are working on robustness analyses using different matching specifications and regression methods.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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1. Introduction and literature[1]

We investigate whether the yield spreads of green bonds of which proceeds are used to finance biodiversity-related projects are lower than yield spreads of green bonds in general and yield spreads of bonds without the green label. Humans negatively impact nature and biodiversity (TEEB, 2010; De Vos et al., 2015; IPBES, 2019; IUCN, 2024), making biodiversity loss one of the most pressing environmental challenges (Karolyi and Tobin-de la Puente, 2023). Financial resources are crucial in the accomplishment of nature conservation objectives (Coad et al., 2019; Gill et al., 2017; Powlen et al., 2021; Waldron et al., 2017; Xu et al., 2021). Given the scarcity and pressure for various uses of public funding and the large amounts of financial resources in the private sector (see e.g. Beverdam et al., 2025), it is likely that the private sector is to play a large role in achieving the required amount of financing for biodiversity conservation and restoration (Deutz et al., 2020; Chami et al., 2022; Flammer et al., 2025), although this yields concerns as well (e.g. Kedward et al., 2023)

Green bonds are among the various instruments (Beverdam et al., 2025) that can be used to generate funding from the private sector for biodiversity. The proceeds of green bonds are earmarked to finance projects that are beneficial to the environment (e.g. climate change mitigation or biodiversity restoration) (Ehlers et al., 2020). The green bond market is growing (Demski et al., 2025). In the period 2020-2024, the outstanding value of global fixed income grew from $128 trillion to $145 trillion, a roughly 13% growth (SIFMA, 2025). Simultaneously, outstanding value of green bonds has increased from roughly $1 trillion to $3 trillion in that same period, a 200% increase (Demski et al., 2025). Most green bonds relate to climate complexities, but they are also increasingly being used with biodiversity in mind (Gao et al., 2025; Naifar, 2025). AXA Investment Managers estimate that roughly 25% of existing green bonds in some way relates to biodiversity (Bamberger, 2025).

[1] The literature is far from exhaustive, given that this is a working paper in progress.

We investigate whether the yield spreads of green bonds with biodiversity ambitions are different from the yield spreads of green bonds without such objectives, and conventional bonds, at issuance of the bond. Lower yield spreads means lower costs for entities issuing the bonds (Nanayakkara and Colombage, 2019**)**, marking the biodiversity green bond as a potentially effective instrument to spur financing of biodiversity-positive projects. Although green bonds have been studied regularly, we contribute to the literature by empirically investigating the pricing of green bonds that with biodiversity ambitions.

In order to analyze the green bonds with nature and biodiversity ambitions, we make use of the Environmental Finance Data (EFData) database. This database covers 95% of sustainability-related bonds, starting with bonds issued in 2007. We filter the instruments so that we end up with green bonds specifically relating to nature and biodiversity. We couple the bonds in the EFData database with the SDC Platinum database within LSEG. We then match on bond characteristics and compare the pricing of the bonds in the EFData database (green bonds including biodiversity ambitions and green bonds without) with 'conventional' bonds that do not specifically include any green ambitions.

First, we extract all the green bonds from the EFData database and filter based on them relating to SDG 14 (life below water) and 15 (life on land). This creates two subsets: 1) green bonds with explicit biodiversity ambitions and 2) green bonds without explicit biodiversity ambitions. Using SDC Platinum within LSEG, we extract bond information to form a third subset 3) conventional bonds. We provide descriptives of all subsets of bonds.

We further refine the sample using matching techniques to match the set of green bonds with biodiversity ambitions with a set of green bonds without such ambitions and a set of conventional bonds. This allows us to compare the green bonds with biodiversity ambitions with the two other sets. In the green bond literature, matching techniques (especially nearest neighbor matching) are frequently used and well accepted (ElBannan and Löffler, 2024;

Flammer, 2021; Reitsema and Scholtens, 2025; Teti et al., 2022). We estimate the Average Treatment effect on the Treated (ATT), to shed light on pricing effects at issuance of the bond in terms of yield spread to its benchmark in basis points. When comparing biodiversity green bonds and general green bonds, we estimate the pricing effect of a green bond relating to biodiversity instead of simply being 'generally green'. When comparing general green bonds and conventional bonds, we estimate the pricing effect that is known in the literature as a possible greenium. When comparing biodiversity green bonds with conventional bonds, we estimate the pricing effect of a green bond relating to biodiversity instead of being a conventional bond.

This research design is meant then to inform about the pricing of green bonds with biodiversity ambitions from the perspective of issuing entities wishing to raise financing for projects. We find a pricing premium at bond issuance when comparing biodiversity green bonds with general green bonds of 10.5 basis points in the first matching specification, and 3.79 basis points when also matching on issue year in the second matching specification. The effect is even more pronounced when comparing biodiversity green bonds with conventional bonds in the first specification: 19.9 basis points, but disappears when including issue year as a matching variable in the second matching specification. Our investigation of the previously studied greenium yields a greenium of 9.38 basis points in the first matching specification but becomes statistically insignificant in the second. Preliminary evidence thus indicates that biodiversity green bonds can be issued slightly cheaper compared to green bonds, marking them as a potentially attractive instrument for spurring biodiversity financing. However, the premium is small.

For robustness purposes, we are working on the use of radius matching, stratification matching and Kernel matching, a strategy employed by e.g. Teti et al. (2022), as well as extending the matching specifications by including additional matching variables.

Furthermore, we are investigating the biodiversity green bond pricing premium using regression methods.

In section 2 we discuss the data used and methodology employed. Section 3 showcases the results and the implications of these results. We conclude in section 4 and highlight avenues for further research.

2. Data and methodology

2.1. Green bond sample construction

To construct the green bond sample, we download data from the Environmental Finance Data (EFData) database, which covers 95% of sustainability-related bonds, starting with bonds issued in 2007. We only download bonds with the label 'green bond'. After downloading the data on December 2, 2025, we end up with a total amount of 30,554 green bonds. Before splitting the sample into biodiversity-related green bonds and general green bonds, we need information on the variable of interest, which is the spread to benchmark at issuance expressed in basis points. This variable needs to be extracted from SDC Platinum within LSEG by matching ISIN codes. Filtering our sample for instruments that have an ISIN code and removing duplicate ISIN codes (as this should, in theory, not be possible) we end up with an intermediate sample of 10,608 green bonds. After matching with SDC Platinum, the final sample of green bonds (including both 'biodiversity' green bonds and general green bonds) constitutes 3,336 green bonds. Inspecting descriptives, there are 8 bonds with maturities larger than 100 years. Having a relatively large influence on the sample, we choose to drop these observations. In addition, we only include bonds with a fixed coupon rate, as variables included in matching techniques should not fluctuate over time (Teti et al., 2022**),** leading to a total sample of 3,328 green bonds spanning the period 2009 - 2025. Within the Environmental Finance Data database, bonds are classified, among other categories, according to the related Sustainable Development Goals. When a green bond from the final

green bond sample of 3,328 relates to Sustainable Development Goal 14: Life Below Water and/or to Sustainable Development Goal 15: Life On Land, we classify the bond as a biodiversity green bond. From our sample of green bonds, there are 581 of these bonds spanning the period 2016 - 2025. This means that we remain with 2,747 general green bonds spanning the period 2009 - 2025.

2.2. Conventional bond sample construction

To construct a sample of conventional bonds (i.e. bonds without the green label), we use SDC Platinum within LSEG. As we deal with LSEG download limitations of max 5,000,000 datapoints each month, we make the decision to only download conventional bonds for the period 2016 – 2025, such that we are able to fully match the biodiversity green bonds sample that spans the same period. We explicitly exclude the ISIN codes when retrieving data of the 3,328 green bonds[2]. We end up with an initial sample of 351,138 conventional bonds. After filtering for the conventional bonds having a value for the variable of interest (spread to benchmark), issue value of the bond, coupon of the bond, tenor of the bond and country incorporating the issuer, filtering for maturities larger than 100 years and only including bonds with fixed coupon rates, we end up with a final sample of 26,074 conventional bonds spanning the period 2016 – 2025.

2.3. Variables and descriptive statistics

Table A1 shows the variables utilized in the study and their definitions.

Table 1 shows the descriptive statistics of the numeric variables in the total sample.

[2] We do not need to explicitly exclude the rest of the already filtered green bond ISIN codes, as in its sample construction we already established there was no value for the variable of interest (spread to benchmark) and thus exclude the observations. When these not explicitly excluded ISIN codes slip in during the conventional bond sample construction, they will once again be excluded due to the lack of a value for the variable of interest. In addition, as EFData includes ~95% of issued sustainable debt instruments, we believe we can reasonably assume we do not accidentally include other green bond data in our conventional bond sample.

Table 2 shows the descriptive statistics of the numerical variables categorized by the sample they belong to (either biodiversity green bonds, general green bonds or conventional bonds). Table A2 shows information on the frequency with which individual credit ratings by Moody's occur. Of the total bond sample, 248 of the bonds were given a credit rating by Moody's of 'P1'. P1 encompasses the credit ratings 'Aaa' to 'A3'. We converted the 'P1' value to the midpoint of 'Aaa' to 'A3', which is 'Aa3'.

Table A3 shows information on the issue year of the bonds in the sample.

Table 1: *Descriptive statistics for the total sample* (2009 – 2025).

Variable	Observations	Mean	Std. dev.	Min	Max
spread to benchmark (basis points)	29,402	133.29	133.05	-56.00	992.00
dollarvalue (million $)	29,402	1269.80	2170.52	1.35	40000.00
tenor (years)	29,402	11.16	9.64	0.43	62.00
couponpercentage (%)	29,402	3.33	2.00	0.00	13.45

Notes: 'spread to benchmark' is measured in basispoints; 'dollarvalue' is measured in millions USD; 'tenor' is measured in years; 'couponpercentage' is measured in percentage.

Table 2: *Descriptive statistics broken down by subgroup of bonds.*

Variable	Observations	Mean	Std. dev.	Min	Max
Biodiversity bonds (2016 – 2025)					
spread to benchmark	581	83.22	76.48	-24.00	597.00
dollarvalue	581	1015.64	1698.09	2.03	18572.40
tenor	581	8.02	5.45	2.00	60.00
couponpercentage	581	2.69	1.77	0.00	9.00
Green bonds (excluding biodiversity bonds) (2009 – 2025)					
spread to benchmark	2,747	91.00	85.20	-56.00	806.00
dollarvalue	2,747	713.44	858.54	1.35	13832.37
tenor	2,747	8.79	6.93	1.00	62.00
couponpercentage	2,747	2.34	1.82	0.00	12.00
Conventional bonds (non green and non biodiversity) (2016 – 2025)					
spread to benchmark	26,074	138.86	137.09	-41.00	992.00
dollarvalue	26,074	1334.08	2265.52	4.34	40000.00
tenor	26,074	11.48	9.90	0.43	60.90
couponpercentage	26,074	3.45	2.00	0.00	13.45

Notes: 'spread to benchmark' is measured in basispoints; 'dollarvalue' is measured in millions USD; 'tenor' is measured in years; 'couponpercentage' is measured in percentage.
When treatment = 1 and green bond = 1, the bonds are biodiversity green bonds; when treatment = 0 and green bond = 1, the bonds are general green bonds; when treatment = 0 and green bond = 0, the bonds are conventional bonds

2.4.Matching

In order to be able to estimate the difference in yield spread of a bond relating specifically to biodiversity when compared to general green bonds and conventional bonds, as well as estimating the yield spread of a bond being green when comparing the bond to conventional bonds, we employ matching techniques. This technique allows for the construction of a similar control sample compared to the treatment sample, due to both samples having similar covariate distributions (Austin, 2011). We employ nearest neighbour

1-to-1 matching based on Mahalanobis distance to match a single closest counterpart, an approach that is frequently used and commonly accepted in the green bond literature (ElBannan and Löffler, 2024; Flammer, 2021; Reitsema and Scholtens, 2025; Teti et al., 2022). Firstly, we approach the matching in a similar vein to Teti et al. (2022), matching on the issue value of the bond, its tenor, its rating and the coupon of the bond. Subsequently we also introduce the issue year of the bond as a matching variable in the second matching specification, as matching bonds on year of issuance is relevant to take into consideration the economic conditions within the given year.

For assessing the balance of models, one should strive for a value of standardized mean differences of 0 (thresholds of 0.10 are common) between the groups of treated and matched observations (Greifer, 2025). In addition, variance ratios between the groups are ideally close 1, but variance ratios within the region of 0.5-2.0 are observed in academic studies (Austin, 2009; Greifer, 2025). Furthermore, Greifer (2025) recommends that, although the standardized mean difference and variance ratio are most important, balance assessment might be supplemented by investigating Kolmogorov-Smirnov (KS) statistics. These should be as close to 0 as possible, although there are no specific thresholds and there is generally a bit more leeway when KS statistics are slightly larger but the standardized mean differences and variance ratios are good.

For the first matching specification (Table A4) that includes issue value, tenor, coupon and credit rating, we observe that the balance statistics are satisfactory. The standardized mean differences are not larger than 0.06. In addition, the largest variance ratio is 1.24, which is still close to 1. The only statistics that give reason for investigating different matching specifications are the KS statistics, which are relatively high for the tenor and coupon

variable when matching the green bonds with the conventional bonds, as well as for the variable tenor when matching the biodiversity green bonds with conventional bonds[3].

For the second matching specification (Table A5), standardized mean differences are reasonable with the exception of the variable tenor (value of 0.11) when matching biodiversity green bonds with general green bonds. The variance ratios are acceptable, with a relatively large value of the issue value variable (1.69) being the exception, when matching biodiversity green bond with conventional bonds. Nonetheless, such a value is still tolerable. When matching green bonds and conventional bonds, and biodiversity green bonds and conventional bonds, the KS statistic for tenor is relatively high; 0.22 and 0.26 respectively. All in all, the balance of the matching model specifications are acceptable and, although they could be further improved, ATT's can be interpreted with confidence.

After matching, we estimate the ATT. We include the covariates and their interactions in the model before estimating the ATT in line with recommendations by Greifer (2025). Lastly, we cluster standard errors by subclass to obtain reliable standard errors for the estimated ATT (Greifer, 2025).

[3] We are in the process of trying different specification methods and settings to improve the balance of matched samples.

3. Results

In this section, we elaborate on the ATT estimation and their economic implications. We use the mean range of the issue value variable of the matched samples to illustrate what the effect of the estimated ATT implies for issuing bonds. To illustrate the effect, we employ a simple back of the envelope calculation, disregarding discounting etc. This is simplistic, but aids in the understanding of the interpretation of the estimated effects. Results are summarized in Table A6.

Table 3 shows the ATT results when the bonds are matched on issue value, tenor, coupon rate and credit rating in line with Teti et al. (2022). The ATT is expressed in spread to the bonds' benchmark instrument in basis points. For instance, when comparing biodiversity green bonds and general green bonds, this means that a negative ATT coefficient indicates a lower spread to benchmark for the biodiversity green bond compared to the general green bond. This, in turn, implies biodiversity green bonds can be issued at a lower cost compared to a similar general green bond. When the ATT coefficient is positive, this indicates a higher spread to benchmark and thus a higher cost of issuing the biodiversity green bond compared to a general green bond.

We observe that, when comparing biodiversity green bonds with general green bonds. The spread to benchmark at issuance of the bond is 10.5 basis points lower, statistically significant at the 1% level. In the first matching specification (Table 3), the mean value of the issue variable for biodiversity green bonds is 1,016 million USD. For general green bonds, this is 896 million USD. Consider an entity that issues a biodiversity green bond, instead of a general green bond. When the issue value of such a bond is 896 – 1,016 million USD, and a 10.5 basis points lower spread exists for biodiversity green bonds, this implies that issuing a biodiversity green bond instead of a general green bond is between 0.00105 x 896 million USD and 0.00105 x 1,016 million USD = 940,800 USD and 1,066,800 USD cheaper. In

percentages, this is 0.09% - 0.105% of issue value when taking the mean issue value of biodiversity green bonds (1,016 million USD) as a starting point, or 0.105% - 0.119% when considering the mean issue value of general green bonds (896 million USD) as point of departure.

When comparing general green bonds with conventional bonds, we estimate that the spread to benchmark at issuance of the bond is 9.38 basis points lower, statistically significant at the 1% level. Mean issue values for general green bonds and conventional bonds are 766 million USD and 772 million USD, respectively. Issuing a general green bond instead of a conventional bond then implies that its issuance is between 0.000938 x 766 million USD and 0.000938 x 772 million USD = 718,508 USD and 724,136 USD cheaper. Taking the mean issue value of general green bonds (766 million USD) as point of departure, this is between 0.0938% and 0.0945% cheaper. From the mean issue value of conventional bonds (772 million USD), this is between 0.093% and 0.0938% cheaper.

Lastly, when comparing biodiversity green bonds with conventional bonds, our results show that the biodiversity green bonds have a lower spread to benchmark at issuance of the bond of 19.9 basis points, statistically significant at the 1% level. The average issue value of biodiversity green bonds in this matched sample is 1,016 million USD, while the average issue value of the conventional bonds is 1,013 million USD. This means that issuing a biodiversity green bond instead of a conventional bond is between 0.00199 x 1,013 million USD = 2,015,870 USD to 0.00199 x 1,016 million USD = 2,021,840 USD cheaper. In percentages, taking the issue value of biodiversity green bonds as a starting point (1,016 million USD), this is between 0.198% and 0.199%. When considering the issue value of conventional bonds as point of reference (1,013 million USD), this is between 0.199% and 0.2%.

Table 4 shows the ATT results when the bonds are matched on issue value, tenor, coupon rate, credit rating and issue year of the bond. In comparing biodiversity green bonds with general green bonds, the results remain statistically significant, but only at the 10% level, indicating that biodiversity green bonds have a spread to benchmark at issuance of the bond that is 3.97 basis points lower. Consider again the perspective of an issuer, when issuing a biodiversity green bond instead of a general green bond. The means of issue value for biodiversity green bonds and general green bonds are 1,016 and 815 million USD, respectively. This implies that issuing a biodiversity green bond instead of a general green bond is between 0.000397 x 815 million USD and 0.000397 x 1,016 million USD = 323,555 USD and 403,352 USD cheaper. In percentages, this is 0.032% - 0.0397% when taking the mean issue value of biodiversity green bonds (1,016 million USD) as a starting point, or 0.0397% - 0.049% when considering the mean issue value of general green bonds (815 million USD) as starting point.

Comparing general green bonds with conventional bonds, statistical significance at the 1% level remains, but the sign of the result changes and indicates that general green bonds have a 2.53 basis points spread to benchmark that is higher than conventional bonds, at the date of issuance. Mean issue values for general green bonds and conventional bonds are 766 million USD and 810 million USD, respectively. Issuing a general green bond instead of a conventional bond then implies that its issuance is between 0.000253 x 766 million USD and 0.000253 x 810 million USD = 193,798 USD and 204,930 USD more expensive. Taking the mean issue value of general green bonds (766 million USD) as point of departure, this is between 0.0253% and 0.0267% more expensive. From the mean issue value of conventional bonds (810 million USD), this is between 0.0239% and 0.0253% more expensive.

Comparing biodiversity green bonds and conventional bonds now yields statistically insignificant results, albeit at the exact cutoff value for 10% significance.

All in all, the results indicate that biodiversity green bonds have a lower basis points spread to benchmark at issuance when comparing them to green bonds in general. The greenium, as documented in previous studies, does not consistently show up in our results. The magnitude of the effect when comparing biodiversity green bonds with conventional bond is large in the first matching attempt, but borderline insignificant in the second matching specification.

Table 3: *Average Treatment effect on the Treated by subgroup of matched bonds.*

Comparison of biodiversity green bonds vs. general green bonds					
#treated	#matched	ATT	Std.error	z	Pr > |z|
581	581	-10.5***	2.51	-4.16	<0.001
Comparison of general green bonds vs. conventional bonds					
#treated	#matched	ATT	Std.error	z	Pr > |z|
3,328	3,328	-9.38***	1.21	-7.75	<0.001
Comparison of biodiversity green bonds vs. conventional bonds					
#treated	#matched	ATT	Std.error	z	Pr > |z|
581	581	-19.9***	2.75	-7.21	<0.001

Notes: Matched on the variables 'dollar value', 'tenor', 'couponpercentage' and 'Moodyrating'. Dependent variable is 'spread to benchmark (basis points)'. For the comparison between biodiversity green bonds and general green bonds, the issue dollar value provided by EFData is used. For the other two estimations of the ATT, the issue dollar value provided by SDC Platinum is used. Standard errors are clustered by subclass. Significance indicated as follows: ***p<0.01, **p<0.05, *p<0.10.

Table 4: *Average Treatment effect on the Treated by subgroup of matched bonds – including year match.*

Comparison of biodiversity green bonds vs. general green bonds					
#treated	#matched	ATT	Std.error	z	Pr > |z|
581	581	-3.79*	2.2	-1.72	0.0854
Comparison of general green bonds vs. conventional bonds					
#treated	#matched	ATT	Std.error	z	Pr > |z|
3,328	3,328	2.53***	0.909	2.79	0.005
Comparison of biodiversity green bonds vs. conventional bonds					
#treated	#matched	ATT	Std.error	z	Pr > |z|
581	581	-3.47	2.11	-1.64	0.1

Notes: Matched on the variables 'dollar value', 'tenor', 'couponpercentage', 'Moodyrating' and 'issueyear'. Dependent variable is 'spread to benchmark (basis points)'. For the comparison between biodiversity green bonds and general green bonds, the issue dollar value provided by EFData is used. For the other two estimations of the ATT, the issue dollar value provided by SDC Platinum is used. Standard errors are clustered by subclass. Significance indicated as follows: ***p<0.01, **p<0.05, *p<0.10.

4. Conclusion

In this study, we have aimed to shed light on the pricing effects of bonds that relate to biodiversity, an issue that is, deservedly, receiving ever-more attention. Whereas the pricing effects of green bonds compared to 'normal' bonds have previously been widely studied, we specifically investigate the subcategorization of biodiversity green bonds. We do so by using matching techniques to create comparable samples. Subsequently, we compare the yield spread at issuance for three groups of bonds: biodiversity green bonds and general green bonds, biodiversity green bonds and conventional bonds, and general green bonds and conventional bonds. Based on our preliminary evidence, we conclude that issuing green bonds relating to biodiversity instead of green bonds 'in general' is between 3.97 and 10.5 basis points cheaper for issuing entities. The effect is small when expressed in basis points, but we have illustrated the economic implications using average issue dollar values and percentages of average issue value.s When entities are already intending to pursue environmentally or climate-conscious projects and considering the issuance of green bonds, such a biodiversity premium might be a stimulus to explicitly take biodiversity considerations into account as well. In our first matching specification, these results seem even more pronounced when comparing biodiversity green bonds to conventional bonds (19.9 basis points). However, in the second matching specification, this result is borderline insignificant, so we cannot claim consistency of this result across specifications.

Although the matching specifications seem reasonable, the estimates would benefit from sensitivity analyses using various other specifications and matching types. In the near future, we investigate what happens with the results when using radius matching, kernel matching and stratification matching, while also utilizing differing matching ratios (1-to-1, 2-to-1, etc.) and matching with- and without replacement. We also aim to investigate extension of the matching model itself, by adding e.g. coupon payment frequency, issuer sector and

whether the issuer is a financial, sovereign or corporate entity, as well as investigating the difference in yield spreads per individual year.. In addition, we are also working on analyses using regression models to investigate the robustness of results.

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Supplement

Table A1: *Variables and variable definitions.*

Variable	Definition
spread to benchmark	The variable of interest is the spread to benchmark in basispoints at issue date. SDC Platinum matches the individual bond to its safest similar counterpart and subtracts the issue yield of the benchmark from the issue yield of the individual bond.
treatment	When a green bond relates to either SDG 14, SDG 15 or SDG 14 and 15 simultaneously, we attach a dummy variable named 'treatment' with a value of 1 to the green bond. For green bonds that do not relate to SDG 14, SDG 15 or both (and the conventional bonds), the value of 'treatment' is 0.
green bond	Similar to the 'treatment' variable, we attach a value of 1 when a bond is a green bond and a value of 0 when the bond is conventional bond.
dollarvalue	This variable measures the issue value of the bond in millions of US dollars (USD).
tenor	This is the maturity of the bond in years, constructed at the date of issuance. For the green bonds, EFData provides the variable 'tenor' in rounded years. For the conventional bonds, SDC Platinum values of 'tenor' may have values up to two decimal places.
couponpercentage	This variable measures the coupon rate of the individual bond in percentages.
Moodyrating	This variable classifies the individual bond's credit rating as bestowed upon it by Moody's.
issueyear	This variable represents the year of issuance of the individual bond.
country	The country that incorporates the issuer of the individual bond.

Table A2: *Breakdown of Moodyrating variable by subgroup of bonds.*

Credit rating by Moody's	**Biodiversity bonds**	**Green bonds**	**Conventional bonds**
	Frequency	*Frequency*	*Frequency*
Aaa	59	287	4,312
Aa1	18	47	438
Aa2	20	117	874
Aa3	19	102	988
A1	45	178	1,260
A2	16	97	1,249
A3	51	209	1,457
Baa1	69	247	1,591
Baa2	44	215	1,956
Baa3	24	114	1,504
Ba1	2	26	280
Ba2	3	19	339
Ba3	-	4	489
B1	-	3	437
B2	-	3	386
B3	1	1	361
Caa1	-	3	161
Caa2	-	-	100
Caa3	-	-	3
Ca	-	-	1
NR (Not Rated)	210	1,075	7,888
Total	581	2,747	26,074

Table A3: *Breakdown of the year of issuance by subgroup of bonds.*

Issue year of bonds	Biodiversity bonds	Green bonds	Conventional bonds
	Frequency	*Frequency*	*Frequency*
2009	-	1	-
2010	-	-	-
2011	-	-	-
2012	-	4	-
2013	-	10	-
2014	-	28	-
2015	-	45	-
2016	6	52	2,395
2017	6	96	2,879
2018	10	128	3,015
2019	20	226	3,549
2020	28	248	2,432
2021	52	417	2,469
2022	71	401	1,915
2023	129	424	2,064
2024	153	386	2,680
2025	106	281	2,676
Total	581	2,747	26,074

Table A4: *Balance statistics of nearest neighbour 1-to-1 matching using Mahalanobis distance by subgroup of bonds – no matching on year in line with Teti et al., (2022).*

Variable	**biodiversity green bonds & general green bonds** (total bonds – 1,162)			**general green bonds and conventional bonds** (total bonds – 6,656)			**biodiversity green bonds and conventional bonds** (total bonds – 1,162)		
	std. mean diff.	*KS statistic*	*Var. Ratio*	*std. mean diff.*	*KS statistic*	*Var. Ratio*	*std. mean diff.*	*KS statistic*	*Var. Ratio*
dollar_value	0.04	0.05	1.22	-0.01	0.07	1.00	0.002	0.09	0.98
tenor	0.06	0.04	1.16	0.02	0.22	1.24	0.024	0.26	1.19
coupon_percentage	0.03	0.01	1.05	-0.01	0.16	1.04	-0.004	0.11	1.02
Moodyrating_catNR	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCa	-	-	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCaa3	-	-	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCaa2	-	-	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCaa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catB3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catB2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catB1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBa3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBa2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBaa3	0.02	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBaa2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBaa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catA3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catA2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catA1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAa3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAa2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAaa	-0.01	0.00	-	0.00	0.00	-	0.00	0.00	-

Table A5: *Balance statistics of nearest neighbour 1-to-1 matching using Mahalanobis distance by subgroup of bonds – match on issue year included.*

Variable	**biodiversity green bonds & general green bonds** (total bonds – 1,162)			**general green bonds and conventional bonds** (total bonds – 6,656)			**biodiversity green bonds and conventional bonds** (total bonds – 1,162)		
	std. mean diff.	*KS statistic*	*Var. Ratio*	*std. mean diff.*	*KS statistic*	*Var. Ratio*	*std. mean diff.*	*KS statistic*	*Var. Ratio*
dollar_value	0.06	0.08	1.16	-0.04	0.08	1.17	0.05	0.08	1.69
tenor	0.11	0.06	1.35	0.04	0.21	1.28	0.04	0.26	1.24
coupon_percentage	0.01	0.01	1.04	-0.06	0.16	0.99	-0.04	0.11	0.99
Moodyrating_catNR	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCa	-	-	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCaa3	-	-	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCaa2	-	-	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catCaa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catB3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catB2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catB1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBa3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBa2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBaa3	0.02	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBaa2	0.01	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catBaa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catA3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catA2	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catA1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAa3	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAa2	0.01	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAa1	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
Moodyrating_catAaa	-0.02	0.01	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2009	0.00	0.00	-	0.02	0.00	-	-	-	-
LSEGissue_year2012	0.00	0.00	-	0.03	0.00	-	-	-	-
LSEGissue_year2013	0.00	0.00	-	0.05	0.00	-	-	-	-
LSEGissue_year2014	-0.02	0.00	-	0.09	0.01	-	-	-	-
LSEGissue_year2015	0.00	0.00	-	0.12	0.01	-	-	-	-
LSEGissue_year2016	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2017	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2018	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2019	0.00	0.00	-	-0.01	0.00	-	-0.01	0.00	-
LSEGissue_year2020	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2021	-0.01	0.00	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2022	-0.01	0.00	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2023	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-
LSEGissue_year2024	0.01	0.00	-	-0.07	0.02	-	0.00	0.00	-
LSEGissue_year2025	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-

Table A6: *Economic implications of ATT estimation on spread to benchmark at issuance.*

Effect of issuing a biodiversity green bond instead of a general green bond	
Model 1 *(-10.5 bp)*	*Model 2* *(-3.79 bp)*
Avg. issue value: $896 million - $1,016 million	**Avg. issue value:** $815 million - $1,016 million
$940,800 - $1,066,800 cheaper	$323,555 - $403,352 cheaper
Effect of issuing a general green bond instead of a conventional bond	
Model 1 *(-9.38 bp)*	*Model 2* *(2.53 bp)*
Avg. issue value: $766 million - $772 million	**Avg. issue value:** $766 million - $810 million
$718,508 - $724,136 cheaper	$193,798 - $204,930 more expensive
Effect of issuing a biodiversity green bond instead of a conventional bond	
Model 1 *(-19.9)*	*Model 2* *(-)*
Avg. issue value: $1,013 million - $1,016 million	No significant effect
$2,015,870 - $2,021,840 cheaper	No significant effect