



Article

The Determinants of Green Bond Issuance in the European Union

Anamaria Dan and Adriana Tiron-Tudor * 

Department of Accounting and Audit, Faculty of Economics and Business Administration,
Babeş-Bolyai University, 400084 Cluj-Napoca, Romania; anamaria.dan@econ.ubbcluj.ro

* Correspondence: adriana.tiron@econ.ubbcluj.ro

Abstract: Green bonds are a new financial tool that has developed rapidly in the context of climate change risks. Their proceeds are used to finance only environmentally friendly projects. This paper aims to examine the determinant factors of the green bonds issue in the context of the European Union countries. Using linear regression, we explore the impact of environmental, social, governance, and macroeconomic indicators on the level of green bond issues in the period 2014–2019. The results reveal that rating, ESG index; fiscal balance, inflation rate, and population have a significant impact and lead to a higher volume of green bond issuances. Our findings provide valuable insights into the development of the green bond market.

Keywords: green bonds; ESG; sovereign rating



Citation: Dan, Anamaria, and Adriana Tiron-Tudor. 2021. The Determinants of Green Bond Issuance in the European Union. *Journal of Risk and Financial Management* 14: 446. <https://doi.org/10.3390/jrfm14090446>

Academic Editors: Tomas Kliestik, Maria Kovacova and Katarina Valaskova

Received: 26 August 2021
Accepted: 14 September 2021
Published: 16 September 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Climate change is a global phenomenon that has observable effects on the environment. One of the most claimed effects is global warming. In this context, the Paris Agreement is the first policy accord between 196 parties that invite action in response to climate change. This agreement highlights three significant objectives (UNFCCC 2015). The first objective is to limit the temperature increase below 2 °C, preferably 1.5 °C, from pre-industrial levels. The second objective is to foster climate resilience and low carbon greenhouse gas emissions without threatening food production. The final objective is to provide finance flows to achieve the previously stated aims. This international treaty was adopted in 2015 and required economic and social transformation over a 5-year cycle. In 2020, countries communicated their actions to achieve the pact goals, which are known as nationally determined contributions. Every five years, countries should assess the progress and report transparently on actions taken.

The transition to a low-carbon economy requires significant investments, so the attention is focused on finding financial sources to fund environmentally friendly projects. Bonds represent a feasible financial alternative to fund infrastructure projects (Tiron-Tudor et al. 2021). Thus, green bonds are new financial tools that provide direct financing for the economy. The International Capital Market Association (2018) provides the well-known definition of green bonds as “any bond instrument where the proceeds will be exclusively applied to finance or refinance, in part or full, new or existing eligible green projects”. These eligible green projects refer to the follows (1) renewable energy; (2) energy efficiency; (3) pollution prevention and control; (4) environmentally sustainable management of living natural resources and land use; (5) terrestrial and aquatic biodiversity conservation; (6) clean transportation; (7) sustainable water and wastewater management; (8) climate change adaptation; (9) eco-efficient and circular economy adapted products, production technologies; and (10) processes and green buildings. According to this definition, we observed that a wide range of issuers could use this financial instrument, from a firm to supranational institutions.

With a similar mechanism as conventional bonds, periodically interest payment and principal repayment at maturity, the difference consists of using proceeds for environmentally friendly projects. These can be labeled green and receive a certification by a second party opinion or independent third-party assurance. This certification provides security to investors regarding the use of funds and reduces greenwashing risks. In some cases, the issuer pretends higher commitment to environmental responsibility, which is only a form of marketing or has an insignificant impact on the environment. Even if the issuer enjoys a good reputation in the short term, the penalties will be harsh when the truth becomes known, leading to a loss of investor confidence.

The European Investment Bank made the first step in green financing in 2007 when it issued the first green bonds. The World Bank followed it in 2008. Today green bonds market reached over 260 billion USD worldwide (CBI 2019), with an ascendant trend after 2015 Paris Agreement, a crucial moment when the awareness of climate change was raised at international levels, and countries started to take action.

Another important step towards sustainability was taken by the European Commission (2019), which proposed the European Green Deal. This deal aims to transform the EU into "a fair, healthy, sustainable and prosperous society". This pact brings together all stakeholders with the incentive to have sustainable behavior and to undertake eco-friendly actions. The green deal promotes values such as science, responsibility, and commitment, transparency, no greenwashing, ambition and urgency, action tailored to the local context, diversity, and inclusiveness. The pact scope is to protect the natural capital and the citizens from environmental risks.

Since the European Union wants to become a climate-neutral economy by 2050, green bonds are key for achieving this objective. The green deal objectives require considerable investments, so green bonds help finance these types of projects. There will be a need for international cooperation and partnership to raise public and private funds to achieve the green objectives. In this vein, the European Commission elaborates legislation to foster investment in green projects. In 2021, a voluntary EU Green Bond Standard will be published that will increase transparency and harmonization in the green market. That will increase investor confidence and reduce the greenwashing effects leading to an efficient market.

The European Commission's strategy for sustainable finance involves a series of actions, such as adopting the taxonomy for classifying environmentally sustainable activities. That will facilitate the identification of sustainable investment. The EU taxonomy is a list of environmentally sustainable economic activities that will help implement the European Green Deal (Technical Expert Group 2019). The taxonomy sets a common language and clear definition for the users such as companies, investors, and policymakers. It also wants to protect the users from greenwashing. The taxonomy regulation has several environmental objectives set: climate change mitigation, climate change adaptation, the sustainable use and protection of water and marine resources, the transition to a circular economy, pollution prevention and control, and the conservation and restoration of biodiversity and ecosystems.

Another step is the demand for increased disclosure on climate and environmental data by public and private companies. The integration of climate and environmental risks into the financial system represents an essential action to sustainable finance.

The green bond market represents a key financial tool that can contribute to the achievement of the Paris Agreement objectives. It is vital to analyze the drivers of green bond market growth in the context of global warming. The objective of this paper is to examine the determinant factors of the green bond issuances in the European Union context. We want to find answers to the following research question: What are the determinants of green bond issuances?

This study focuses on the European Union green bond market since the EU plays a leading role in the global green market. The total value of green bonds issued in the EU

countries represents 40% of the total. In addition, the European Commission implemented several regulations to address climate change and to promote green financing.

The rest of the paper is structured as follows. Section 2 summarizes the literature on green bond market development. Section 3 describes the empirical model and methodology. Then we present and discuss the results. Finally, we present concluding remarks.

2. Literature Review

The recent trends move the attention from economic or financial indicators towards sustainability ones. In this context, green bonds as a new financing tool have become a much debated topic in the literature.

Due to the short period and heterogeneity between the sample, the literature about green bonds concentrates on qualitative studies rather than quantitative ones (Zhou and Cui 2019). We identified a large topic about the main benefits of issuing green bonds. The advantages highlighted can be summarized as follows: (1) insurance against environmental risks; (2) a strong reputation and social trust; (3) lower cost of debt, pricing advantage; (4) diversification and a large investor base; (5) strong oversubscription; (6) pro-active messages to stakeholders; and (7) strengthened reputation (Bachelet et al. 2019; Gilchrist et al. 2021; CBI 2016; Wiśniewski and Zieliński 2019).

On the other hand, financing through green bonds can present some disadvantages, like limiting the type of project. Moreover, the issuance imposes an additional cost for certification (Cheong and Choi 2020).

Although this market has grown rapidly, it represents a relatively small part of the financial market compared with conventional bonds. Therefore, scholars (Tolliver et al. 2020) have tried to identify the main obstacle in developing the green bond and provide potential solutions that are detailed in the Table 1 below.

Table 1. Green bond market barriers and solutions.

Barriers	Solutions
General bond market development challenges	Increasing green bond issuance and investment activity by national and local governments and multilateral development banks
Difficulties accessing local markets from abroad	Promote international collaboration and cross-border flows
Lack of green investors at the domestic level	Promote green bond integrity and raise awareness of benefits
Higher perception of risk for green investments	Providing credit enhancements, tax incentives, aggregation and securitization options, and other supply-side measures
Lack of awareness of benefits, existing international/local guidelines, and standards to identify eligible projects, a deficit of harmonized global standards	Supporting definition and framework standardization
Lack of labeled green bond, greenwashing risks	Label qualified bonds
Lack of bankable projects	Enhance roles of development finance and public institutions
Costs of meeting requirements	Reducing issuance, certification, reporting, and other administrative costs, tax incentives from Ministries of Finance
Lack of ratings, indices, second opinion, and listings	Develop indices, ratings, and stock exchange lists
Lack of green bond project impact information/mandatory disclosure from issuers	Regular reporting on environmental impact

Source: (Tolliver et al. 2020).

Pricing green bonds and the existence of greenium (the difference between conventional and green bond yields with the same characteristics) represent a large part of the empirical literature on green bonds. A recent study (Löffler et al. 2021) examines the difference between the yield of green bonds and conventional bonds. The evidence shows that the yields of green bonds are lower than those of conventional ones. Also, Cheong and

Choi (2020) review the literature about green bond pricing and identified mixed results. Still, most studies argue a positive greening that involves investors interested in projects that bring societal benefits. On the other hand, the opposite effects are explained by the novelty of the instrument and a limited investor base. These contrasting results can be explained by different methodologies, samples, and periods. MacAskill et al. (2020) reveal that the green premium is influenced by the bond sample characteristics such as bond type, bond credit rating, green bond principles, climate bond certified, third-party assessment, and issuer type.

Two theoretical paradigms can explain the difference between conventional and green bonds (Löffler et al. 2021). The first one refers to investor's pro-environmental preference. In this vein, investor are more interested in the environmental or social benefits of the project than in return. The asset pricing theory is the second paradigm that states that green bonds have lower risks compared to conventional ones. Considering that, issuing green bonds involve a more transparent and regular monitoring process.

The scholars did not investigate the drivers of green premium; thus, MacAskill et al. (2020) propose a tridimensional framework that includes social, economic, and environmental factors.

The cost of capital for green bonds can be lowered by improvements in credit quality, tax-based incentives, and green awareness (Agliardi and Agliardi 2019). Analyzing the Chinese green bond market, Li et al. (2020) find that credit rating, corporate social responsibility, and green certification lower the interest costs. In addition, issuer type and third party verification significantly impact yields, liquidity, and volatility of a green bond (Bachelet et al. 2019). There are differences between the institutional and private issuers, and the latter have less favorable conditions. Russo et al. (2021) analyze the green bond performance from three perspectives on a sample of 306 corporate green bond issuance between 2013–2016. Their results reveal that the green bond performance is influenced by the project financed and the issuer orientation towards sustainability.

The literature on determinants of green bonds is minimal. Chiesa and Barua (2019) are the first studies that analyze the security characteristics, issuer characteristics, and market characteristics on the green bond issue size. Their results reveal that coupon, rating, collateral, issuer's sector, and financial health influence the issue size. Going further, Barua and Chiesa (2019) find that various factors affect issue size but do not persist over time, and the rating grades change the relevance of the other variables. Using a structural equation model over panel data of green bond issuances in 49 countries, Tolliver et al. (2020) found that the index of Nationally Determined Contributions, macroeconomic and institutional factors lead to an increase in green bond issuances. The authors constructed the Nationally Determined Contribution index (NDC) and included 11 categories of country-specific pledges to achieve the Paris Agreement objective. On the other hand, in developing countries, the main drivers of green bond issuances are represented by legal infrastructure, interest rate, and economic stability (Anh Tu et al. 2020). Also, green public policies and the issuance of green bonds by the government are viewed as a win-win solution to the development of this market (Monasterolo and Raberto 2018). Zhou and Cui (2019) analyze the impact of green bond issuances in China. They found a positive effect on stock prices, profitability, operational performance, environmental improvement, and increased the company's corporate social responsibility.

Another group of papers studies the economic and environmental impact of green bond issuance, focusing on market reaction and economic value implication. From the shareholders' point of view, Baulkaran (2019) finds that green bonds are a value-added financing instrument. The stock market reacts positively to the announcement of green bond issuances, this effect is stronger for certified bonds (Flammer 2021). Pham and Huynh (2020) find that green bond market performance is influenced by investor attention measured as the daily Google Search Volume Index. On the other hand, Piñeiro-Chousa et al. (2021) analyzed the influence of social networks on investor sentiment. They reported

that social networks provide helpful information for investors that they consider in the decision-making process.

Macroeconomic and institutional factors influence the development of capital and the financial market (Tolliver et al. 2020). The size of the economy, trade openness, capital account, and the distance from the equator leads to the development of the government bond market, while the control of corruption and the quality of bureaucracy lead to the development of the corporate bond market (Eichengreen and Luengnaruemitchai 2004). Claessens et al. (2007) found similar results, but they also emphasize that the banking system and the stock market capitalization led to the development of the bond market. Banga (2019) states that the drivers of the green bond market are similar to conventional bonds. Also, the climate awareness from investors and the commitment of policymakers to counter climate change are essential determinants of the development of the green bond market.

Green finance has a different definition according to the priorities sets in developed and developing countries; for instance, coal finance is considered green in China while in Europe it is not (Gilchrist et al. 2021). The European market has a leading role in terms of volume, followed by the Asia-Pacific and North American markets (Cheong and Choi 2020). Halkos et al. (2020) measure the interdependencies between 96 countries around the world using network analysis. They find that European countries (Germany, Sweden, Luxembourg, the Netherlands, France, and United Kingdom) and the USA have the leading role in the green bond market and are the main suppliers in frequency and volume. Emerging market economies have a larger green bond issue than non-emerging economies (Chiesa and Barua 2019). In addition, they find that the impact factors of the issue size differ among emerging and non-emerging economies. The coupon rate and euro denomination of the bonds influenced both. However, the coupon rate has a positive influence in the emerging market. In contrast, the non-emerging market has a negative influence due to the Chinese bonds market influence and the leading role in the emerging economies. The issuer sector, financial indicators, and bond rating have a significant impact only in non-emerging economies. On the other hand, maturity, and *pari passu* influence the emerging market.

The Climate bond initiative grouped the green bond issuer in eight categories. We observe that the issuer type varies across the region; on the top, we find non-financial corporations, financial corporations, and Government-Backed Entities. In Europe and Latin America the green bonds are most frequently issue by non-financial corporations, while in North America, ABS is the first place. In the Asia Pacific region, the financial corporation represents the issuers most of the time. In terms of the project finance type, the energy, buildings, and transport projects are top priorities. Energy projects are a priority in all regions, except North America, where building projects are first, and energy projects take the second place.

The development of the green bond market differs around the world. In many countries, green bonds have not been issued yet. Our study wants to shed light on the drivers of the issuances in pioneer countries, which can be an example for other countries.

3. Model Description and Methodology

In the context of climate change risks, the European Union's priority is to become a climate-neutral economy. There is a considerable need for funds to develop environmentally friendly projects, and green bonds represent a way to obtain these resources. To explore the green bond issue, we construct a model that could impact the issue size of green bonds in the European Union market starting from previous studies (Chiesa and Barua 2019; Tolliver et al. 2020).

We choose the regression analysis because it allows us to examine the relationship between the variables of interest. Moreover, it reveals which factors have a more significant influence and helps to understand the patterns that occur in our data. Thus, regression anal-

ysis is an appropriate method of forecasting and finding the causal relationship between variables.

The parameters of the linear model were estimated through the Ordinary Least Squares regression method. First, we test the linearity between the dependent and independent variables; the scatterplots reveal that this assumption is met. The Variance Inflation Factor test shows that we do not have a multicollinearity problem in our data; the scores obtained are below 10. Then we examine the correlation matrix, and the Pearson Correlation coefficients do not show multicollinearity problem. The Durbin-Watson test (1.753) shows that the residuals are independent. The variance of residuals (homoscedasticity) is constant, as shown by the plot of standardized residuals and standardized predicted values. Our data do not show a heteroscedasticity problem according to the Breusch-Pagan test in SPSS. Cook’s distance values suggest that in our model, no influential cases are biasing.

The equation is presented below, and α_1 is the constant, β represents the estimated coefficient, i represent the issuer host country, t stands for the year of issuance, and ϵ is the error term.

$$\begin{aligned} \text{Issue_size}_{i,t} = & \alpha_1 + \beta_1 \text{ESG}_{i,t} + \beta_2 \text{rating}_{i,t} + \beta_3 \text{fiscal_balance}_{i,t} + \beta_4 \text{trade}_{i,t} \\ & + \beta_5 \text{inflation}_{i,t} + \beta_6 \text{unemployment}_{i,t} + \beta_7 \text{GDP_per_capita}_{i,t} \\ & + \beta_8 \text{population}_{i,t} + \epsilon_{i,t} \end{aligned}$$

4. Data Description

The dependent variable (issue_size) is the amount of funds raised through all green bond issues in a country in a respective year, measured in billion USD dollars. Data are collected from Climate Bond Initiative databases in the period 2014 to 2019. We limit our research on this period considering two reasons. First, is the data availability, and second is the amount issued. Finance through green bonds had recorded a higher level starting from 2014, when a consortium of the investment bank established the Green Bond Principles; these principles set a standard procedure for issuing green bonds and encourage transparency and comparability that increase the confidence of the market participants (Cheong and Choi 2020). In addition, MacAskill et al. (2020) review the literature of the green premium determinants, and observe that the analysed period is after 2013 due to data availability.

The independent variables were selected from empirical literature, and are detailed in Table 2 below:

Table 2. Green bond market barriers and solutions.

Variable	Variable Description	Data Source	Expected Effects	Literature
Issue	Sum of gross value of green bond issuances in a respective year	CBI		(Barua and Chiesa 2019; Chiesa and Barua 2019; Tolliver et al. 2020)
ESG	ESG risk rating of the issuer state of residence	Country risk.io	+	(Diouf and Hebb 2016; Li et al. 2020; Prajapati et al. 2021)
Rating	Numerical codes for the rating, measure the creditworthiness and riskiness of the issuer country	S&P, Moody’s, or Fitch	+	(Barua and Chiesa 2019; Li et al. 2020; Prajapati et al. 2021)
Fiscal_balance	General government net lending/borrowing (% of fiscal year GDP)	Eurostat	+	(Yamahaki et al. 2020)
Trade	Trade openness measure as the ration of exports to GDP	Eurostat	+	(Tolliver et al. 2020)
Inflation	Consumer price index	Eurostat	-	(Anh Tu et al. 2020; Tu and Rasoulinezhad 2021)

Table 2. Cont.

Variable	Variable Description	Data Source	Expected Effects	Literature
Unemployment	State unemployment rate	Eurostat	+	(Anh Tu et al. 2020)
GDP_per_capita	The gross domestic product of the country residence of the issuer divided by its population	Eurostat	+	(Glomsrød and Wei 2018; Tolliver et al. 2020)
Population	Total population, in logarithms	Eurostat	+	(Banga 2019)

Environmental, Social, and Governance risk index (ESG). Nowadays, investors move their attention to more soft aspects like environmental, social, and governance performance indicators when they decide to invest. ESG criteria are closely related to corporate social responsibility and socially responsible investment objectives (MacAskill et al. 2020). Ntsama et al. (2021) exposure as ways of responsible investing the elimination of companies with balance sheets that are not responsible or to rate companies on ESG indicators. The empirical studies (Capelle-Blancard et al. 2016, 2019; Berg et al. 2016; Crifo et al. 2017; Margaretic and Pouget 2018; Badía et al. 2019) reveal that the ESG indicators positively affect the bond market resumed in lower borrowing costs. Li et al. (2020) analyze the impact of ESG on the interest cost in the Chinese green bonds market and show that a higher ESG score led to lower yield spreads, a better financial condition, and a long-term orientation. Moreover, the extra financial performance has important economic roles at the country level (Berg et al. 2016; Margaretic and Pouget 2018). This supposed that countries have a long-term orientation, collaborate, and communicate with outside parties, leading to an increase in investor's trust. Besides, act as a buffer against adverse shocks, which is perceived as an extra guard against possible losses. ESG risk index provided by CountryRisk.io explain how its components will affect the long-term sustainability of a country. If the risk is higher, there is a more increased need for financing. Diouf and Hebb (2016) find that socially responsible investing is associated with the ESG issuer rating; the ESG rating influences the decision of the individual social investor. In addition, studying green bonds in India, Prajapati et al. (2021) reveal that ESG rating is an important determinant in investment decisions.

Rating. Credit rating agencies are an independent organization that analyzes an issuer's creditworthiness using various information. It is well known that credit ratings have a significant influence on the bond market. The issuer's credit rating impacts the investment decision in green bonds, and the issuer can attract more investors if they have good ratings (Prajapati et al. 2021). This fact leads by default to a large amount of green bond issues; Chiesa and Barua (2019) reveal the positive influence of rating on the issue amount. Also, Li et al. (2020) and Sheng et al. (2021) find that rating influence the spreads and yields of green bonds. Low ratings are associated with higher financing costs since it presents the issuer's ability to repay their debt and access capital market (Benito et al. 2016; Bastida et al. 2017; Wang et al. 2019). We used the sovereign rating provided by S&P, Moody's, or Fitch (according to rating availability) and transformed it into numerical variables of 1 (CCC) to 17 (AAA) following Capelle-Blancard et al. (2019).

Fiscal balance. Fiscal balance is an essential determinant of the bond market. Using a semi-structured interview with representatives of the Brazilian market, Yamahaki et al. (2020) reveal that fiscal balance may also influence the development of the green bond market. Previous studies disclose that if fiscal balanced improves, bond financing will decrease (Ahwireng-Obeng and Ahwireng-Obeng 2019). Also, stronger fiscal balances indirectly influence the spreads (Presbitero et al. 2016; Capelle-Blancard et al. 2019). Fiscal deficits have a significant and positive impact on bond spreads (Nickel et al. 2011; Balima and Combes 2019) and lead to increased government bond supply (Balima and Combes 2019). Considering previous work, we want to analyze if there exists a statistically significant influence of the fiscal balance on the level of green bonds issuances.

Trade openness. Trade openness represents the connection with the rest of the world. [Tolliver et al. \(2020\)](#) found that trade openness led to the growth of the green bond market. Previously studies also demonstrate that trade openness has an impact on financing costs. The importance of this macroeconomic indicator increases after the financial crisis, when [Capelle-Blancard et al. \(2019\)](#) findings reveal that a higher level of trade openness leads to lower bond spreads.

Inflation rate. In the literature, the inflation rate is perceived as the quality of economic management that directly influences the default risks. [Nickel et al. \(2011\)](#) stated that higher inflation rates lead to macroeconomic instability that lowers the government's creditworthiness. Also, the inflation rate plays an essential role in accessing long-term finance by new EU countries ([Alexopoulou et al. 2010](#)). Furthermore, [Presbitero et al. \(2016\)](#) find that higher inflation leads to a lower probability of issuing government bonds, and the issuances will have a higher borrowing cost. The inflation rate is a financial factor that influences the green market expansion, a higher level of inflation negatively affects the investor's decisions ([Anh Tu et al. 2020](#)). In addition, analyzing the OECD members [Tu and Rasoulnezhad \(2021\)](#) find that inflation has a negative and significant impact on energy efficiency. Therefore, investors consider inflation when they decided to finance energy efficiency projects.

Unemployment rate. The development of the green bond market is also linked with social factors like the unemployment rate. So, using the analytic hierarchy process, [Anh Tu et al. \(2020\)](#) find that expert's judgments consider the unemployment rate as a factor of influence of the issuance of green bonds. The literature reveals that higher unemployment rates lead to an increase in the debt level obtained with higher costs ([Greer and Denison 2016](#)).

Population. A large population constitutes an increasing demand for investment projects, which implies considerable financial resources. Green bonds can be used to attract money from investors to finance environmentally friendly projects. However, in countries with low population density, the green projects have a small size ([Banga 2019](#)). The country size is measure by the population number. [Presbitero et al. \(2016\)](#) find that the population positively influences the issue of government bonds.

Gross domestic product per capita (GDP_per_capita). The capacity to issue green bonds is positively influenced by the economy's size ([Tolliver et al. 2020](#)). Analyzing the drivers of issuance of sovereign bonds in developing countries, [Presbitero et al. \(2016\)](#) find that economic size, and higher per capita GDP characterize countries that frequently issue bonds. Also, [Glomsrød and Wei \(2018\)](#) also find that when green financing increases, the GDP levels increase worldwide. The level of growth is more pronounced in the European Union.

5. Results

5.1. Descriptive Statistics

In the period under analyses (2014 to 2019) we identified that in 19 countries, members of the European Union were issued green bonds. Countries such as France, Germany, Netherlands, and Sweden were issued green bonds in each year under analysis. These countries have the highest volume of issues representing over 60% of total issuance at the EU level. Small issues in terms of volume and frequencies are recorded in Portugal, Greece, Lithuania, Slovenia, Estonia, and Latvia. In nine countries (Bulgaria, Croatia, Cyprus, Czechia, Hungary, Luxembourg, Malta, Romania, and Slovakia), we do not identify issuances of green bonds. Luxembourg was the home of the first green issue in 2007 by the European Investment Bank.

The descriptive statistics of the variables are presented in Table 3. The average issue is 4 billion US dollars, with an extensive range from 0.01 to 30 billion US dollars. Also, a significant variance is identified in the variables about environmental, social, and governance. Considering the rating, Greece has a smaller rating (BB), and the higher ratings were obtained by Austria, Denmark, Germany, Netherlands, and Sweden (AAA). The overall rating is high with good qualification. In terms of fiscal balance as a percentage

of GDP, higher deficits are identified in Spain, while Denmark has budget surpluses. Trade openness as a percentage of GDP represents on average 101%; there is a significant variation, while Ireland has 239%, Italy has only 55%. On average, the inflation rate is 1.11%, and the unemployment rate is 7.71%. Higher levels of GDP per capita are registered in Ireland, and more minor levels are in Poland. The population was logarithm to remove the large-value bias in our sample.

Table 3. Descriptive statistics.

Element	Minimum	Maximum	Mean	Std. Deviation
Issue	0.0100	30.1000	4.1036	5.4284
ESG	11.4700	46.3400	20.7430	6.6296
Rating	6	17	13.90	3.0350
Fiscal_balance	−5.9000	3.8000	−0.94927	1.9306
Trade	55.3221	239.2151	101.4771	43.0959
Inflation	−0.6648	3.7230	1.1167	0.8961
Unemployment	3.1391	24.4413	7.7114	4.0232
GDP_per_capita	12,447	78,661	39,927	15,176
Population	14.0897	18.2359	16.7026	1.2327

Source: Author's calculation.

In Table 4, we provide the correlation matrix between our dependent variable and the independent ones. Among the selected variables, we did not identified a higher level of Pearson coefficients (above 0.8). Strong correlations are between rating and GDP per capita. Following Barua and Chiesa (2019), we use the Variance Inflation Factor tests and run OLS estimation with robust standard errors. The results obtained reveal that there is no multicollinearity problem.

Table 4. Correlation matrix.

Pearson Correlation	1	2	3	4	5	6	7	8	9
Issue	1.000								
ESG	−0.031	1.000							
Rating	0.275	−0.759	1.000						
Fiscal_balance	0.004	−0.528	0.252	1.000					
Trade	−0.179	−0.284	0.043	0.443	1.000				
Inflation	0.125	−0.287	0.097	0.245	0.131	1.000			
Unemployment	−0.047	0.681	−0.537	−0.552	−0.366	−0.365	1.000		
Population	0.437	0.226	0.069	−0.427	−0.606	−0.062	0.121	1.000	
GDP_per_capita	0.202	−0.435	0.690	0.213	0.261	−0.35	−0.294	−0.001	1.000

Source: Author's calculation.

5.2. Regression Results

The ordinary least squares regression results are presented in the Table 5. The regression result is significant ($p < 0.001$), and the R-squared value suggests that about 35% variation in the issue size is explained by the factors included in the analysis. Among the variables consider, the significant ones are the ESG index, rating, fiscal balance, inflation rate, and population. However, trade openness, unemployment rate, and GDP per capita have the expected sign but are not significant.

Table 5. Regression Results.

Variable	Coefficient	t	p-Value	VIF
(Constant)		−4.368	0.000	
ESG	0.328	1.845 *	0.070	4.376
Rating	1.184	2.708 ***	0.009	5.549
Fiscal_balance	0.811	2.034 **	0.046	1.870
Trade	0.024	1.198	0.236	2.342
Inflation	1.185	1.689 *	0.096	1.246
Unemployment	0.306	1.366	0.177	2.564
Population	2.306	3.604 ***	0.001	1.962
GDP_per_capita	0.00005	−0.835	0.407	2.626
N = 69	R = 0.595	R ² = 0.354	F = 4.116	Sig. = 0.001

Significance level: *** = 1%, ** = 5%, and. * = 10%.

Consistent with our expectation, the ESG has a positive and significant association with the issue of green bonds. A higher ESG risk score requires higher investment, and green bonds represent a way to fund the projects that will reduce the risk. Investors have moved their attention to non-financial aspects that can have an impact on the issuer's performances. To our knowledge, this is the first study that analyses the impact of the ESG index on green bond issuance and finds a significant impact. Previous studies (Capelle-Blancard et al. 2016, 2019; Berg et al. 2016; Crifo et al. 2017; Margaretic and Pouget 2018; Badía et al. 2019) assessed the impact on borrowing costs and revealed that ESG leads to lower costs. That will allow the issuer to access more capital. Moreover, the ESG score will increase the demand for green bonds considering the increasing confidence of investors, as shown by Prajapati et al. (2021). ESG rating influences the investment decision and can be used as an opportunity to access the financial market. The green bonds ensure diversity for the investors with specific implications on ESG related activities.

With respect to the sovereign rating, similar to Barua and Chiesa (2019), Benito et al. (2016), and Bastida et al. (2017), we find a positive and significant impact on green bond issues. Investors rely on a rating that is an evaluation tool that presents the issuer's risk of default. A higher rating increases the creditworthiness of the issuer, which can attract more sources. The policymakers should encourage the issuers to obtain a rating (bond rating, issuer rating). This would increase the green bond demand, and investors would perceive the bond as more secure and creditworthy. The rating is an essential factor in determining the market value of green bonds. To reduce the financing cost, it is necessary to improve the rating mechanism by including green information (Wang et al. 2019).

The coefficient of ESG is 0.328, with a *p*-value of less than 0.10, while the rating coefficient is 1.184, with a *p*-value of less than 0.05. These results show that sovereign rating has a gathering power on the green bond issuance amount over the ESG scores. The green bond market is in a beginning stage and in continuous development, and investors have no tools for evaluation. This can be one reason why the credit rating has a gather impact. Investors rely on ratings because it measures the default risk, mitigates against information asymmetry, and is a primary information source (Li et al. 2020).

Fiscal balance is another significant variable that led to an increase in the level of green bonds issuances. In the context of a sustainable economy, green bonds represent a viable way of funding the deficit. A higher level of deficits leads to an increased need for alternative sources of funding. Our result confirms the conclusions of the interviews obtained by Yamahaki et al. (2020) regarding the importance of the fiscal balance in developing the green bond market. Also, Balima and Combes (2019) had obtained similar results. A stable macroeconomic environment will increase investor trust, implicitly a higher demand for green bonds. The issuer should also focus on stabilizing the macroeconomic indicators when they intend to issue green bonds.

In our model, the population has a positive impact on the level of the green bond issue. This aligns with the findings of Presbitero et al. (2016) where issue size increase with the population number. This result can be explained by the fact that the country's size

can be measure by the number of its citizens, and the country has to meet the needs and requests of a large population. The population growth will require reliable and affordable green finance for climate change projects (Banga 2019). Also, the green bonds improve the population's quality of life and standards of living.

In contrast with our expectation inflation rate have a positive and significant influence on the level of green bond issuance. This result can be explained by the fact that the cost of green projects implementation rises in the context of a higher inflation rate, and more resources will be needed to find these projects. The state should create mechanisms to lower the inflation risk and to create an adequate environment for the investor (Anh Tu et al. 2020).

The other macroeconomic variables analyzed (i.e., trade, unemployment rate, and GDP per capita) have the expected sign, respectively lead to an increase of the issue volume of green bonds but does not have a statistically significant influence. This may lead us to think that in the green bond market, the economic factors lose their significance in front of the sustainability indicators. On this market prevails the impact of more soft aspects, considering the benefits of this financial tool in the fight against global warming. In this context, all the parties involved have to join forces for a common goal that has an impact on everyone's life.

Overall, our results confirm the increasing role of non-financial information. The orientation towards sustainability of the host country represents a determinant of the green bond issue. Investors also pay attention to environmental, social, and governance indicators. Sustainability being perceives as the ability to manage the green bond issues efficiently.

To access the financial market for funding the green projects request a good rating. Our results provide evidence that sovereign rating impacts the green bond market. The rating of the host country is essential for investors when they decide to invest. As Li et al. (2020) stated that green bonds are a new financial tool, and investors face difficulty assessing the potential risks, and ratings provide helpful information.

6. Conclusions

The global awareness of climate change risks moves the attention to new financial tools to finance the environmentally friendly projects. In this context, the green bonds become a viable financial instrument that their proceeds are used exclusively to finance eligible projects. This market had rapidly grown, but there are some biases because stakeholders do not understand the economic benefits, green bonds being perceived only as a communication instrument (Maltais and Nykvist 2020). The international institutions and organizations made considerable efforts to develop regulations and standards to better understanding of priorities, eligible projects, taxonomy, and financial instruments.

This study explores the link between the issue size of the green bond and identified factors in previous literature from diverse areas such as environmental, social, governance, and macroeconomic. Our results reveal that countries with a higher level of the green bond issue are firstly characterized by good ratings that increase investor confidence and a large population. Also, ESG risk index, inflation rate, and fiscal balance impact the issue level. These findings are consistent with our expectations and represent elements taken into consideration by investors when they decided to invest. We observe that non-financial performance information becomes more important in the issuances of green bonds, and the attention is moved towards more soft elements.

An implication of our findings is that ratings, ESG risk index are essential in the development of green bonds. Besides, the study brings added value to the literature on green bond development and determinants. Understanding the drivers of the green bond issue would help the market participants to make informed decisions. Our study would have policy implications because policymakers can consider this finding in order to promote the development of green financing.

We contribute to the literature by focusing on green bond market issuances and provide empirical evidence of a wide range of factors that influence the issue size. The analysis shows that the rating is the most critical factor that influences the issue size. The ratings help the issuer to attract more investment by increasing investor's trust. In this vein, it is vital for the issuer to obtain a rating. In addition, we show that macroeconomic stability (i.e., fiscal balance and inflation rate) impacts the green bond issuances. In addition, we provide the first evidence of the importance of the ESG risk index in developing the green bond market.

The investor motivation theories reveal that the decision to invest in a green bond is related to social, financial, and institutional factors (Prajapati et al. 2021). Also, the sustainable theory presents the maximization of the social value, which considers all stakeholders' needs as a core objective (Tolliver et al. 2021).

Further research can be undertaken by expanding the sample. Going beyond the European Union area could provide a piece of larger-scale evidence on the drivers of the green bond issue. In addition, additional variables about information disclosure and transparency could provide valuable insights. Dividing the sample into categories of the issuer could provide differences between the determinant factors.

Author Contributions: Conceptualization, A.D. and A.T.-T.; methodology, software, validation, formal analysis, investigation, resources, data curation, writing—original draft preparation, writing—review and editing were conducted by A.D.; supervision, A.T.-T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Databases used for this study are available on Eurostat and Climate Bonds Initiative.

Conflicts of Interest: The author declares no conflict of interest.

References

- Agliardi, Elettra, and Rossella Agliardi. 2019. Financing environmentally sustainable projects with green bonds. *Environment and Development Economics* 6: 608–23. [\[CrossRef\]](#)
- Ahwireng-Obeng, Asabea Shirley, and Frederick Ahwireng-Obeng. 2019. Macroeconomic determinants of sovereign bond market development in African emerging economies. *International Journal of Emerging Markets* 5: 651–69. [\[CrossRef\]](#)
- Alexopoulou, Ioana, Irina Bunda, and Annalisa Ferrando. 2010. Determinants of government bond spreads in new EU countries. *Eastern European Economics* 5: 5–37. [\[CrossRef\]](#)
- Anh Tu, Chuc, Ehsan Rasoulnezhad, and Tapan Sarker. 2020. Investigating solutions for the development of a green bond market: Evidence from analytic hierarchy process. *Finance Research Letters* 34: 1–5.
- Bachelet, Maria Jua, Leonardo Becchetti, and Stefano Manfredonia. 2019. The green bonds premium puzzle: The role of issuer characteristics and third-party verification. *Sustainability* 4: 1098. [\[CrossRef\]](#)
- Badía, Guillermo, Vicente Pina, and Lourdes Torres. 2019. Financial performance of government bond portfolios based on environmental, social and governance criteria. *Sustainability* 9: 2514. [\[CrossRef\]](#)
- Balima, Hippolyte Wenéyam, and Jean-Louis Combes. 2019. Remittances and bond yield spreads in emerging market economies. *Review of International Economics* 1: 448–67. [\[CrossRef\]](#)
- Banga, Josué. 2019. The green bond market: A potential source of climate finance for developing countries. *Journal of Sustainable Finance & Investment* 9: 17–32.
- Barua, Suborna, and Micol Chiesa. 2019. Sustainable financing practices through green bonds: What affects the funding size? *Business Strategy and the Environment* 6: 1131–47. [\[CrossRef\]](#)
- Bastida, Francisco, María-Dolores Guillamón, and Bernardino Benito. 2017. Fiscal transparency and the cost of sovereign debt. *International Review of Administrative Sciences* 1: 106–28. [\[CrossRef\]](#)
- Baulkaran, Vishaal. 2019. Stock market reaction to green bond issuance. *Journal of Asset Management* 20: 331–40. [\[CrossRef\]](#)
- Benito, Bernardino, María-Dolores Guillamón, and Francisco Bastida. 2016. The impact of transparency on the cost of sovereign debt in times of economic crisis. *Financial Accountability & Management* 3: 309–34.
- Berg, Florian, Paula Margaretic, and Sébastien Pouget. 2016. *Sovereign Bond Spreads and Extra-Financial Performance: An Empirical Analysis of Emerging Markets*. Santiago: Central Bank of Chile.

- Capelle-Blancard, Gunther, Patricia Crifo, Marc-Arthur Diaye, Bert Scholtens, and Rim Oueghlissi. 2016. Environmental, Social and Governance (ESG) Performance and Sovereign Bond Spreads: An Empirical Analysis of OECD Countries. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2874262 (accessed on 12 March 2021).
- Capelle-Blancard, Gunther, Patricia Crifo, Marc-Arthur Diaye, Rim Oueghlissi, and Bert Scholtens. 2019. Sovereign bond yield spreads and sustainability: An empirical analysis of OECD countries. *Journal of Banking & Finance* 98: 156–69.
- CBI—Climate Bond Initiative. 2016. Green Bond Labels and Standards. Available online: <https://www.climatebonds.net/files/files/Green%20Bond%20Labels%20and%20Standards%2010-06-2016.pdf> (accessed on 12 March 2021).
- CBI—Climate Bond Initiative. 2019. Green Bonds Global State of the Market 2019. Available online: https://www.climatebonds.net/system/tdf/reports/cbi_sotm_2019_vol1_04d.pdf?file=1&type=node&id=47577&force=0 (accessed on 12 March 2021).
- Cheong, Chiyoung, and Jaewon Choi. 2020. Green bonds: A survey. *Journal of Derivatives and Quantitative Studies: Seonmul yeon'gu* 28: 175–89. [CrossRef]
- Chiesa, Micol, and Suborna Barua. 2019. The surge of impact borrowing: The magnitude and determinants of green bond supply and its heterogeneity across markets. *Journal of Sustainable Finance & Investment* 9: 138–61.
- Claessens, Stijn, Daniela Klingebiel, and Sergio Schmukler. 2007. Government bonds in domestic and foreign currency: the role of institutional and macroeconomic factors. *Review of International Economics* 15: 370–413. [CrossRef]
- Crifo, Patricia, Marc-Arthur Diaye, and Rim Oueghlissi. 2017. The effect of countries' ESG ratings on their sovereign borrowing costs. *The Quarterly Review of Economics and Finance* 66: 13–20. [CrossRef]
- Diouf, Dominique, and Tessa Hebb. 2016. Exploring factors that influence social retail investors' decisions: Evidence from Desjardins fund. *Journal of Business Ethics* 134: 45–67. [CrossRef]
- Eichengreen, Barry, and Pipat Luengnaruemitchai. 2004. *Why Doesn't Asia Have Bigger Bond Markets?* w10576. Cambridge: National Bureau of Economic Research.
- European Commission. 2019. Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1596443911913&uri=CELEX:52019DC0640#document2> (accessed on 12 March 2021).
- Flammer, Caroline. 2021. Corporate green bonds. *Journal of Financial Economics* 30: 1–18. [CrossRef]
- Gilchrist, David, Jing Yu, and Rui Zhong. 2021. The Limits of Green Finance: A Survey of Literature in the Context of Green Bonds and Green Loans. *Sustainability* 2: 478. [CrossRef]
- Glomsrød, Solveig, and Taoyuan Wei. 2018. Business as unusual: The implications of fossil divestment and green bonds for financial flows, economic growth and energy market. *Energy for Sustainable Development* 44: 1–10. [CrossRef]
- Greer, Robert A., and Dwight V. Denison. 2016. Determinants of debt concentration at the state level. *Public Budgeting & Finance* 4: 111–30.
- Halkos, George, Shunsuke Managi, and Kyriaki Tsilika. 2020. Ranking Countries and Geographical Regions in the International Green Bond Transfer Network: A Computational Weighted Network Approach. *Computational Economics* 56: 1–46. [CrossRef]
- International Capital Market Association. 2018. Green Bond Principles Voluntary Process Guidelines for Issuing Green Bonds. Available online: <https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Green-Bonds-Principles-June-2018-270520.pdf> (accessed on 12 March 2021).
- Li, Zhiyong, Ying Tang, Jingya Wu, Junfeng Zhang, and Qi Lv. 2020. The interest costs of green bonds: Credit ratings, corporate social responsibility, and certification. *Emerging Markets Finance and Trade* 12: 2679–92. [CrossRef]
- Löffler, Kristin Ulrike, Aleksandar Petreski, and Andreas Stephan. 2021. Drivers of green bond issuance and new evidence on the “greenium”. *Eurasian Economic Review* 1: 1–24. [CrossRef]
- MacAskill, Stefan, Roca Eduardo, Liu Benjamin, Stewart Rodney, and Sahin Oz. 2020. Is there a green premium in the Green Bond market? Systematic literature review revealing premium determinants. *Journal of Cleaner Production* 280: 124491. [CrossRef]
- Maltais, Aaron, and Björn Nykvist. 2020. Understanding the role of green bonds in advancing sustainability. *Journal of Sustainable Finance & Investment* 10: 1–20.
- Margaretic, Paula, and Sébastien Pouget. 2018. Sovereign bond spreads and extra-financial performance: An empirical analysis of emerging markets. *International Review of Economics & Finance* 58: 340–55.
- Monasterolo, Irene, and Marco Raberto. 2018. The EIRIN flow-of-funds behavioural model of green fiscal policies and green sovereign bonds. *Ecological Economics* 144: 228–43. [CrossRef]
- Nickel, Christiane, Philipp Rother, and Jan-Christoph Ruelke. 2011. Fiscal variables and bond spreads—evidence from Eastern European countries and Turkey. *Applied Financial Economics* 17: 1291–307. [CrossRef]
- Ntsama, Ursule Yvanna Otek, Chen Yan, Alireza Nasiri, and Abdel Hamid Mbouombou Mboungam. 2021. Green bonds issuance: Insights in low-and middle-income countries. *International Journal of Corporate Social Responsibility* 6: 1–9.
- Pham, Linh, and Toan Luu Duc Huynh. 2020. How does investor attention influence the green bond market? *Finance Research Letters* 35: 101533. [CrossRef]
- Piñeiro-Chousa, Juan, M. Ángeles López-Cabarcos, Jérôme Caby, and Aleksandar Šević. 2021. The influence of investor sentiment on the green bond market. *Technological Forecasting and Social Change* 162: 120351. [CrossRef]
- Prajapati, Dhaval, Dipen Paul, Sushant Malik, and Dharmesh K. Mishra. 2021. Understanding the preference of individual retail investors on green bond in India: An empirical study. *Investment Management and Financial Innovations* 18: 177–89. [CrossRef]
- Presbitero, Andrea F., Dhaneshwar Ghura, Olumuyiwa S. Adedeji, and Lamin Njie. 2016. Sovereign bonds in developing countries: Drivers of issuance and spreads. *Review of Development Finance* 1: 1–15. [CrossRef]

- Russo, Angeloantonio, Massimo Mariani, and Alessandra Caragnano. 2021. Exploring the determinants of green bond issuance: Going beyond the long-lasting debate on performance consequences. *Business Strategy and the Environment* 1: 38–59. [CrossRef]
- Sheng, Qiaoyan, Xuan Zheng, and Nian Zhong. 2021. Financing for sustainability: Empirical analysis of green bond premium and issuer heterogeneity. *Natural Hazards* 107: 2641–51. [CrossRef]
- Technical Expert Group. 2019. Taxonomy: Final Report of the Technical Expert Group on Sustainable Finance. Available online: https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf (accessed on 12 March 2021).
- Tiron-Tudor, Adriana, Stefanescu Cristina, and Dan Anamaria. 2021. The Determinants of the municipal market in Romania. *Transylvanian Review of Administrative Sciences* 17: 175–92. [CrossRef]
- Tolliver, Clarence, Alexander Ryota Keeley, and Shunsuke Managi. 2020. Drivers of green bond market growth: The importance of Nationally Determined Contributions to the Paris Agreement and implications for sustainability. *Journal of Cleaner Production* 244: 118643. [CrossRef]
- Tolliver, Clarence, Hidemichi Fujii, Alexander Ryota Keeley, and Shunsuke Managi. 2021. Green innovation and finance in Asia. *Asian Economic Policy Review* 16: 67–87. [CrossRef]
- Tu, Chuc Anh, and Ehsan Rasoulinezhad. 2021. Energy efficiency financing and the role of green bond: Policies for post-Covid period. *China Finance Review International* 11: 1–16. [CrossRef]
- UNFCCC—United Nations Framework Convention on Climate Change. 2015. The Paris Agreement. Available online: https://unfccc.int/sites/default/files/english_paris_agreement.pdf (accessed on 12 March 2021).
- Wang, Qinghua, Yaning Zhou, Li Luo, and Junping Ji. 2019. Research on the factors affecting the risk premium of China's green bond issuance. *Sustainability* 11: 6394. [CrossRef]
- Wiśniewski, Marcin, and Jakub Zieliński. 2019. Green bonds as an innovative sovereign financial instrument. *Ekonomia i Prawo. Economics and Law* 1: 83–96. [CrossRef]
- Yamahaki, Camila, Annelise Vendramini Felsberg, Alexandre Köberle, Angelo Costa Gurgel, and Janaína Stewart-Richardson. 2020. Structural and specific barriers to the development of a green bond market in Brazil. *Journal of Sustainable Finance & Investment* 10: 1–18. [CrossRef]
- Zhou, Xiaoguang, and Yadi Cui. 2019. Green bonds, corporate performance, and corporate social responsibility. *Sustainability* 11: 6881. [CrossRef]