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## Global shocks and green bonds issuance: An empirical evidence from firm-level panel data

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**ADB Working Paper Series**

**GLOBAL SHOCKS AND GREEN BONDS  
ISSUANCE: AN EMPIRICAL EVIDENCE  
FROM FIRM-LEVEL PANEL DATA**

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Dina Azhgaliyeva and Zhanna Kapsalyamova

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**Abstract**

This paper investigates the determinants of corporate green bond issuance using annual firm-level data for 300 issuers of green bonds, which issued green bonds over the period 2017–2021. Using the Poisson fixed-effects models we find that bond-specific characteristics, such as maturity, coupon rate, and currency are important determinants of the green bond issuance. Issuers of green bonds prefer longer maturity. Thus, governments can promote green bonds by stimulating demand for them from long-term investors such as pension funds. The issuance of green bonds in EURO, USD, CNY, JPY, SEK currencies has a positive impact on their issuance. Governments can promote green bonds by stimulating local demand for them, that way issuance in local currency will be more attractive. Or governments can make it easier to finance green projects using green bonds in foreign currency by denominating revenues to foreign currency using policy instruments, such as a feed-in tariff. More green bonds are issued with a higher coupon rate to attract sufficient demand for them. Thus, policies that increase revenue from green projects, such as feed-in tariffs or subsidized loans, can promote financing projects using green bonds. The effect of the COVID-19 pandemic is positive but insignificant.

**Keywords:** green bonds, COVID-19, green finance, bond maturity, coupon rate, currency

**JEL Classification:** G15, G18, G28, G38

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# 1. INTRODUCTION

Human-induced climate change has increased the probability of extreme events such as heatwaves, drought, heavy rainfall events, storms, and hurricanes (IPCC 2021). Limiting global warming to 1.5°C requires significant investments (IPCC 2022). Green bonds could play an effective role in drawing financial resources toward addressing such challenges. However, global shocks, such as the COVID-19 pandemic, war conflicts, etc. pose risks to the further development of the green bond market (Narayan 2020). The effects of such shocks on the issuance of corporate green bonds are understudied.

This paper provides a comprehensive quantitative assessment of the COVID-19 pandemic on the issuance of green bonds at the firm level. The literature on the effects of global shocks on the issuance of corporate green bonds is limited in scope. Existing studies investigate the effects of oil price shocks on green bonds issuance (Azhgaliyeva, Kapsalyamova, and Mishra 2022), distinguishing between crude oil supply and demand shocks. Azhgaliyeva, Kapsalyamova, and Mishra (2022) find that both demand and supply shocks leading to the increase in the oil prices increase the issuance of corporate green bonds. Yang et al. (2022), studying the effects of armed conflicts on renewable energy finance, find a negative effect of the conflicts on renewable energy finance and green innovation. Flammer (2021) studies three major incentives to issue corporate green bonds, such as “signaling,” “greenwashing,” and “cost of capital” arguments. Companies issue green bonds because they want to send the signals regarding their environmental commitment (“signaling argument”), or they would rather prefer to present themselves as environmentally responsible without undertaking any rigorous commitments (“greenwashing argument”), or get access to cheaper financing (“cost of capital argument”). Flammer (2021) finds that corporate green bonds play a role in signaling the environmental commitment of the companies and does not find any evidence of “greenwashing.”

We use annual data from green bond-issuing firms over the period 2017 to 2021. The data are sourced from the Bloomberg terminal and Compustat dataset by the Wharton Research Data Services. We include bonds that are labeled “green,” which are bonds that use the proceeds for green projects (Climate Bonds Initiative [CBI] 2016). To study the effects of the COVID-19 pandemic we use the Oxford stringency index and the binary variable that reflects the COVID-19 period. We show the effects of the COVID-19 pandemic and green bonds issuance at the issuer-level.

The paper contributes to the existing literature in several ways. First, it provides additional evidence on the determinants of green bonds issuance at the firm level (Flammer 2020, 2021; Karpf and Mandel 2017; Zerbib 2019). Second, it contributes to the literature that studies the effects of the global shocks on energy finance, such as firm-level corporate green bonds (Azhgaliyeva, Kapsalyamova, and Mishra 2022; Yang et al. 2022). Third, the paper contributes to the literature that studies the relationship between environmental sustainable governance indicators and firm-level issuance of green bonds. Finally, the study contributes to the broader literature on finance that studies the effects of firm-level characteristics on the issuance of corporate green bonds. The remainder of the paper is structured as follows. Section 2 reviews the literature. Section 3 and 4 explains the data and methodology respectively. Section 5 discusses the results. Section 6 concludes.

## 2. LITERATURE REVIEW

The COVID-19 pandemic showcased the vulnerability of the global financial system to extreme events and natural disasters (Arif et al. 2022). High volatility in financial markets and pandemic-related significant losses in the stock markets demonstrated the need for safe-haven assets and portfolio diversification. During the COVID-19 pandemic, green bonds demonstrated “hedging and safe-haven potential” due to their marked differences from conventional bonds and diversification benefits (Arif et al. 2022; Naeem and Karim 2021; Nguyen et al. 2021). Likewise, Naeem and Karim (2021) find that green financial assets provide larger diversification opportunities compare to Bitcoin, implying that green investors pursue their green investments and avoid the financial risks, especially during turbulent times. Han and Li (2022), comparing portfolios with and without green bonds in the US and European markets, find that green bonds improve the risk and return profile of the portfolios in those markets. Reboredo, Ugolini, and Ojea-Ferreiro (2022), studying the de-risking ability of green bonds for low-carbon stocks in the People’s Republic of China (PRC), Europe, and the US, find that green bonds entail a de-risking capacity for low-carbon investments in the PRC and Europe, while they have no de-risking capacity in the US.

Hacıömeroğlu, Danişoğlu, and Güner (2022), studying the performance of green and conventional bonds during the COVID-19 pandemic, find that primary market yields on green and brown bonds declined, while the yields on green corporate bonds declined more compared to conventional bonds, pointing towards a stronger demand for the former. They also find that corporate green bonds have safe-haven potential. The results are overall consistent with other literature on the resilience of social impact investing (Lins Servaes, and Tamayo 2017) that find that firms with high corporate social responsibility (CSR) intensity had higher stock returns compared to firms with low CSR during the 2008–2009 financial crisis. Yi et al. (2021), investigating the impact of COVID-19 on the PRC’s green bond market, find that the COVID-19 pandemic significantly increased the cumulative abnormal return of the green bonds. Guo and Zhou (2021) find that the green bonds have a great potential “to hedge against tail risks for traditional assets.” Elsayed et al. (2022) studying the interdependence between green bonds and financial markets, find that diversification benefits of green bonds exist in the short term. The hedging properties of green bonds reduce in the long term.

Zerbib (2019) finds that the green bonds premium is either close to zero in several markets or is negative. Similarly, Löffler, Petreski, and Stephan (2021) find that yields for green bonds are 15–20 basis points lower than for conventional bonds, implying that a “greenium” exists. Teti et al. (2022) also find that the issuance spread of green bonds is 35 to 40 basis points lower than that of comparable conventional bonds. The studies explain such difference in spreads through the lenses of two theories: preferences of pro-environmental investors and the asset pricing theory. Investors engaged in sustainable and responsible investment (SRI) activities tend to be more concerned about environmental effects rather than payoffs. According to the asset pricing theory, lower yields of green bonds are due to the lower risks of green bonds. That is in contrast to Karpf and Mandel (2017), who find that the spread between brown and green bonds is positive and significant. The authors argue that the greenness features of the bonds are penalized by the markets, since green bonds have lower prices. That is supported by Wu (2022), who finds no negative green bond premium in the PRC or globally.

Studies on the determinants of green bond issuance are rare. Cicchiello et al. (2022) study green bond issuance by examining the determinants of firms' decisions over green and conventional bonds issuance in Europe. They find that the probability of issuing a green bond is affected by the corporate short-term debt repayment capability, debt maturity structure, and the presence of independent directors. They find that board gender diversity increases the green bond issuance.

Barua and Chiesa (2019) study the determinants of green bond issuance, such as the bond characteristics and firm characteristics. They find that coupon rate has a negative and significant effect on the issue size of the bonds. Collateral security is likely to have a positive effect on the issue size. Bond credit rating also has a positive and significant effect on bonds issuance. The firm characteristics, such as firm size and firm profitability have a positive and significant effect on the issue size, whereas the firm's revenue growth has a negative and statistically significant effect on the issue size. Another study by Lin and Su (2022) investigates the determinants of the issuance of green bonds in the PRC. They find that the costs and the size of bonds issuance have a negative and significant effect on the probability of green bonds issuance. The issuance of green bonds by corporates is preferred to the issuance of conventional bonds in the presence of poor financing conditions. Corporates that require large-scale funding would prefer conventional debt financing instruments. Firms with high environmental responsibilities would prefer green bonds.

Some studies investigate whether green bonds are effective instruments in addressing climate change, especially during the times of economic distress (Flaherty et al. 2017). Flammer (2020) finds that the issuance of certified green bonds issuance has a positive and significant effect on the financial performance of firms in the long run. The issuance of green bonds leads to a reduction of companies' CO2 emissions and increase their environmental ratings.

Our study relates to the bulk of growing literature that investigates the determinants of the green bond issuance at the firm level. We also discuss the effects of the COVID-19 pandemic on the issuance of green bonds.

### 3. DATA

Data on green bond issuance and on firm characteristics were sourced from the Bloomberg terminal and from the Compustat dataset by the Wharton Research Data Services, respectively. Our sample includes data from 1,778 green bond issuers from 2017 to 2021 (but the authors plan to update with 2022 in January 2023 and include a War variable). We include firm-level data of green bond issuers who issued bonds over the period 2017–2021. We also included a COVID-19 variable, which is measured using two variables: (i) as a binary variable (equals 1 in 2020–2021); or (ii) the country level annual average stringency index, which measures the strictness of “lockdown style” policies (Hale et al. 2021). The sample data is a balanced panel data with 1,778 firms over the period 2017–2021.

Compustat data are firm-level annual data. However, Bloomberg data are green bond-level data. In order to be able to merge both datasets, Bloomberg data were converted from daily green bond-level data to annual firm level. The amount of green bonds issued per firm  $i$  in country  $j$  per year  $t$ ,  $B_{ijt}$ , is calculated as a sum of all bonds issued in a year  $t$  per firm  $i$  in country  $j$ ,  $b_{ijt}$ :  $B_{ijt} = \sum_{i=1}^{n_{ijt}} b_{ijt}$ . Annual firm-level coupon rate and maturity  $M_{ijt}$  are calculated using an average of coupon rate and maturity  $m_{ijt}$ , weighted by the share of issued green bonds  $\frac{b_{ijt}}{B_{ijt}}$ : *e.g.*,  $M_{ijt} = \sum_{i=1}^{n_{ijt}} (m_{ijt} \frac{b_{ijt}}{B_{ijt}})$ .



**Table 1: Summary Statistics**

Variable	Obs	Mean	Std. Dev.	Min	Max
<b>Dependent variable</b>					
Amount issued, share of assets	1,778	0.42	2.49	0	58.14
<b>Green bond characteristics</b>					
Maturity, years	1,778	1.27	3.35	0	60
Coupon, %	1,778	0.62	1.62	0	14
Currency:					
Other	1,778	0.80	0.40	0	1
CNY	1,778	0.05	0.21	0	1
EUR	1,778	0.08	0.27	0	1
JPY	1,778	0.04	0.19	0	1
SEK	1,778	0.02	0.14	0	1
USD	1,778	0.02	0.15	0	1
<b>Issuer characteristics</b>					
Size	1,778	11.85	2.85	2	19
Profit	1,768	0.07	0.05	0	0
Dividend	1,778	1.00	0.07	0	1
Leverage	1,733	2.09	15.32	-53	628
Tangibility	1,488	0.29	0.27	0	1
COVID, binary (=1 if $t \geq 2020$ )	1,778	0.40	0.49	0	1
COVID, stringency index				0	100
Sector:					
Utility	1,778	0.18	0.38	0	1
Energy	1,778	0.05	0.21	0	1
Financial	1,778	0.46	0.50	0	1
Industrial, material, and technology	1,778	0.19	0.39	0	1
Other sectors	1,778	0.13	0.34	0	1

Note: N = 1,778; number of countries = 38; number of years = 5 (2017–2021).

## 4. METHODOLOGY

The firms do not issue green bonds every year; therefore, the data contain many zero values. To exploit the unique nature of the data, we apply the Poisson fixed-effects estimator, as it provides robust estimation of conditional mean parameters (Wooldridge 2010). The model is specified as follows:

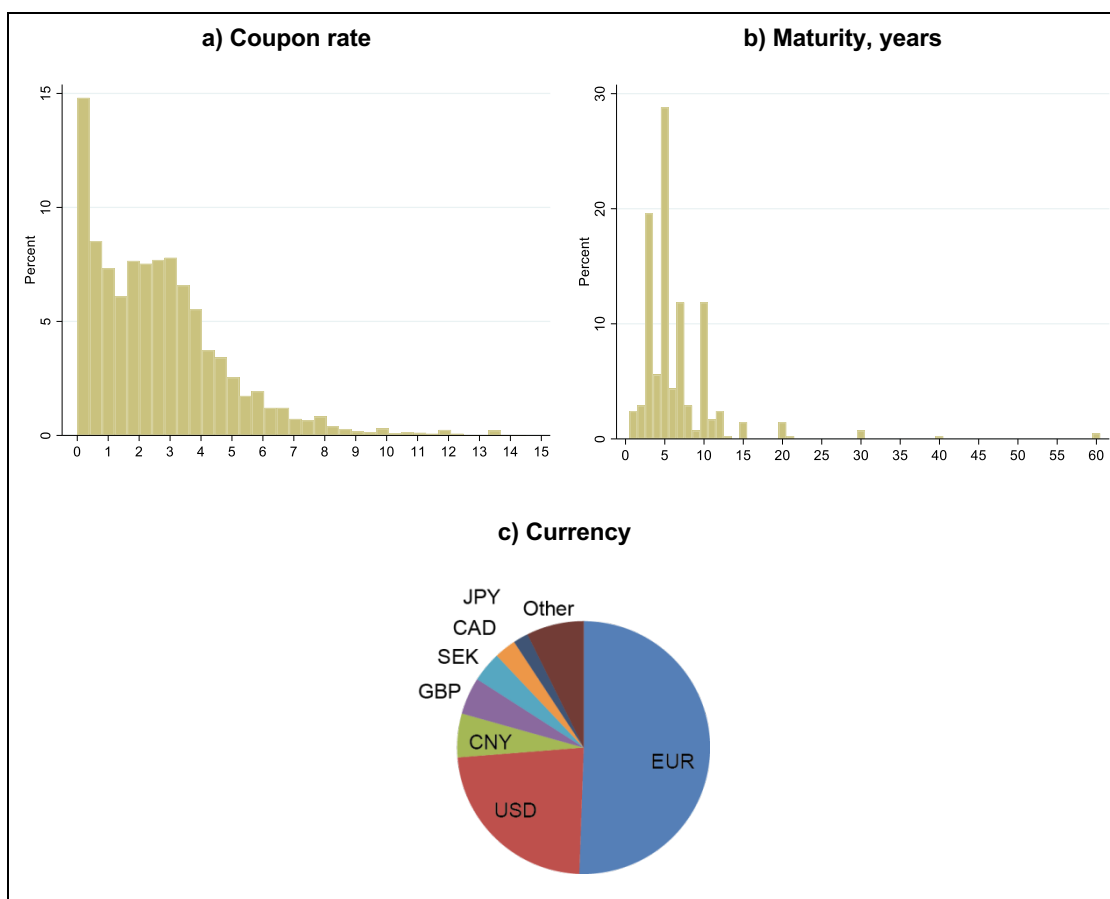
$$\frac{B_{ijt}}{A_{ijt}} = \exp(\beta X_{ijt} + \gamma Y_{ijt} + \delta COVID_{jt} + \mu_{ij} + u_{ijt}),$$

where the dependent variable  $\frac{B_{ijt}}{A_{ijt}}$  is the annual issuance of green bonds as a share of total assets of firm  $i$  in country  $j$  in year  $t$ .  $COVID_{jt}$  is measured using two indicators: First, using an indicator that is equal to one if  $t \geq 2020$  and zero otherwise; second, using an annual average stringency index of country  $j$  in year  $t$ .  $X_{ijt}$  is a vector of green bond characteristics;  $Y_{ijt}$  is a vector of firm characteristics.  $\mu_{ij}$  are fixed effects and  $u_{ijt}$  is the error term. The variance-covariance matrix of the estimates is obtained using the Huber/White/Sandwich linearized estimator. We also test for the presence of endogeneity in the regression. The Hausman test does not find evidence of endogeneity. We cannot reject the null hypothesis that coupon rate and stringency index are exogenous ( $P > |t| = 0.491$  and  $P > |t| = 0.854$ , respectively).

### 4.1 Green Bond Characteristics

We include the following three green bond characteristics as explanatory variables: (i) annual weighted<sup>1</sup> average of coupon rate; (ii) annual weighted average of maturity; and (iii) a set of five<sup>2</sup> binary variables with currency (CNY, EUR, JPY, SEK, USD). Coupon rate (or interest rate) is the rate of interest that is paid on the bond to bond holders by the bond issuer. Most green bonds issued over the period 2017–2021 had a coupon rate within 6% (Figure 1a). Maturity is measured as the number of years between maturity and the issuance of green bonds. Most green bonds issued over the period 2017–2021 had maturity within 10 years from issuance (Figure 1b). Currency is a categorical variable that includes major currencies in which green bonds are issued. Most of the green bonds are issued in EUR (50%) and in USD (23%) (Figure 1c). Issuers choose in which currency to issue green bonds, which are not necessarily matching to the local currency. Moreover, institutions can issue bonds in many (more than one) currencies. For example, most of green bonds issued in India and Indonesia are in USD. This is to attract international investors, as the demand for green bonds issued in USD or EUR tends to be higher than for bonds issued in local currency, especially for countries with volatile local currency.

**Figure 1: Currencies and Maturity of Green Bonds Issued in 2017–2021**



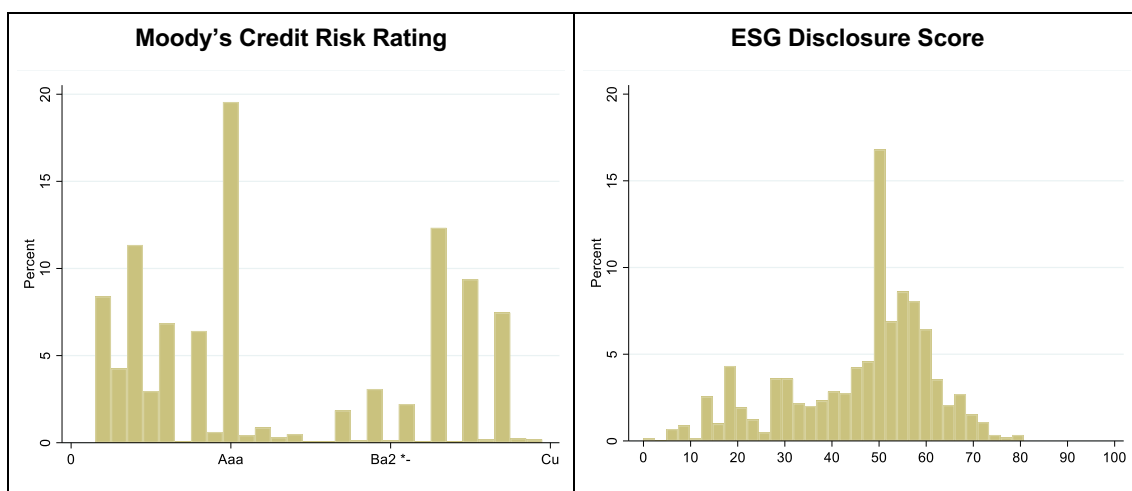
<sup>1</sup> Weighted by the share of green bond issuance of each bond of firm *i* in year *t* in total bond issuance of firm *i* in year *t*.

<sup>2</sup> Other currencies are excluded to avoid multicollinearity.

## 4.2 Firm Characteristics

We include the following firm characteristics, which can affect issuance of green bonds: Moody’s credit risk rating, environmental, social, and corporate governance (ESG) disclosure score, ESG reporting (=1 if reports), size (total assets), profit as a share of assets, dividend (=1 if paid dividends), financial leverage (debt as a share of equity), and tangibility (property, plant and equipment as a share of total assets). From the data we can see that Moody’s credit risk rating varies greatly across issuers of green bonds. ESG disclosure score is mainly around 50–60.

**Figure 2: Characteristics of Green Bond Issuers**



## 5. RESULTS

### 5.1 Main Results

We estimate the impact of green bond characteristics, firm characteristics, and COVID-19 impact on green bond issuance using annual firm-level data over the period 2017–2021 from 300 green bond issuers. The results of the fixed effects Poisson models are presented in Table 2. We obtained important results, which have policy implications on promoting green bonds.

#### 5.1.1 COVID-19

We could not find evidence of a statistically significant impact of COVID-19 on corporate green bond issuance (either using the COVID-19 stringency index or using a binary variable). Although the issuance of green bonds slowed down in 2020 (especially in the first half), later it recovered and the annual issuance of green bonds nearly tripled in 2021 comparing to 2020 (Figure 1). The temporary slowdown of green bond issuance was mainly due to the switch from the issuance of green bonds to pandemic bonds (especially in the People’s Republic of China [PRC]) by government. However, we exclude issuance of green bonds by government from this paper and only cover corporate green bonds. Another possible explanation for the insignificant effect of the pandemic is due to the annual country-level data used for the study, whereby the stringency measures for COVID-19 varied across months, provinces and even sectors.

### **5.1.2 Green Bond Characteristics**

All the green bond characteristics which we included have a significant impact on green bond issuance. Thus, green bond characteristics are major determinants of green bond issuance. Coupon rate, maturity, and currency are important green bond characteristics – determinants of green bond issuance.

#### **Coupon Rate**

The coupon rate of issued green bonds has a positive impact on green bond issuance. That implies that more green bonds (as a share in assets) are issued with a higher coupon rate and thus more green bonds are issued at a higher coupon rate in order to attract sufficient demand for them. Firms that can afford to issue with a higher coupon rate issue more green bonds.

#### **Maturity**

Maturity of issued green bond has a positive and statistically significant impact on green bond issuance. Firms with greater green bond issuance (as a share in total assets) issue green bonds with longer maturity. This means that issuers of green bonds prefer longer maturity. This result is consistent with existing literature. Green projects, such as renewable energy and green buildings, have a high upfront cost compared to the marginal cost and have a long project life (around 20 years). That is why the role of long-term investors—such as pension funds—in promoting green bonds is crucial. The governments can promote green bonds by stimulating demand for them from long-term investors, such as pension funds (for example, see the commitment of Japan's Government Pension Investment Fund to invest in green bonds).

#### **Currency**

The issuance of green bonds in EURO, USD, CNY, JPY, SEK currencies has a positive impact on the issuance of green bonds when compared to other currencies. Firms issuing more green bonds (as a share in total assets) are more likely to issue in the above currencies. This is probably because firms are expecting a better demand if green bonds are issued in these currencies. A better demand for green bonds issued in the above currencies is expected probably due to two reasons: (i) either the currency is strong; or (ii) the demand for green bonds with such currency is supported. For EURO and USD the result is not surprising because 3/4 of green bonds (over the period 2017–2021) were issued in EURO and USD (Figure 2). Issuers are trying to attract international investors when issuing in EUR or USD. This could be challenging for issuers from countries with volatile or depreciating local currency because revenue is received in local currency but payments of the interest rate for bonds will be in a foreign currency if issued in foreign currency, or they face the risk of low demand if issued in local currency. Governments can promote green bonds by (i) stimulating local demand for green bonds (such as tax incentives in Malaysia) or (ii) denominate revenues to foreign currency (EUR or USD) using policy instruments such as a feed-in tariff, which is a long-term contract of renewable energy generator with government with a promise of government to purchase electricity from renewable energy sources at the predetermined rate, which is usually above the current electricity rates. In a number of developing countries feed-in tariffs are denominated in foreign currency in order to attract investors.

**Table 2: Results of Random-Effects Poisson Regression**

<b>Variables</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
COVID-19, stringency index	0.00146 (0.00299)	0.00375 (0.00340)	0.00375 (0.00340)	0.00375 (0.00340)	0.0220 (0.0241)
<b>Bond characteristics</b>					
Coupon rate, log	1.566*** (0.301)	1.304*** (0.333)	1.304*** (0.333)	1.304*** (0.333)	1.406*** (0.445)
Maturity, log	0.966*** (0.183)	0.749*** (0.181)	0.749*** (0.181)	0.749*** (0.181)	0.822*** (0.180)
Currency (base=other):					
• CNY	5.293*** (1.001)	6.093*** (1.208)	6.093*** (1.208)	6.093*** (1.208)	5.773*** (1.232)
• EUR	4.163*** (0.995)	4.443*** (1.075)	4.443*** (1.075)	4.443*** (1.075)	4.245*** (1.103)
• JPY	5.153*** (0.857)	5.250*** (0.877)	5.250*** (0.877)	5.250*** (0.877)	4.835*** (1.015)
• SEK	5.366*** (0.919)	5.522*** (0.989)	5.522*** (0.989)	5.522*** (0.989)	5.174*** (1.043)
• USD	4.088*** (1.143)	4.237*** (1.225)	4.237*** (1.225)	4.237*** (1.225)	4.188*** (1.311)
<b>Issuer characteristics</b>					
Size (total assets)		-0.462** (0.213)	-0.462** (0.213)	-0.462** (0.213)	-0.379 (0.296)
Profit/assets		-1.549 (2.208)	-1.549 (2.208)	-1.549 (2.208)	-0.719 (2.788)
Dividend (=1 if paid dividends)		4.049*** (1.327)	4.049*** (1.327)	4.049*** (1.327)	4.160*** (1.317)
Leverage		-0.00269*** (0.000241)	-0.00269*** (0.000241)	-0.00269*** (0.000241)	-0.00243*** (0.000340)
Tangibility		1.768 (1.222)	1.768 (1.222)	1.768 (1.222)	0.949 (1.643)
Country control				Yes	Yes
Sector control			Yes	Yes	Yes
Time control					Yes
Observations	1,494	1,207	1,207	1,207	1,207
Number of issuers	300	244	244	244	244

Note: Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Number of countries = 37.

## 5.2 Robustness Check

For robustness check we used an alternative variable (i) COVID-19 binary variable (equals one if year = 2020 or 2021 and zero otherwise; and (ii) excluded time control variables. By comparing results from Table 2 with Table 3, we can see that the main results have survived the robustness check.

**Table 3: Robustness Check**

<b>Variables</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
COVID-19, binary	0.0840 (0.0897)	0.0829 (0.202)	0.0829 (0.202)	0.0829 (0.202)
<b>Bond characteristics</b>				
Coupon rate, log	1.416*** (0.284)	1.249*** (0.306)	1.249*** (0.306)	1.249*** (0.306)
Maturity, log	0.775*** (0.168)	0.658*** (0.213)	0.658*** (0.213)	0.658*** (0.213)
Currency (base=other):				
• CNY	4.994*** (0.966)	5.480*** (1.080)	5.480*** (1.080)	5.480*** (1.080)
• EUR	3.710*** (0.941)	3.800*** (1.010)	3.800*** (1.010)	3.800*** (1.010)
• JPY	4.699*** (0.760)	4.643*** (0.789)	4.643*** (0.789)	4.643*** (0.789)
• SEK	4.866*** (0.888)	4.795*** (0.961)	4.795*** (0.961)	4.795*** (0.961)
• USD	3.580*** (1.038)	3.637*** (1.105)	3.637*** (1.105)	3.637*** (1.105)
<b>Issuer characteristics</b>				
Size (total assets)		-0.224 (0.265)	-0.224 (0.265)	-0.224 (0.265)
Profit/assets		-4.011 (2.440)	-4.011 (2.440)	-4.011 (2.440)
Dividend (=1 if paid dividends)		3.581*** (1.194)	3.581*** (1.194)	3.581*** (1.194)
Leverage		-0.00116*** (0.000234)	-0.00116*** (0.000234)	-0.00116*** (0.000234)
Tangibility		1.445 (1.522)	1.445 (1.522)	1.445 (1.522)
Country control				Yes
Sector			Yes	Yes
Observations	1,494	1,207	1,207	1,207
Number of issuers	300	244	244	244

Note: Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1; Number of countries = 37.

## 6. CONCLUSION

This paper investigates the determinants of green bond issuance using annual firm-level data with 300 issuers of green bonds, which issued green bonds over the period 2017–2021. We find very interesting results which have policy implications for promoting green bonds.

We could not find evidence of a statistically significant impact of COVID-19 on corporate green bond issuance.

Green bond characteristics, including coupon rate, maturity, and currency, are major determinants of green bond issuance. Issuers of green bonds prefer longer maturity. Thus, governments can promote green bonds by stimulating demand for them from long-term investors, such as pension funds. Firms that can offer a higher coupon rate issue more green bonds. Policy support that increases the revenue of green projects, such as feed-in tariffs or subsidized loans, can promote the financing of green projects using green bonds. The issuance of green bonds in EURO, USD, CNY, JPY, SEK currencies has a positive impact on the issuance of green bonds when compared to other currencies. Policy support for issuing green bonds in countries with volatile or depreciating currencies could be provided for promoting the issuance of green bonds (i) by stimulating local demand for green bonds or (ii) by denominating revenues from green projects to foreign currency (EUR or USD) using policy instruments such as feed-in tariffs.

These results have some limitations mainly due to limited data availability. We used annual country-level data for COVID-19 stringency measures, however it would be better to use stringency measures for COVID-19 across months, provinces, and even sectors.

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## APPENDIX A

**Table A1. Description of Firm Characteristics Variables**

<b>Firm Characteristics</b>	<b>Description</b>
Moody's credit risk rating	Credit rating from the highest quality Aaa (minimal risk) to the lowest quality C (in default) <sup>a</sup>
ESG reporting score	Bloomberg ESG reporting score, which varies from zero (not reporting at all) to 100 (the full reporting).
ESG reporting	Binary variable which equals one if ESG information is reported and zero otherwise
Size	Logarithm of total assets
Profit	Operating income before depreciation/total assets
Dividend	Binary variable, which equals one if a firm paid dividends or zero otherwise
Leverage	Total debt, as a share in total assets
Tangibility	Property, plant and equipment/Total assets

<sup>a</sup> For more information see here [https://www.moodys.com/sites/products/productattachments/ap075378\\_1\\_1408\\_ki.pdf](https://www.moodys.com/sites/products/productattachments/ap075378_1_1408_ki.pdf).

**Table A2: Correlation Matrix**

	amts~d	cpn2	maturi~n	esgdis~2	esgprep~3	Size	profit	dividend	leverage	fcf	ssale	roa	roi	tangib~y	tltd	Inta
cpn2	-0.1334*	1														
maturity_d~n	0.1162*	-0.1456*	1													
esgdisclos~2	-0.1473*	0.0271	-0.1282	1												
esgreporti~3	0.0775	-0.1149*	-0.0105	-0.0929*	1											
size	0.1720*	-0.3489*	-0.0875	0.1686*	0.1383*	1										
profit	-0.2091*	0.0011	0.0683	0.0147	-0.0156	-0.1347*	1									
dividend	0.0291	-0.0312	0.053	-0.0301	-0.0126	-0.1235*	-0.0307	1								
leverage	-0.032	0.0618	-0.0373	-0.0588	0.0076	-0.0372	-0.0606*	-0.0003	1							
fcf	-0.2227	-0.1153	0.032	0.2928*	.	0.2353*	0.8710*	.	-0.1419*	1						
ssale	0.0949	-0.0884	-0.0463	0.0815	0.0544	0.4830*	0.0578	-0.1071*	-0.013	0.0843	1					
roa	-0.1512*	-0.0698	0.0427	0.0444	0.1540*	-0.0981*	0.6369*	0.0575*	-0.0458	0.4026*	-0.0076	1				
roi	-0.0982*	-0.0468	0.013	0.0909*	0.1848*	0.0093	0.5103*	0.0605*	-0.0393	0.0302	-0.0157	0.8926*	1			
tangibility	-0.2744*	0.0507	0.0843	-0.0545	-0.0816*	-0.1964*	0.4232*	-0.0836*	0.0275	0.7306*	-0.039	0.0869*	-0.0619*	1		
tltd	-0.1833*	0.0529	0.0381	-0.1643*	-0.0189	-0.1932*	0.0995*	-0.0206	0.1269*	0.2848*	-0.0975*	-0.0543*	-0.2142*	0.5270*	1	
Inta	0.1720*	-0.3489*	-0.0875	0.1686*	0.1383*	1.0000*	-0.1347*	-0.1235*	-0.0372	0.2353*	0.4830*	-0.0981*	0.0093	-0.1964*	-0.1932*	1
capex	0.1343*	-0.03	-0.0134	0.1099*	0.0417	0.3827*	0.2276*	-0.1915*	-0.0105	0.0926	0.6819*	0.0845*	0.0458	0.0453	-0.0746*	0.3827*