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GREEN BONDS AS THE DRIVING FORCE OF ENVIRONMENTAL PERFORMANCE – THE EUROPEAN PERSPECTIVE

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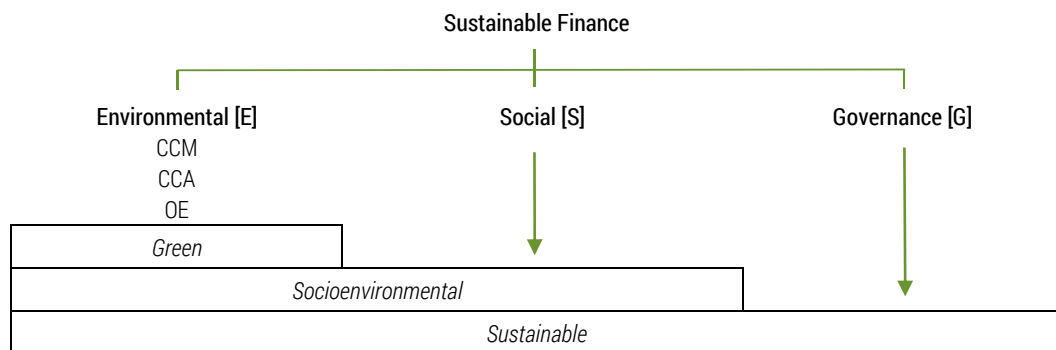
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ABSTRACT: This paper identifies regions with high environmental performance by assessing the size of green bond issuance in European countries from a cause-and-effect perspective. Cluster analysis and descriptive statistics were used to meet this research objective. The research subject was the size of green bond issuance, understood as the driving force for the green economy in European countries. The main findings of the research show a strong correlation between the size of green bond issuance and environmental performance. Due to limited access to source data, the analysis of green sources of financing was restricted only to the size of green bond issuance, excluding other funding sources. Identifying the regions with high environmental performance and high value of green bond issuance will allow for an effective support plan for pro-ecological actions by using soft and complex tools of green policy, bearing in mind existing limitations, too. This approach determines groups of countries that share similar features, i.e., the ones that take advantage of green projects financed by the issuance of green bonds and simultaneously have a high environmental performance index.

KEYWORDS: green finance, green economy, sustainable finance, green bonds, environmental performance

Introduction

Appropriate financing of different green projects is the critical factor that influences the development of a green economy to a great extent. Such financing is possible through green finance, which supports climate change mitigation and adaptation and other favourable environmental changes. Green finance is part of a larger concept known as sustainable finance. Sustainable finance applies to all ESG (Environmental, Social, Governance) factors; hence, this concept is broader than green finance (see Figure 1).



Note: ESG (Environmental, Social, Governance); CCM – Climate Change Mitigation „Low carbon“; CCA – Climate Change Adaptation; OE – Other Environmental.

Figure 1. The relation between green and sustainable finance

Source: authors' work based on the UNEP (2016).

The primary goal of green finance is to invest in initiatives that advance energy conservation and environmental protection. It encompasses diverse financial instruments, including green bonds, green credit, and climate finance. In economic practice, green bonds prevail (Wang et al., 2022; Wang & Taghizadeh-Hesary, 2023). Empirical studies have demonstrated that green finance policies can effectively support Environmental, Social, and Governance (ESG) objectives (Li et al., 2022; Sinha et al., 2021).

Green finance may be distinguished by different financing types depending on the classification method. The main category includes the subject being financed (see Figure 2).

According to the Green Bond Principles (GBP), “green bonds are any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance new or existing eligible green projects”. A “green bond” differs from a regular bond by its label, which signifies a commitment to use exclusively the funds raised to finance or re-finance “green” projects, assets, or business activi-

ties (International Capital Market Association, 2015). Green bonds are one of the financing options available to private firms and public entities to support climate and environmental investments. Investors are attracted to green bonds because they allow for a closer connection to positive social and environmental impacts (World Bank, 2015). Also, green bonds are gaining popularity among ecologically responsible and conventional investors who try to benefit from portfolio diversification and expect returns bigger than average.

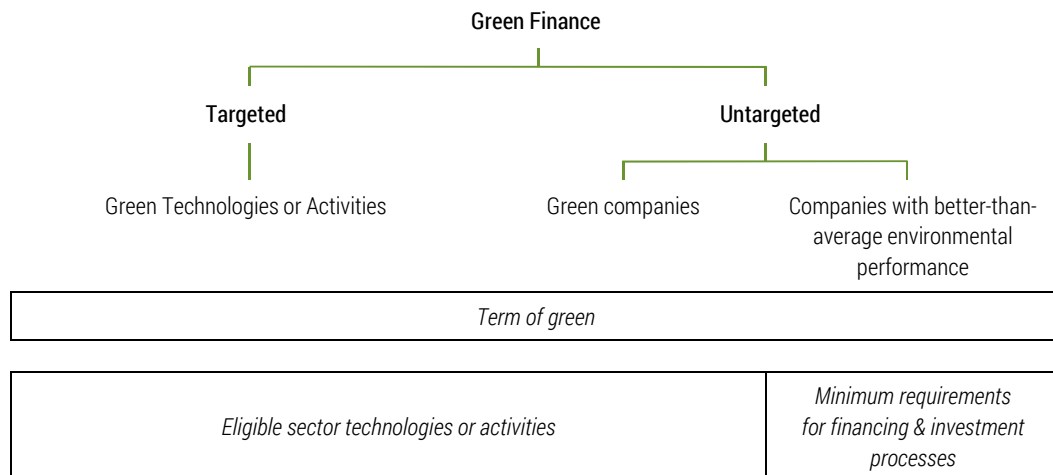


Figure 2. Types of green finance are classified according to the purpose

Source: authors' work based on European Commission (2017).

Public or private financing through the issuance of green investments is both environmental protection and investments to prevent, minimise, and compensate for environmental and climate damage, which are only part of green financing. This term also encompasses financing environmental protection policies, climate change mitigation, and adaptation. To meet such challenges as climate change or environmental degradation, the EU Green Deal has been established. It is to help transform the European Union into a modern, resource-efficient, and competitive economy. Despite different sources of green finance, this paper analyses the size of green bond issuance.

Increased demand for green bonds motivates private and public issuers to increase their issuance. The legally binding and joint Paris Agreement in 2015 played an unprecedented role in the extraordinary growth of green bond issuance. Green bond issuers, enjoying increased demand due to partial regulatory factors, can finance projects related to environmental protection. Naaraayanan et al. (2020), in the paper *The Real Effects of Environmental Activist Investing* suggest that engagements are an effective tool for long-term shareholders to address

climate change risks. Green bonds are also practical tools for issuers to achieve a lower cost of debt to finance green projects and for investors to support the transition to a more sustainable economy (Teti et al., 2022). Several studies have found that issuing green bonds can improve environmental, social, and governance performance (Flammer, 2021; Kanamura, 2020). However, an instant impact of green bonds on environmental changes should not be expected. The effect may come in the long-term perspective because ecological systems have long developmental cycles resulting from interactions between expenditure absorption and production of more extensive resources. Still, it is essential to regularly monitor the effects of green bonds on the environment, which offers the possibility of adjusting environmental policy to current challenges. The research is consistent with the trend concerning financing green projects within „green finance”, including implications for a green economy.

This paper is organised as follows: Section 2 presents the review of the literature; Section 3 discusses research methods; Section 4 indicates research results; Section 5 presents further discussion/limitations; Section 6 provides conclusion.

Review of the literature

There is relatively little research in the subject literature that presents factors that holistically influence the development of a green economy in Europe. Only a few research areas may be indicated, and they concentrate on:

- financing green projects within „green finance”, including implications for the green economy (Ozili, 2022; Chuah, 2020; Demirel et al., 2019), also indicates the investor’s perspective (Pastor et al., 2022; Starks et al., 2017),
- the results of introducing proper regulations (Wang et al., 2022; Peng et al., 2022),
- the results of agreements under the European Green Deal (Ciot, 2022),
- the development of technology and eco-innovations (Valério et al., 2023; Ennomotive, 2023; Lee et al., 2021).

This paper focuses on the first area mentioned above. We identify the regions with high environmental performance and the size of green bond issuance.

The green bond market has experienced rapid growth worldwide in recent years due to many reasons. From the investor’s perspective, green bonds may come with tax incentives (Heine et al., 2019), good investment performance (Kanamura, 2020), and diversification of investment returns (Nanayakkara & Colombage, 2019). Additionally, for socially responsible investors, there are environmentally friendly preferences (Zerbib, 2019).

The literature review results indicate an increasing interest in articles on green bonds in recent years. There were 46% publications more with the critical term green bonds in the Scopus database in Economics, Econometrics, and Finance than a year before.

The review of selected literature concerning the European market allows us to draw the following conclusions.

The research conducted in V4 countries shows that capital mobilisation, the development of the green financial market, investor demand, and reputational benefits are among the most important stimulants for issuing green government bonds (Hadaś-Dyduch et al., 2022).

The British market research by the Confederation of British Industries (2019) indicates that a lack of awareness of green finance, limited access to precise data, and inadequate policy pose limitations to their green bond issuance.

Based on Dutch market research, the main obstacle to developing green finance in the Netherlands is the lack of carbon prices and the uncertainty of government policies related to long-term green financing measures. The authors also indicate long payback periods for green investments, lack of venture capital, inadequate sustainability criteria, or small investment projects (Ermakova & Frolova, 2021).

Another research based on a sample of enterprises in selected European countries indicates the importance of governance factors in companies that issue green bonds and shows that the combined effect of board gender diversity and the issuer's debt maturity structure is positively related to green bond issuance (Cicchello et al., 2022).

The research by Björkholm and Lehner (2021) based on partly structured interviews assessed that, in general terms, Nordic issuers of green bonds welcomed positively the EU standard of green bonds in response to Green Building Standards (GBS). However, they also indicate that the standard as such goes with challenges such as time-consuming reporting practices or the risk of losing reputation. They also argue that the standard is unfair because it does not appeal to all countries and companies. Domestic regulations of particular European countries do not always follow the norm. For instance, the requirements concerning green buildings are perceived in Scandinavia as complex. Nordic issuers of green bonds are afraid that the market will not grow but will diminish instead.

In their article, Torvanger et al. (2021) compared the issuance of green bonds in Norway and Sweden between 2013 and 2019. Their research is one of the first comparative analyses designed especially to explain the differences in the size of green bond issuance between two similar financial markets. The research results show that Sweden recorded faster growth in issuance than Norway, especially in enterprises and municipalities. The interviews with experienced members of the green bonds market in Norway and Sweden led the research authors to conclude that it is probably due to business culture and Swedish financial institutions concentrating more on sustainable development and a more diversified company sector. According to the authors, disseminating green bonds in Norway could be more difficult because of the competition from highly profitable oil, gas, and shipping investments.

Chuah (2020), on the other hand, criticised green finance and argued that green financing will always have contractual constrictions, policy constraints, and finance prudential limits, which calls into question the usefulness of “green finance”.

Ozili (2022), in his research literature review, concluded that green finance has the potential to make a significant difference in the environment, society, and climate change mitigation. However, many challenges abound, such as a need for more awareness of green finance, inconsistent definitions, and a lack of profitable incentives for investors and financial institutions willing to invest in climate change mitigation.

A detailed review of the literature on green finance, including green bonds, in various aspects, is presented by among others: Bhutta et al. (2022), Cortellini and Panetta (2021), Kashi and Shah (2023) and environmental concern is one of them. The practitioners and researchers are trying to study the mechanism of funding for environment-friendly projects and how it affects its stakeholders. To the best of our understanding, no literature review is conducted to analyze the factors associated with the growth and the impact of green bonds on issuers' fundamental performance measures to meet Environmental, Social, and Governance (ESG).

Considering the literature mentioned above and the research gap, we have formulated the main research goal.

This research aims to identify regions with high environmental performance by assessing the size of green bonds (GB) issuance in European countries from a cause-and-effect perspective. Hence, two research hypotheses were formed herein:

H1: There is a positive correlation between the size of green bonds (GB) issuance and the environmental performance in European countries.

The preliminary assessment of this relation allows us to form such a hypothesis because issuers use financial resources obtained from green bond issuance to finance environmental projects. Our approach's environmental performance (EP) refers to three areas: Ecosystem Vitality, Environmental Health, and Climate Policy, which are reflected in the Environmental Performance Index (EPI). EPI, created by Yale University, provides a data-driven level of achievement of sustainable development by countries worldwide. We assume that the countries with high issuance records of green bonds also have high EPI scores.

H2: Nordic countries dominate in terms of green bonds (GB) issuance and environmental performance indicators.

It is emphasised that Nordic countries are of a unique modern character based on caring for natural resources (Czech, 2011; Veggeland, 2014). They have strong climate and energy policies (Aytikin, 2022). These countries are characterised by long-term traditions in terms of environmental protection. The societies in these countries, as first in Europe, indicated their readiness to bear the financial consequences of the activities supporting pro-ecological solutions.

Research methods

Implementing the research objective was feasible due to the selected quantitative methods. It resulted in operationalising the terms used in this article, i.e., green finance, socio-environmental finance, sustainable finance, and targeted and untargeted green finance. The literature review also allowed me to arrange collected research materials, summarise selected publications, and identify a research gap in the conducted study.

The study used data on the volume of green bond issuance published by the Climate Bonds Initiative, available from 2014 to 2022 (Climate Bond Initiative, 2022). The Environmental Performance Index (EPI) issued by the Yale Center for Environmental Law & Policy was chosen as a synthetic measure of the environmental efficiency of European countries. The EPI includes Ecosystem Vitality, Environmental Health, and Climate Policy. These three areas are represented by different indicators, which show how close the nations are to the assumed goals of environmental protection policy. General EPI rankings indicate which countries deal with environmental challenges best (Wolf et al., 2022).

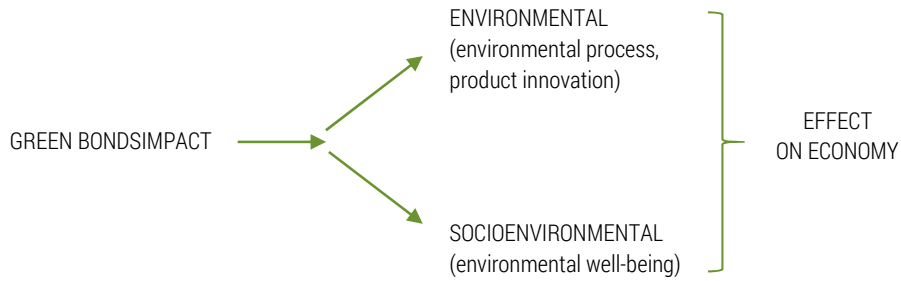
Quantitative methods allowed the implementation of the research objective. It was carried out by assessing the correlation between the size of green bonds and selected diagnostic features. Here, statistical methods such as descriptive statistics and cluster analysis were applied. This task was realised in three stages. The first stage involved a review of the global green bond market and the green bond market in selected European countries. In the second stage, European countries were grouped according to the size of green bond issuance, which allowed the identification of a strong, weak, and average group of countries regarding the size of green bond issuance per capita. The correlation analysis of the size of green bond issuance, including the indicator assessing environmental performance in selected countries, was conducted in the final stage.

The purpose of the paper is to identify regions with high environmental performance by approaching the assessment of the size of green bond issuance in European countries. Research attention was focused on explaining the diversity of European countries in terms of green bond issuance and environmental performance.

The quantitative analysis included correlation analysis and agglomeration clustering methods. Spearman's rank correlation was used in the study to measure monotonic dependence due to outliers in the dataset. The Ward method was used in the grouping process. As a result, the similarity structure of European countries is presented in a dendrogram, which shows the linkage distances of the forming clusters of the countries.

In addition to the literature review, the cause-and-effect approach was also adopted to measure the impact of green bonds on the green economy. This approach generates a logically ordered sequence of interrelated information

(Borys, 2006; Borys et al., 2022). Figure 3 presents a synthetic cause-and-effect approach used in the research.



Note: Environmental process and product innovation are treated in this study as green technologies or activities.

Figure 3. The effect of GB on the economy in a cause and effect approach

The authors realise the diversity of factors influencing environmental performance or facilitating the development of a green economy. Nevertheless, the conducted research may be the basis for further discussion.

Results of the research

In the first stage of the quantitative survey, we present the size of the green bonds market in Europe compared to other regions (see Figure 4).

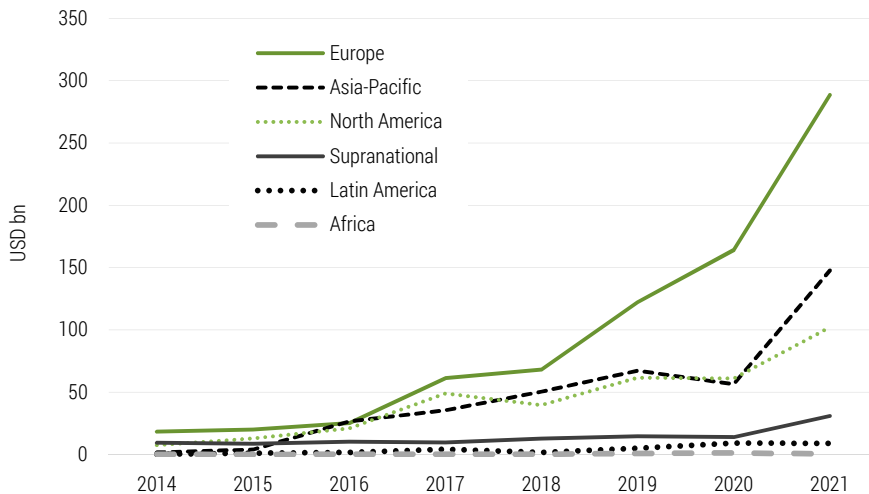


Figure 4. The value of green bonds issuance by region between 2014-2021

Source: authors' work based on Climate Bonds Initiative (2022).

The size of the global issuance was USD 578.4 billion in 2021, driven mainly by the European countries. Since 2018, the dynamics of the value of green bond issuance in Europe have been higher than in other regions, and as a result, in 2021, it accounted for 49.9% of the world issuance (Climate Bonds Initiative, 2022).

The issuers of green bonds include corporations (financial and non-financial), governments, local governments, credit institutions, asset-backed securities (ABS), development banks, and sovereigns.

In the further study stage, we present the size of the bonds market in selected European countries in absolute values and per capita (see Figure 5).

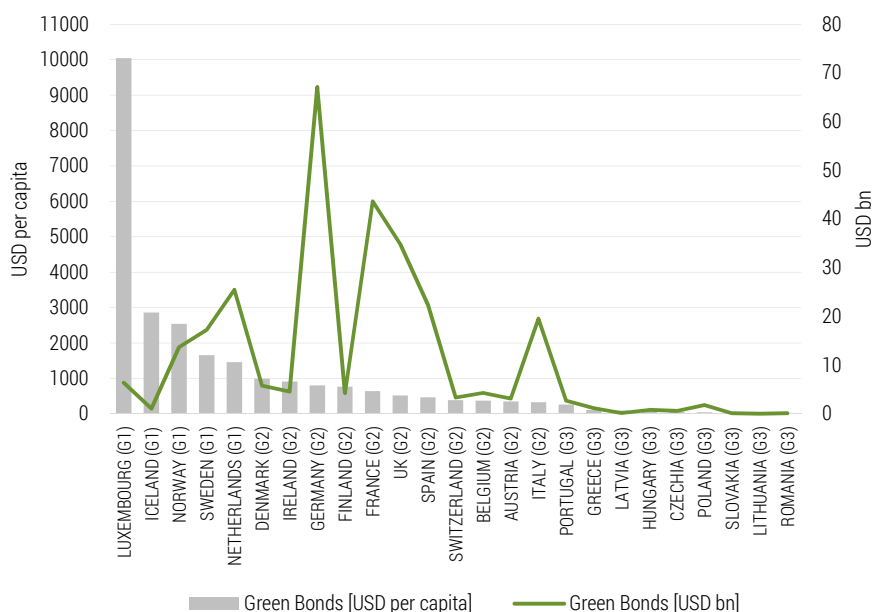


Figure 5. Green Bonds (USD per capita) and Green Bonds Total (USD billion) by country in Europe in 2021

Source: authors' work based on Climate Bonds Initiative (2022).

The unquestionable leader of green bond issuance per capita is Luxembourg. The grouping of linearly ordered 25 European countries according to GB issuance in USD per capita indicates three groups:

- G1: Luxembourg, Iceland, Norway, Sweden, Netherlands,
- G2: Denmark, Ireland, Germany, Finland, France, UK, Spain, Switzerland, Belgium, Austria, Italy,
- G3: Portugal, Greece, Latvia, Hungary, Czechia, Poland, Slovakia, Lithuania, Romania.

The first group with the highest issuance values per capita included three Nordic countries, and in the second group, two other Nordic countries ranked high.

The research results also show that Germany is the leader in issuing green bonds in absolute values. However, the growth rate of green bond issuance in particular countries was diversified. The dynamics of changes for the countries with the highest values of issuance are presented in Figure 6.

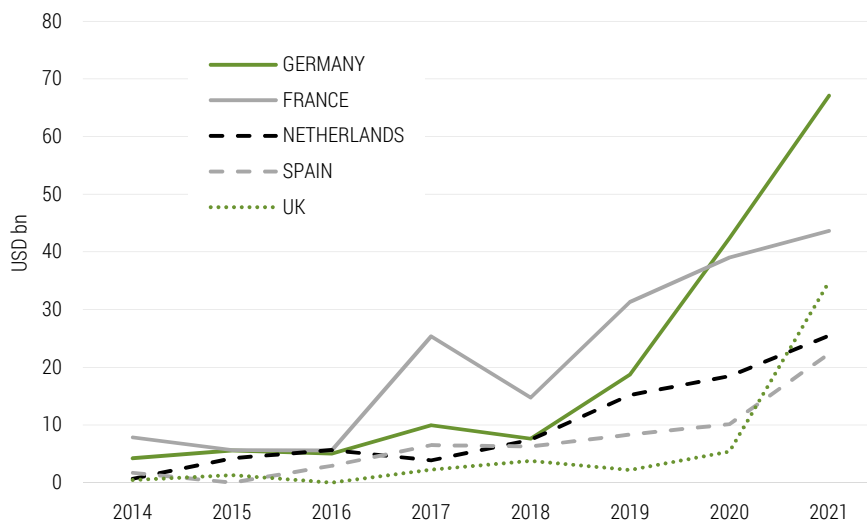


Figure 6. The value of green bonds issuance in selected European countries between 2014-2021

Source: authors' work based on Climate Bonds Initiative (2022).

The high growth rate in the size of issuance in particular European countries since 2019 may result from the expectations issuers had towards the adaptation of the EU Green Bonds Standard (EU GBS) in 2021, which was established due to the need to direct better financial and capital flows to green investments.

In the following research stage, we assessed the correlation between the size of green bond issuance and the Environmental Performance Index (EPI) between 2014 and 2022. H1 divided into five sub-periods is presented below (see Table 1).

The correlation between GB issuance per capita and EPI in the research periods increased regularly; however, only since 2018 was a statistical significance of the correlation shown.

Analysis of Environmental Performance Index (EPI) vs. GB issuance in USD per capita indicate the predominance of Nordic countries over other examined states (see Figure 7).

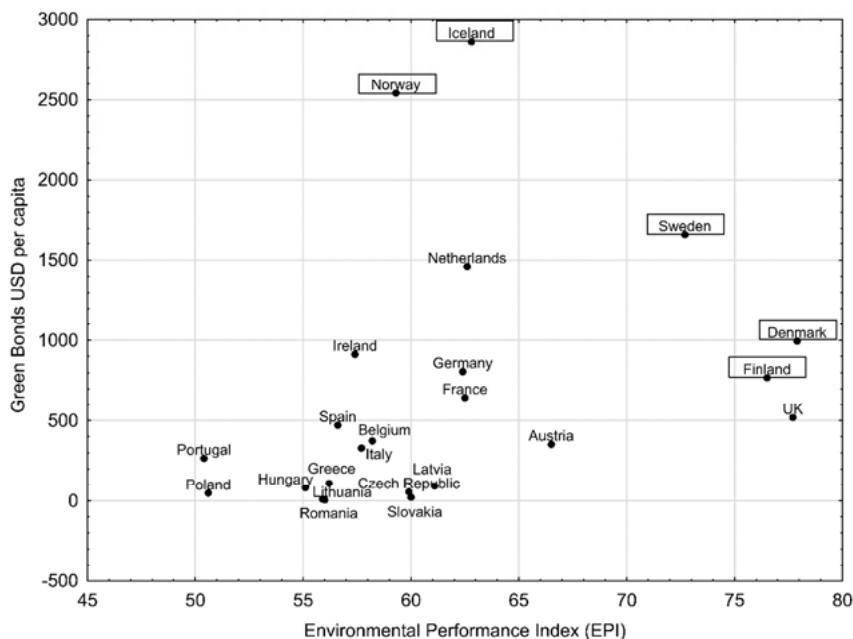
Table 1. Spearman's correlation coefficients between GB (USD per capita) and EPI

Value	Years				
	2014	2015-2016	2017-2018	2019-2020	2021-2022H1
rho	0.10	0.261	0.466*	0.621**	0.651**
p-value	0.798	0.348	0.038	0.003	<0.001
N	9	15	20	21	25

*p<0.05 ;**p<0.01

Note: EPI score values are calculated every two years.

Source: authors' work based on Climate Bonds Initiative (2022) and Wolf et al. (2022).



Note: The chart excludes Luxemburg as the outlier (GB=USD 10 042 per capita; EPI=72.3).

Figure 7. The diagram of the correlation between EPI (2022) and GB (USD per capita, 2021)

Source: authors' work based on Climate Bonds Initiative (2022) and Wolf et al. (2022).

The use of green energy sources requires financial resources also derived from the issuance of green bonds. To assess the structure of energy supply in European countries, we present energy supply in Europe by country, divided into different sources and those derived from black energy (see Table 2).

Table 2. Energy Supply by Country in Europe, 2019

Country	Renewable Energy Supply				Others (Oil, Coal, Natural Gas, Nuclear) [%]
	Biofuels and waste [%]	Wind, solar, etc. [%]	Hydro [%]	Total [%]	
	[1]	[2]	[3]	[1+2+3]	
Iceland	0	69	19	89	11
Norway	7	2	40	49	51
Latvia	38	0	4	42	58
Sweden	26	4	11	41	59
Denmark	30	10	0	40	60
Finland	33	2	3	38	62
Austria	19	3	11	32	68
Greece	15	7	4	26	74
Switzerland	11	1	13	25	75
Lithuania	22	2	0	24	76
Italy	10	6	3	19	81
Romania	12	2	4	19	81
Germany	10	5	1	16	84
Spain	7	7	2	15	85
Slovak Republic	11	0	2	14	86
Portugal	6	6	2	13	87
Serbia	7	1	5	13	87
United Kingdom	9	4	0	13	87
Ireland	6	6	1	13	87
Hungary	10	2	0	12	88
Czech Republic	11	1	0	12	88
France	7	2	2	11	89
Poland	9	1	0	11	89
Luxembourg	9	1	0	10	90
Belgium	7	2	0	9	91
Netherlands	6	2	0	8	92

Source: authors' work based on IEA (2022).

The analysis of the results presented in Table 2 shows that the leading positions in energy supply are occupied by Nordic countries, with Latvia ranked third as a country beyond this region. The unquestionable leader is Iceland, which uses as much as 89% of its energy from green sources. The distance between the Island and the county ranked second, i.e., Norway, is huge – as many as 40 percentage points. It results, to a great extent, from favourable geographical conditions. Island is the unquestionable leader in using wind and solar energy sun, and Norway in using hydropower. Sweden, Denmark, and Finland concentrate their green energy supplies on biofuels.

Figure 8 presents groups of European countries classified according to the structure of energy supply enumerated in Table 2.

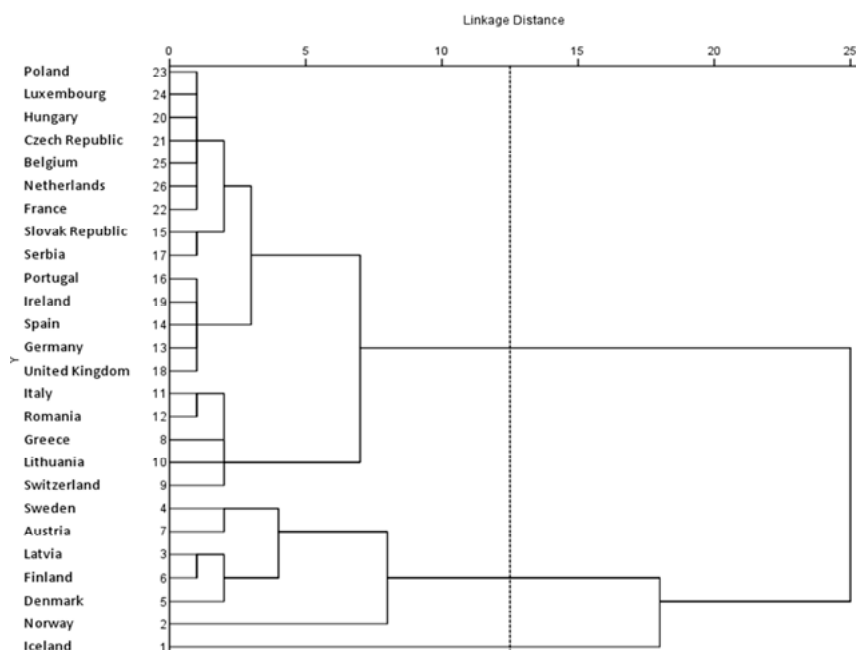


Figure 8. The dendrogram of regions grouping according to the structure of the energy supply

Source: authors' work based on IEA (2022).

Three separate groups of countries were distinguished in the grouping process. In the first group, there is only one country, Iceland; in the second, there are six countries, where apart from Nordic countries, there are also Austria and Latvia. The remaining examined countries are in the third group. Iceland is a dominating country in terms of the share of renewable energy supply, and, as shown in the dendrogram, the structure of energy supply for this country is similar to the structure of other Nordic countries.

Discussion / Limitation and Future Research

The research results show that the market of green bonds in Europe is growing. Many factors contribute to this phenomenon, such as international agreements or purely European regulations, but also increased social awareness, particularly in mitigating climate change. This study tries to determine if the size of green bond issuance influences the development of the green economy. We do not refer directly to the legal order in particular European countries, i.e., we do not assess the power of legal regulations or implemented tax incentives. However, we know these factors significantly influence the development of the green economy.

Also, we do not analyse all financing sources of green projects (loans, equity capital, bonds issuance) and their influence, smaller or bigger, on the development of a green economy, which also may be the subject of further, profound research and provide the opportunity to obtain answers concerning the availability of different financing sources and the assessment of the range of their influence. We are also aware that a multi-dimensional approach, which considers quantitative factors (e.g., different sources of financing green projects) and qualitative factors (features of a society in approaching environmental protection), would surely complete the image of this phenomenon. Another yet justified research direction may be to show to what extent legal regulations influence the development of the green economy.

The hypothesis assuming that 'there is a positive correlation between the size of green bonds (GB) issuance and environmental performance in European countries' has been confirmed for three sub-periods since 2017, and the correlation shows an upward trend. Based on the research results, it may be concluded that the countries recording high green bond issuance have a relatively high EPI score, which may result from properly conducted pro-ecological policy and greater social awareness concerning the management of natural resources.

The hypothesis that Nordic countries hold a strong position in bond issuance and environmental performance was verified positively. Many research projects confirm high ecological awareness of the communities in Nordic countries, which, in our research, constitute a strong group of countries (Bacsi, 2020; Rosenlund et al., 2020). Still, critical voices in the literature and journalistic texts also state that social pragmatism often drives pro-ecological activities in the Nordic countries. In contrast, the ecological awareness of society has only been an ideological superstructure since time immemorial, supported by conscious state actions, e.g., by conscious marketing (Lyytimäki, 2020). A critical look at modern silviculture in Sweden is well described by Zaremba Bielawski in his reportages (2014), who reveals illegal connections between lumber-producing companies and public administration, whose policies aim to convert forests into industrial crops.

Despite visible positive tendencies in the development of the green economy, it is also important to point out a few still harmful practices to minimise the effects of greenwashing or illusive activities in all dynamically developing movements and pro-ecological trends.

Conclusions

From a practical point of view, the possibility to finance green projects is crucial for developing the green economy. Investments in, especially renewable sources of energy are capital intensive. Research shows that countries with favourable geographical or geological conditions and higher social and economic development have greater access to financing (Wolf et al., 2022). Not only may it result from some economic viability, but it may also be due to higher ecological awareness of the society. Although motivation for pro-ecological activities may be used by different interest groups, it is hard to negate its positive effects. Unfortunately, there is not enough research here. Further research should focus on examining environmental performance. We formed a few questions for future research:

- Q1: What should green bond issuance size be to achieve the desired effects?
- Q2: Which type of financing has the most significant impact on achieving environmental outcomes?

European countries have been building a standard pro-ecological policy for a few years, which will undoubtedly increase the research in this area, but it creates new questions:

- Q3: How should environmental policy be conducted so that it has a positive impact on all stakeholders?

On the margins of this study, but essential, there are questions about greenwashing, e.g.:

- Q4: How to effectively recognise greenwashing in the activities of enterprises to avoid financing spurious activities (investor's perspective).

The formulated questions do not exhaust the catalogue of future research problems. However, at the moment, they are the most important.

The contribution of the authors

Conception, B.J. and K.M.; literature review, B.J. and K.M.; acquisition of data, B.J. and K.M.; analysis and interpretation of data, B.J. and K.M.

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ZIELONE OBLIGACJE JAKO STYMULANTA EFEKTYWNOŚCI ŚRODOWISKOWEJ – EUROPEJSKA PERSPEKTYWA

STRESZCZENIE: Celem badania jest wskazanie regionów, gdzie efektywność środowiskowa jest wysoka poprzez przyczynowo-skutkowe podejście do oceny wielkości emisji zielonych obligacji w krajach europejskich. Do realizacji celu badania wykorzystano analizę treści i opisowe metody statystyczne. Przedmiotem badań była wielkość emisji zielonych obligacji rozumiana jako jedna z sił napędowych zielonej gospodarki w krajach europejskich. Rezultaty badania wykazują silną zależność pomiędzy wielkością emisji zielonych obligacji a efektywnością środowiskową. Ze względu na ograniczony dostęp do danych źródłowych, analiza zielonych źródeł finansowania została zawężona tylko do wielkości emisji zielonych obligacji z pominięciem innych źródeł finansowania. Identyfikacja regionów o wysokiej efektywności środowiskowej i wysokiej wartości emisji zielonych obligacji pozwoli na skuteczne planowanie wspierania działań proekologicznych, poprzez wykorzystanie miękkich i twardych narzędzi polityki środowiskowej, mając na uwadze także istniejące ograniczenia. Podejście takie wskazuje grupy krajów o zbliżonych cechach, korzystających z zielonych projektów finansowanych przez emisję zielonych obligacji i jednocześnie mających wysoki wskaźnik efektywności środowiskowej.

SŁOWA KLUCZOWE: zielone finanse, zielona ekonomia, zrównoważone finanse, zielone obligacje, efektywność środowiskowa