energies

MDPI

Article

The Determinants of the Environmental Performance of EU Financial Institutions: An Empirical Study with a GLM Model

Konstantina Ragazou [1], Ioannis Passas [1], Alexandros Garefalakis [1,2], Eleni Zafeiriou [2,3,*] and Grigorios Kyriakopoulos [4]

[1] Department of Business Administration and Tourism, Hellenic Mediterranean University, GR71410 Heraklion, Greece; koragazo@uth.gr (K.R.); ipassas@hmu.gr (I.P.); agarefalakis@hmu.gr (A.G.)
[2] Department of Business Administration, Neapolis University Pafos, Paphos 8042, Cyprus
[3] Department of Agricultural Development, Democritus University of Thrace, GR68200 Orestiada, Greece
[4] School of Electrical and Computer Engineering, National Technical University of Athens (NTUA), GR15780 Zografou, Greece; gregkyr@chemeng.ntua.gr
* Correspondence: ezafeir@agro.duth.gr

Abstract: Within the last few decades, the issue of the environmental performance of European financial institutions has become a significant feature of their strategic plans. Financial institutions can contribute through their own activities and investments, and also through their relationship with economic sectors and consumers, in decreasing environmental footprint. The purpose of this research is to investigate the determinants that affect the environmental performance of European financial institutions. Financial markets have been selected as the main research field for this study, as it presents an opportunity for environmental policy and is useful in view of the need for a wider range of policy instruments. Moreover, on a more practical level, financial institutions can interact with the environment in several ways, such as investors, innovators, valuers, powerful stakeholders, and polluters. The study is based on a mixed methodology approach, which integrates: (i) bibliometric analysis based on R package and (ii) panel data analysis with the assistance of a generalized linear model (GLM). Findings show that socioeconomic, governance, and technology factors positively affect the environmental performance of European financial institutions. Moreover, the incorporation of alternative energy sources, such as renewable energy in the corporate function, is a requirement for greening the financial institutions. The above can guide financial institutions to develop the appropriate strategies for decreasing their environmental footprint, improving their operational efficiency, and becoming more attractive and competitive in the market.

Keywords: environmental performance; socio-economic determinants; renewable energy; GLM

Citation: Ragazou, K.; Passas, I.; Garefalakis, A.; Zafeiriou, E.; Kyriakopoulos, G. The Determinants of the Environmental Performance of EU Financial Institutions: An Empirical Study with a GLM Model. *Energies* **2022**, *15*, 5325. https://doi.org/10.3390/en15155325

Academic Editor: Behnam Zakeri

Received: 20 June 2022
Accepted: 21 July 2022
Published: 22 July 2022

1. Introduction

Within the last few decades, the adoption of environmental measures by financial institutions worldwide is in the core of their strategic plans, as they aim to improve their sustainability and viability. The irrational use of natural resources has led them to increase their environmental awareness. In this context, companies are trying to introduce as many practices as possible to decrease their ecological footprint and improve their environmental efficiency [1]. Businesses in the European Union (EU) have integrated the European environmental policy, which is subject to the principles of (i) provision, (ii) avoidance, (iii) remediation of environmental damage at source, and (iv) the principle of the "polluter pays" [2]. The multiannual environmental action plans set the framework for future action in all areas of environmental policy. They are now being integrated into horizontal strategies and discussed in international environmental negotiations. Recently, environmental policy has been at the heart of EU policymaking, with the European Commission launching the Europe Green Agreement as the key driver of its economic growth strategy [3,4].

The benefits that businesses can obtain by improving their environmental performance are plentiful, with the most important being the enhancement of financial performance. Initially, the adoption of environmentally friendly practices eases access into specific markets. Thus, a company that is characterized for its eco-friendly behavior can gain competitive advantage within the market. For the institutional investors, a firm's performance in terms of environment, society, and governance (environmental, social, and governance—ESG) practices is a significant determinant of risks and returns [5,6]. Each pillar represents a different measurable dimension, based on different criteria. The corporate environmental performance indicators related to the environment, involve carbon emissions, greenhouse gas emissions, climate change (risks posed by business activities), ecosystem changes, facilities that can cause environmental damage, business, permits, renewable energy sources, the depletion of natural resources, waste disposal, the use of toxic chemicals, and more. The social performance of the company is measured by criteria, such as child labor, discrimination, diversity (diversity of employees/councils), facilities that could pose social risks, the wage labor problems of employees, political contributions and risks, sexual harassment, and more [6]. Furthermore, corporate governance is measured using various indicators, such as the synthesis of the board of directors for executive compensation, executive remuneration, stakeholder relationship, stakeholder rights, distribution of positions, director's power, managers, shareholders, and others [7].

Investigating the environmental awareness of businesses at sector level, food, tourism, and construction are among the most environmentally aware. However, financial institutions have also been systematically involved in adopting good environmental practices, recognizing that the principles of sustainable development are a fundamental prerequisite for sound entrepreneurship [8,9]. That is why financial institutions have (i) begun to integrate environmental criteria into their business processes and (ii) develop strategies to continuously improve their environmental performance, reduce their environmental footprint, enhance green entrepreneurship, reduce the climate change risk, as well as the protection of biodiversity, to contribute to tackling the great social and environmental problems of the planet [9,10]. As part of the commitment of financial institutions to continuously reduce the environmental impact due to their operation, companies in the industry monitor and measure their environmental performance; set improvement goals; implement and evaluate environmental management and environmental protection actions, such as environmental protection programs and water waste management recycling; reduce travel; and promote green supplies. In addition, the extended use of new technologies contributes even more to the protection of the environment [11].

The scope of this study is twofold: (i) to map the research trend in the environmental practices adapted by EU financial institutions and (ii) to investigate the factors that mostly affect their environmental performance. A mixed methodology approach was applied in this research, which combines the elements of both qualitative and quantitative research and answers the research question. Moreover, the use of mixed methods contributes to gain a more complete perspective of the studied field than a self-sufficient quantitative or qualitative study, as it offers more benefits of both methods. From the side of qualitative research, a bibliometric analysis was applied to: (i) map the research trends of the environmental practices adopted by EU financial institutions and (ii) help in the variable selection process. About the bibliometric analysis, data were retrieved from Scopus database while results were analyzed with the use of the Biblioshiny tool based on R package and VOSviewer software. As for the second part of the analysis, 1005 observations were collected for the fiscal years (FY) 2018–2020, derived from Eikon Refinitiv powered by Thomson Reuters. The generalized linear model (GLM) was employed for the analysis of the panel data. The development of the GLM model was important, as this research aims to present which factors influence the environmental performance of the European financial institutions the most.

The paper is organized in six sections. Section 2 present the literature review with the use of bibliometric analysis. Section 3 presents the materials and methods used in this

paper. Section 4 shows the results of the GLM test. Section 5 discusses the results while Section 6 concludes it.

2. Literature Review

Factors Affecting the Sustainability Performance of Financial Institutions in Europe: The Role of Green Finance

The global financial sector plays a key role in promoting sustainable development. On the one hand, it has the potential to support the economy through the financing of finance activities that strengthen social cohesion and, on the other hand, guide customers and stakeholders to manage current social and environmental challenges more effectively [11].

As Europe aspires to become the first climate-neutral continent by 2050, significant investments will be required from both the public and private sectors to increase funding for the transition to a low-carbon economy. Based on this purpose, the "Sustainable Europe Investment Plan", which is the investment pillar of the Green Agreement, strives to activate funds of EUR 1 trillion for the next decade [12]. This will create a framework that supports coordinated private and public sector efforts to make the future of sustainable development a reality. The European Union has already formulated the integrated "Action Plan for Financing Sustainable Growth" (EU Action Plan for Financing Sustainable Growth), in response to the United Nations Global Sustainable Development Goals and the Paris Climate Agreement. The Action Plan has three main objectives: (i) to channel capital towards sustainable investment; (ii) to manage the financial risks arising from climate change, and to address the depletion of natural resources, environmental degradation, and disrupting social cohesion; and (iii) enhancing the transparency and long-term nature of financial and economic activities [13].

European financial institutions are closely following all developments in the implementation of the Action Plan for the Financing of Sustainable Development, as well as the new regulatory requirements, as we see that significant new opportunities are being created. Numerous European policies and guidelines are creating a new regulatory framework while investments in ESG (environmental, social, and governance) criteria are becoming increasingly interesting. In December 2019, the European Parliament and the European Council reached a political agreement on a unified classification system, known as the "EU Taxonomy", which deals with financially environmentally sustainable financial activities [14]. EU Taxonomy sets out a commonly accepted framework for which financial activities are considered environmentally sustainable and which are not, and it will be an important tool to facilitate the flow of funds to sustainable investments. In addition, other actions under the EU Action Plan, such as green bonds, climate benchmarks, and the release of ESG benchmarks, also help build a strong transparent framework for sustainable financing [15,16]. Moreover, financial institutions globally have committed to net-zero emission goals by working to address carbon emitted directly through their operations, as well as indirectly through activities, such as energy use. However, the real impact is going to come from acting in response to emissions up and down their value chains—including the entirety of their portfolios. So, amid these developments, financial institutions present and actively participate in global initiatives to design joint strategies and practices that will support sustainable development [17]. However, which are the key research trends of European financial institutions' strategies about ensuring environmental performance?

A bibliometric analysis was applied to answer to this question. Bibliometric analysis can be characterized as a well-known and precise method that contributes to the exploration and analysis of large volumes of scientific data [18]. Moreover, bibliometric analysis helps researchers to reveal the evolutionary subtle differences of a specific subject area while shedding light on the emerging areas in that field. Scopus database was selected as the main data source for the bibliometric analysis [19,20]. The data collection was carried out in May 2022 with the entered search terms to be the following: [("environmental performance" OR "sustainable performance" OR "sustainable management") AND ("financial sector" OR "financial institutions")]. The search was carried out in the English language, and

the examination for the keywords was undertaken in the titles, abstracts, main text, and authors' keywords of the published work in the research field. The Scopus bibliographic citation database includes various types of documents, but only original articles were considered in the present analysis. A sum of 497 documents were selected for this analysis. The records for each publication retrieved during the search were converted as a Scopus BibTex file and imported into Biblioshiny and VOSviewer software.

Figure 1 presents the network visualization based on the co-occurrence of authors' keywords. To visualize the co-occurrence of authors' keywords, VOSviewer tool was used. The size of each of the circle highlights the occurrence of the keywords. The bigger the size of the circle, the greater the frequency of authors' keywords. The similar color of the circles indicates the cluster of the keywords, while the lines between the circles show the link between the keywords [21]. A total of 44 keywords were selected and divided into seven clusters while each cluster was represented by a different color. Clusters in red and purple color highlighted the role of corporate governance as a critical one for the decrease in emissions of financial institutions and the improvement of their environmental performance. The difference between the two clusters is the following: clusters in red color illustrates the link among the board of directors, integrated reporting, and environmental performance, and the second one (in purple color) presents the relationship between corporate social responsibility (CSR) and environmental performance [22]. The relationship between integrated reporting and businesses' sustainable performance represents an unexplored area of interest [23,24]. In general, the role of integrated reporting in a sustainability framework has prompted a "conceptual debate". Therefore, the result of this discussion is the further investigation of the role of integrated reporting in the context of sustainability and the environment [25]. As for the relationship among the corporate social responsibility (CSR) and the environmental performance of financial institutions, it is worth mentioning that the environment is a key component of CSR [26]. Usually, CSR is referred to as the triple bottom line, as it consists of three components: profit, people, and planet. By focusing on the planet, CSR aims to reduce any harmful effects that come from businesses' processes.

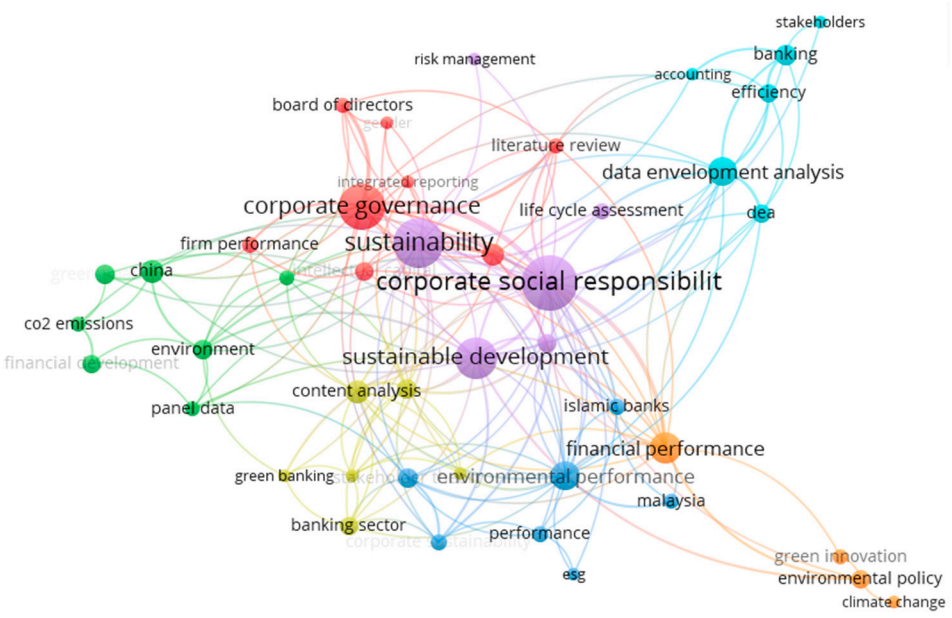

Figure 1. Co-citation analysis of authors' keywords. Source: Scopus/Biblioshiny.

In addition, Figure 2, which represents the thematic map, illustrates the importance of green innovation for the improvement of environmental performance. Green innovation refers to the significant advancement of technology that contributes to sustainable development, reducing the impact of business on the environment, enhancing resilience to environmental pressures or achieving more efficient and responsible use of natural re-

sources. [27]. By supporting new processes, technologies, and services that make business more environmentally friendly, green innovation helps Europe to optimize its growth potential while tackling common challenges, such as climate change, resource depletion, and biodiversity reduction. Moreover, green innovation is an opportunity for businesses, while it leads to cost reduction, contributes to the development of new growth opportunities, and improves the image of the company [28]. That is why the EU must accelerate the implementation of successful business and industrial development ideas by removing economic and regulatory barriers and promoting investment, demand, and awareness.

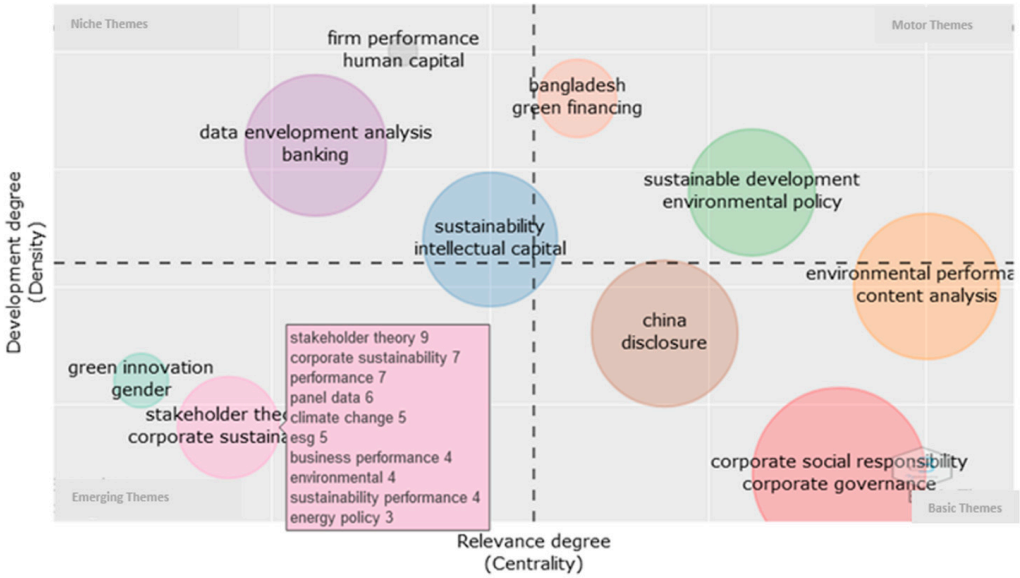

Figure 2. Thematic map. Source: Scopus/Biblioshiny.

Figure 3 shows the factorial analysis based on the multiple correspondence analysis (MCA). MCA method is used to define, examine, and visualize the relationship among two or more categorical variables. The visualization of the results is presented in a conceptual structure map [18]. In the current research, the map of the MCA method shows the clustering of documents and indicates the importance of emerging technologies in the environmental performance of financial institutions. This can be understood by the concept of green banking, which is included in the cluster in red color. The changing expectations of consumers, the technological transformation, and the evolution of human resources, combined with the pressure of the regulatory environment and intense competition, has radically change the banking landscape [28,29]. To meet these challenges, banking and insurance institutions will need to prioritize new skills, build a green environment that encourages innovation, meets customer needs, and incorporate a deeper meaning and vision into their strategy. Upcoming changes will be sweeping and the need for adjustment immediate.

So, based on the above description, the hypotheses in this study are as follows:

Hypothesis 1 (H1). *Energy productivity has a positive effect on emission score.*

Hypothesis 2 (H2). *Environmental innovation score has a positive effect on emission score.*

Hypothesis 3 (H3). *Percentage of ICT sector in GDP has a positive effect on emission score.*

Hypothesis 4 (H4). *Management score has a positive effect on emission score.*

Hypothesis 5 (H5). *Renewable energy has a positive effect on emission score.*

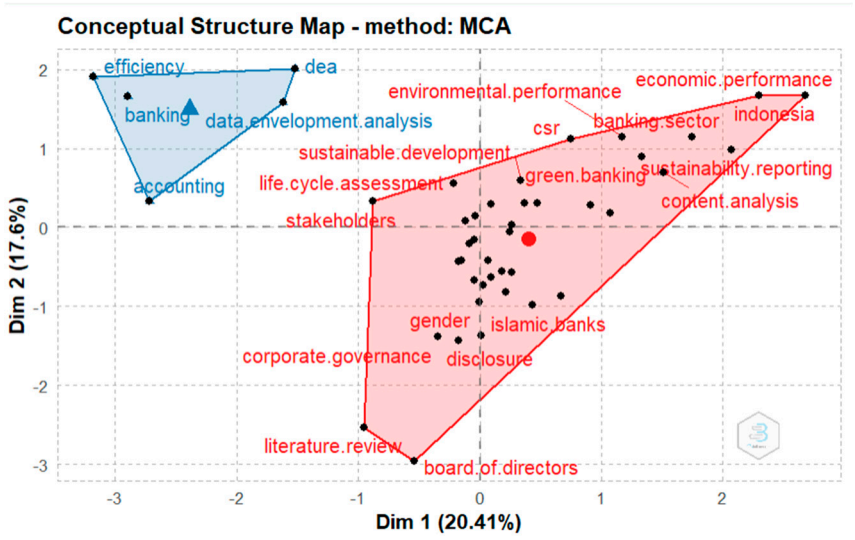

Figure 3. Factorial analysis based on MCA method. Source: Scopus-Biblioshiny.

3. Materials and Methods

3.1. Data

The sample of the present study involves annual data for 335 companies in financial industry and are headquartered in Europe. Table 1 indicates the number of the firms per country, where all the countries are well represented in the top five European economies, United Kingdom, France, Germany, Sweden, and Italy, which comprise over the 70% of the studied sample. The data were extracted from the following databases: (i) Refintiv Eikon powered by Thomson Reuters and (ii) Eurostat. Eikon is one of the biggest financial market databases globally, which provides access to information relevant for macro analysis, asset allocation strategy, and sector research. The retrieved data consider the Fiscal Years (FY) 2018, 2019, 2020.

Table 1. Firms included in the sample per country. Source: Authors' own elaboration.

Country	Number of Companies
Austria	4
Belgium	6
Czech Republic	3
Denmark	9
Finland	5
France	12
Germany	23
Ireland	3
Italy	15
Netherlands	8
Poland	26
Portugal	1
Sweden	37
United Kingdom	183
Total	335

3.2. Variables

The variables employed for the present study are present in Table 2, while in the coming paragraphs are provided in the model and the estimation results.

Table 2. Variables of the study. Source: Own elaboration.

Symbols	Variables	Measures	Source
EMISSCO	Emission Score	This score is developed by Thomson Reuters database.	Thomson Reuters (Refinitiv Eikon)
ENERPRODUC	Energy productivity (euro per kilogram of oil equivalent)	An indicator that measures the amount of economic output that is produced per unit of gross available energy.	Eurostat
ENVIROINNOV	Environmental Innovation Score	This score is developed by Thomson Reuters database.	Eurostat
ICTGDP	Percentage of the ICT sector in GDP	The percentage share is calculated by dividing the value added in the ICT sector, by the value added in all sectors (all NACE activities).	Eurostat
MANGSCOR	Management Score	This score is developed by Thomson Reuters database.	Thomson Reuters (Refinitiv Eikon)
RENEWABL	Share of renewable energy in gross final energy consumption by sector (%)	The indicator measures the share of renewable energy consumption in gross final energy consumption according to the renewable energy directive.	Eurostat

Dependent variable:

Emission Score. This study selects emission score to investigate environmental performance of European financial institutions. Emission score is referred to the measurement of a company's dedication and efficacy towards the decrease in environmental emission that comes from the operational processes of businesses. Data for the dependent variable were collected from Thomson Reuters' database [30].

Exogenous Variables:

Energy productivity (euro per kilogram of oil equivalent). The particular variable denotes the value of economic output generated by energy quantities at the disposal of the research area synopsized in the concept of gross available energy.

Environmental Innovation Score. The particular index denotes a firm's ability to limit the environment-related corporate costs and to extent its market share, by using the design of eco-friendly products or by adopting environmentally friendly processes and technologies. The data for this variable were retrieved from Thomson Reuters database [30].

Percentage of the ICT sector in GDP. The ICT role in the corporate performance related to the knowledge economy, investments allure, and innovation creation has become vital within the last two decades. Implicitly the sector of information and communication technologies (ICT) and its applications to other sectors enhances economic growth, innovation, and competitiveness across European economies. Therefore, ICT industries provide increased productivity and efficiency. The value of production is based on the value-added concept and is calculated by the result of the ICT sector divided by total value added. Dividing the value added in the ICT sector by the value added generated by all sectors provides the percentage share (all NACE activities) [31–33].

Management Score. The particular index reflects corporate commitment and effectiveness in the adoption of best corporate governance practices. Thomson Reuters is the source database [30].

Share of renewable energy in gross final energy consumption by sector (%). The last exogenous variable measures the share of renewable energy consumption used as a fraction of gross final energy consumption in accordance with the renewable energy directive. The denominator denotes the energy used by end-consumers (final energy consumption) added to grid losses and self-consumption of power plants. The calculation of the particular index

is based on Directive 2009/28/EC, that involves the expansion of the use of renewable energy. The particular index was based on data collected in compliance with the framework of Regulation (EC) No 1099/2008 on energy statistics along with data derived by Eurostat (collected by national administration offices). In some countries, the statistics collection is not in accordance with Directive 2009/28/EC, instead mainly on the measurement ambient heat captured from the environment by heat pumps [34].

3.3. Generalized Linear Model (GLM) Regression

Nelder and McCullagh (1972) describe generalized linear models (GLM) as a class of statistical models, which include linear regression, dispersion analysis, logit and probit, and logarithmic and polynomial models. The above series of models share some common characteristics while they have a common parameter estimation method. These common properties allow researchers globally to study through GLM models, a wide range of statistical models, despite each of them being stored separately.

The present analysis involves a panel data analysis for 335 financial institutions in the European Union, while the period studied includes three fiscal years. The methodology employed to estimate our model is the generalized linear model, which outperforms the ordinary linear models.

The model to be estimated is described by the following equation;

$$EMISSCO_{it} = f(X_{it}) \quad (1)$$

where, $EMISSCO_{it}$ denotes the emission score and X_{it} denote the independent variables that are analytically described in Table 2.

The ingredients of the particular model involve a random component, a systematic component, and a link function. The model estimation was based on Newton Raphson, while the link function g is the one that 'links' the predictors in a model with the expected value of the dependent variable in a linear form. More specifically the relationship $\eta_i = g(\mu_i)$ is validated and for n cross-section data. The function g is the selected function that, in our case, is the identity function [35]. The particular function was selected given that our endogenous variable is continuous while the distribution of the exogenous variable is difficult to be specified [36]. Regarding the response variable the estimation results are based on the assumption that the moments of first and second order are known apriori. In addition, the mean and variance of Y are provided by the following formulas;

$$\mu = E\,(Y), \text{Var}\,(Y) = a\,(\varphi)\cdot V\,(\mu)$$

φ denotes the dispersion parameter, and $a\,(\cdot)$ and $V\,(\cdot)$ are known functions. Wedderburn [37] proposed the quasi-likelihood method.

The methodology implementation provides an estimate for the $g(\mu_i)$'s, and, therefore, an estimate for the μ_i's. The particular models (GLMs) are significantly more complex than ordinary least squares models. Given that we have n data $(X_1, X_2, \ldots . X_p, \text{Yi}) \epsilon R^{p+1}$ for $i = 1, 2, 3, \ldots . n$, we intend to build a model of the response y using the impact of the exogenous variables, namely $X_1, X_2, \ldots . X_p$. Moreover, in the case of cross-section data, heteroscedasticity is a common problem in model estimation. In our case, the quasi-likelihood function of the samples is provided by the following formula;

$$Q(\mu; y) = \sum_{i=1}^{k} Q_i(\mu_i; y_i) = \sum_{i=1}^{k} \int_{y_i}^{k_i} F(t)dt = \sum_{i=1}^{k} \int_{y_i}^{k_i} \frac{y_i - t}{a(\varphi)V(t)}dt \quad (2)$$

The parameter to be estimated is the emission score. All the covariate data $X_\beta X_\beta$ provide information to the value of the independent variables. More specifically, the estimation involves the expected value of the response vector. The covariates of the present model take into consideration environmental innovation, energy productivity, management score, renewables, and ICT GDP.

4. Results

In this research, Eviews 12 software was used for the estimation of the results. To examine the effects on emission score, a generalized linear model (GLM) regression was applied. Findings from the GLM model were estimated by an exponential mean Quasi-likelihood function and the Newton-Raphson/Marquardt steps methodology. Moreover, Huber–White method was used to eliminate the impact of misspecifications in the discrete choice models. Namely, the Huber–White correction provides asymptotically correct standard errors from a misspecified model for a consistent estimator.

Prior to the presentation of the estimation results, Table 3 illustrates the descriptive statistics of the model variables.

Table 3. Descriptive Statistics.

	ICTGDP	MANGSCOR	RENEWABL	ENVIROINNOV	ENERPRODUC	EMISSCOR
Mean	6.487	51.03	19.04	32.35	10.182	44.12
Median	5.94	50.04	12.34	30.95	11.5	41.720
Maximum	325.1	99.71	56.39	99.5	19.59	99.89
Minimum	3.29	0.110	7.39	0.00	4.11	0.000
Std. Dev.	17.14	28.25	14.09	33.40	2.726	32.03
Skewness	18.14	0.063	1.922	0.643	−0.455	0.046
Kurtosis	331.3	1.915	5.122	2.054	3.603	1.792
Jarque-Bera	4,570,873	49.95	807.89	106.8	50.08	61.36
Probability	0.000	0.0000	0.0000	0.000	0.000	0.000

In addition, the correlation matrix was also estimated in order to measure the degree of linear relationship among the model variables. Table 4 synopsizes the matrix estimated.

Table 4. Correlation Matrix.

	ENERPRODUC	ENVIROINNOV	ICTGDP	MANGSCOR	RENEWABL
ENERPRODUC	1.000	−0.002182	0.034	0.033489	0.020833
ENVIROINNOV	−0.002	1.000	−0.002	−0.002741	−0.000538
ICTGDP	0.034	−0.002	1.000	0.024109	0.012320
MANGSCOR	0.033	−0.002741	0.024109	1.000	0.012575
RENEWABL	0.020	−0.0005	0.012320	0.012575	1.000

The deviation of the covariance values from one validates no correlation along the exogenous variables employed (Appendix A). The following table (Table 5) provides the model estimation results.

Table 5 shows the results of the GLM regression. Findings illustrate a positive and significant relationship between the energy productivity and environmental performance of financial institutions in Europe [38,39]. Energy productivity has an odds ratio value of 0.233350, so that it can be said that increases in the percentage of the energy productivity of 100 percent will increase the chances of improvement of the environmental performance by 0.233350 times. Then H1 is accepted and concludes that energy productivity has a positive relationship on the empowerment of environmental performance [38]. To measure environmental performance the dimension of both energy productivity and environmental pollution are vital. Therefore, to improve energy productivity this is crucial as it enhances more economic activity and GDP growth, so that a country and economic sector, which belong within it, can prosper [40]. Moreover, environmental innovation has a positive and significant relationship with the dependent variable (environmental performance) too [41]. Odds ratios highlight that an increase in the percentage of environmental innovation will increase the possibilities of improvement of the environmental performance by 0.074671 times. These findings lead to the acceptance of H2 and present a directional link among the two concepts. Environmental innovation refers to the practices of green innovation with a consequent effect on environmental and organizational performance [29,42].

Green practices on innovation include management strategies and technological advancements that expand the environmental performance of businesses while contributing to the gain of a competitive advantage for firms [28]. Moreover, this type of practice consists of unique processes and products that make firms more resilient and sustainable.

Table 5. Model estimation results.

Variable	Coefficient	Std. Error	z-Statistic	Prob.
CONSTANT	−29.79436	3.926141	−7.588714	0.0000
ENERPRODUC	1.704889	0.233350	7.306144	0.0000
ENVIROINNOV	0.256721	0.074671	3.438013	0.0006
ICTGDP	1.044818	0.152081	6.870149	0.0000
MANGSCOR	1.017929	0.166152	6.126493	0.0000
RENEWABL	0.775151	0.096250	8.053513	0.0000
Meandependentvar	44.12399	S.D.dependentvar		32.03078
Sumsquaredresid	1,917,634	RootMSE		43.68173
Quasi-loglikelihood	1391.299	Deviance		391.7555
Deviancestatistic	0.392148	Restr.deviance		401.3409
Quasi-LRstatistic	2782.597	Prob(Quasi-LRstat)		0.000000
PearsonSSR	3.441308	Pearsonstatistic		0.003445
Dispersion	0.003445			
Totalobs	1005			

Moreover, from Table 3 it has been observed that an increase in the percentage of the ICT sector in GDP can be linked with the environmental performance positively. Information and communication technology (ICT) can be recognized as a method with great contributions to solving the environmental problems of businesses [43]. Financial institutions in Europe have shifted towards to the adoption of ICT practices [33,44]. For example, European banks have integrated some of the most well-known practices, such as automated teller machines, internet, and mobile banking [43]. Moreover, evidence from previous empirical studies indicate that ICT has a positive impact on banks' environmental performance, owing to the multitude of benefits that offers its users [45,46]. Based on the above, H3 is acceptable. According to the findings, an increase in management score has a positive effect on financial institutions' environmental performance too. Management score reflects a company's commitment and effectiveness towards following the best practice corporate governance principles. Corporate governance can lead to the sustainability of businesses because it is the ability to positively influence environmental, social, and economic development through their governance practices and market presence [47,48]. Therefore, H4 can be accepted. Finally, the role of renewable energy is very important for the assurance of a good environmental performance level of financial institutions. In theory, the issue of environmental performance is linked to the use of renewable energy sources, as compared to traditional energy sources, such as crude oil and coal [49]. The use of renewable energy sources significantly reduces the level of emissions while their production is friendly to the environment. Thus, renewable energy sources affect environmental performance [50]. Results from GLM regression shows that H5 is accepted, as an increase to the renewable energy dimension can lead to a positive effect on environmental performance by 0.096250 times.

Therefore, having generated the model based on the above estimation results, we provide the dependency graph (Figure 4). This graph visualizes the interaction among the model variables. All the independent variables of the current period affect the emission score and not the leads and lags of those variables.

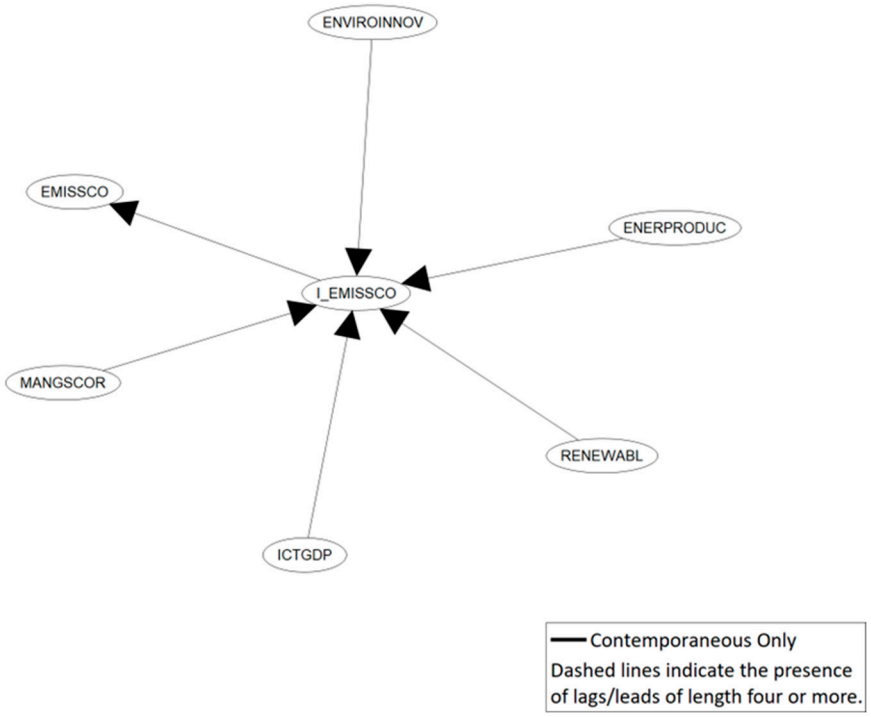

Figure 4. The interlinkages of the model variables. Source: Eviews 12.

5. Discussion

The Paris Climate Agreement, signed in 2015 with the central aim of reversing the phenomenon of climate change, set the framework for changing the current economic model. At the same time, scientific research highlighting the dangers of global warming due to emissions accelerates the process of aligning the business strategy of organizations with the goals of sustainable development. In this context, all businesses, regardless of size and activity, should understand the importance of their contribution to environmental protection and tackling climate change. This can be achieved by integrating and applying environmental criteria in its business activities. With this move, the companies essentially subscribe to the agreement and at the same time strengthen the collective effort to limit the increase in global temperature to below 2 °C.

The role of the financial sector can be the catalyst in managing sustainability issues and promoting economic growth in balance with environmental protection and social prosperity. Financial institutions can contribute through their own activities and investments, and also through their relationship with other economic sectors and consumers. The financial system can lead the effort for a sustainable future by directing funds to actions that bring positive results to society and contribute to the sound management of environmental challenges. There are multiple challenges along this way, as adjustments to established practices are needed to achieve long-term sustainability. In this regard, the present study attempts to capture the current trends and practices towards a sustainable and environmentally responsible financial system.

This study highlights the strategies that were adopted by financial institutions regarding their goals towards the environment and determine the factors that play a crucial role in the improvement of their environmental performance. Many studies have investigated the relationship between energy consumption and environmental pollution. However, few studies can reflect the role of financial institutions in energy productivity and environmental performance. Financial institutions have invested in improving their energy efficiency by adopting strategies that have a direct impact on the decrease in carbon dioxide emissions. Moreover, these environmental practices should be a key part of corporate social responsibility (CSR) strategies too, as energy efficiency is one of the main ways to reduce greenhouse gas emissions. For example, banks' regulators in Europe are increasingly

considering climate-related risks. Actions include asking banks to disclose the climate-related risks of their loan portfolios. Moreover, findings indicate green innovation as an important factor for improving the environmental performance of financial institutions too. Green innovation refers to the process followed by financial institutions that refer to the development of products or processes that contribute to sustainable development while at the same time offering value to both customers and businesses. To date, few academics have conducted research to study the impact of green innovation on the environmental performance of financial institutions. The lack of empirical data at the extent to which new technologies, knowledge, and practices may indirectly affect financial institutions' environmental performance is one of the inhibitor factors for researchers to address this issue. In addition, results illustrate the contribution of information and communication technologies (ICT) to the improvement of environmental performance. ICT have great potential for improving the environment. However, there remains considerable ambiguity in the study of how ICT capability affects business-level environmental performance. However, to address this gap, from the perspective of the competency hierarchy, scholars in the field should explore the internal mechanism and coordinators in the relationship between the environmental performance and ICT.

In the future, this study would further examine the role of environmental, social, and governance (ESG) factors related to the sustainable performance of financial institutions in Europe. Sustainable development and ESG (Environmental, Social, Governance) are now among the most important issues for investors and the capital markets worldwide. Adapting to a more sustainable model and focusing on creating a long-term value is directly linked to the smooth functioning of markets, a fact that is now recognized by a significant number of investors. ESGs are often cited as non-financial but are inextricably linked to corporate competitiveness and have significant financial implications. Numerous studies have shown that companies that publish this information and perform well on essential ESG issues have greater access to lower-cost funds. Companies that perform better on substantial ESG issues show stronger business results, stock returns, and future profitability. Moreover, investors use ESG data in conjunction with financial data to gain a more complete picture of a company and to determine whether it can meet the challenges and seize the opportunities that come with sustainable development. Along with the increased investment interest, the European Commission legislative work through the Sustainable Financial Action Plan comes to propose changes aimed at enhancing transparency and reorienting funds towards sustainable investment while pushing companies and the financial system to adopt new practices. Stock markets are in a special position among investors, companies, and regulators, where they can help highlight the criticality of sustainable investment and enhance investor transparency and confidence in the markets. Through the international Sustainable Stock Exchanges (SSE) initiative, stock exchanges are mobilizing for sustainable development and joining forces to promote good governance and sustainable business practices in their markets. The channeling of investments to sustainable activities and the substantial contribution of the financial sector to sustainable development presuppose the existence of reliable data. In addition, another proposal for future research could be the following: (i) to measure the environmental efficiency of financial institutions with the use of data envelopment analysis (DEA) and (ii) to investigate the relationship of the previous score with indicators from each of the three ESG pillars.

6. Conclusions

Climate change has reordered the corporate priorities, while in order to state its seriousness and importance, the term "climate crisis" is used. However, to achieve economic growth in balance with environmental protection and social prosperity—the three pillars of sustainable development—the role of the financial sector is very important. Banks and other financial institutions, such as insurance companies, investment companies, etc., have a catalytic role in the transition to this new low-emission economy. Properly assessing and monitoring the financial risks posed by climate change and the transition to a

climate-neutral economy are important factors in promoting sustainable development and maintaining the proper functioning of the financial system. For these reasons, central banks support the transparency and disclosure of data that ultimately allows markets to play a role in this whole process. Markets need the right information to incorporate the risk associated with climate change into the costs of doing business and, above all, to evaluate new business opportunities. For example, in this context, the banking sector can direct funds to actions that bring positive results to society.

This study has investigated the research trends in the field of environmental performance of European financial institutions and the factors that are linked to the improvement of it [51]. To approach the above issues, a mixed methodology was used, including: (i) bibliometric analysis based on R package and (ii) the development of GLM regression model. Findings present the major role of financial institutions in the mitigation of environmental crises, such as climate change, while companies in the sector have integrated reducing their environmental footprint into their strategies methods for [52,53]. Moreover, results highlight the strong link among green technology and innovation with the improvement of the environmental performance of financial institutions. Moreover, energy productivity is presented as highly important too [54].

In sum, the development of the global and consequently of the European economy is being redesigned and revolves around a term that prevails everywhere and has to do with respect for the environment. Scholars in the research field of sustainable finance have highlighted the importance of the transition of financial institution to the green "age" by adopting sustainable practices, such as ESG criteria [6,19,55]. Financial institutions in Europe are committed to playing a leading role in compliance with the principles of sustainable economy, and that is why their priority is to fully support entrepreneurship and investment in areas related to "green and sustainable" growth. At the same time, financial institutions promote actions and initiatives and utilize all available financial tools in cooperation with national and supranational bodies to ensure adequate financing on competitive terms.

Author Contributions: Conceptualization K.R., A.G., E.Z. and I.P., Data curation K.R., E.Z. and A.G., Software K.R., E.Z. and A.G., Formal analysis K.R., A.G., E.Z., I.P. and G.K., Investigation K.R., A.G., E.Z., I.P. and G.K. Writing—original draft K.R., A.G., E.Z., I.P. and G.K., Validation, K.R., A.G., E.Z., I.P. and G.K., Supervision A.G. and E.Z., Project administration K.R., A.G., E.Z., I.P. and G.K. 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: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Correlogram.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob *
| |	| |	1	−0.003	−0.003	0.0109	0.917
| |	| |	2	0.008	0.008	0.0762	0.963

* Probabilities may not be valid for this equation specification.

References

1. Burns, C.; Eckersley, P.; Tobin, P. EU environmental policy in times of crisis. *J. Eur. Public Policy* **2019**, *27*, 1–19. [CrossRef]
2. Lowe, P.; Ward, S. *British environmental Policy and Europe: Politics and Policy in Transition*; Routledge: New York, NY, USA, 2005; pp. 1–315.
3. Borghesi, S.; Castellini, M.; Comincioli, N.; Donadelli, M.; Gufler, I.; Vergalli, S. European green policy announcements and sectoral stock returns. *Energy Policy* **2022**, *166*, 113004. [CrossRef]
4. Cortez, M.C.; Andrade, N.; Silva, F. The environmental and financial performance of green energy investments: European evidence. *Ecol. Econ.* **2022**, *197*, 107427. [CrossRef]
5. Lööf, H.; Sahamkhadam, M.; Stephan, A. Is Corporate Social Responsibility investing a free lunch? The relationship between ESG, tail risk, and upside potential of stocks before and during the COVID-19 crisis. *Financ. Res. Lett.* **2021**, *46*, 102499. [CrossRef]
6. Shakil, M.H. Environmental, social and governance performance and financial risk: Moderating role of ESG controversies and board gender diversity. *Resour. Policy* **2021**, *72*, 102144. [CrossRef]
7. Salo, J. Corporate governance and environmental performance: Industry and country effects. *Compet. Chang.* **2008**, *12*, 328–354. [CrossRef]
8. Killins, R.N.; Ngo, T.; Wang, H. Financial institution IPOs and regulatory environments. *Financ. Res. Lett.* **2022**, *46*, 102503. [CrossRef]
9. Li, D.; Ferreira, M.P. Institutional environment and firms' sources of financial capital in Central and Eastern Europe. *J. Bus. Res.* **2011**, *64*, 371–376. [CrossRef]
10. Kumar, R. Regulatory Environment of Financial Institutions. In *Strategies of Banks and Other Financial Institutions: Theories and Cases*; Elsevier: Amsterdam, The Netherlands, 2014; pp. 31–60.
11. Charfeddine, L.; Zaouali, S. The effects of financial inclusion and the business environment in spurring the creation of early-stage firms and supporting established firms. *J. Bus. Res.* **2022**, *143*, 1–15. [CrossRef]
12. Potrč, S.; Čuček, L.; Martin, M.; Kravanja, Z. Sustainable renewable energy supply networks optimization—The gradual transition to a renewable energy system within the European Union by 2050. *Renew. Sustain. Energy Rev.* **2021**, *146*, 111186. [CrossRef]
13. Rees, S.E.; Foster, N.; Langmead, O.; Pittman, S.; Johnson, D.E. Defining the qualitative elements of Aichi Biodiversity Target 11 with regard to the marine and coastal environment in order to strengthen global efforts for marine biodiversity conservation outlined in the United Nations Sustainable Development Goal 14. *Mar. Policy* **2018**, *93*, 241–250. [CrossRef]
14. Dumrose, M.; Rink, S.; Eckert, J. Disaggregating confusion? The EU Taxonomy and its relation to ESG rating. *Financ. Res. Lett.* **2022**, *48*, 102928. [CrossRef]
15. Hacıömeroğlu, H.A.; Danışoğlu, S.; Güner, Z.N. For the love of the environment: An analysis of Green versus Brown bonds during the COVID-19 pandemic. *Financ. Res. Lett.* **2021**, *47*, 102576. [CrossRef]
16. Azhgaliyeva, D.; Kapsalyamova, Z.; Mishra, R. Oil price shocks and green bonds: An empirical evidence. *Energy Econ.* **2022**, 106108. [CrossRef]
17. Ragazou, K. Business Strategies in HR in Times of Crisis: The Case of Agri-Food Industry in Central Greece. *Businesses* **2021**, *1*, 4. [CrossRef]
18. Xie, L.; Chen, Z.; Wang, H.; Zheng, C.; Jiang, J. Bibliometric and Visualized Analysis of Scientific Publications on Atlantoaxial Spine Surgery Based on Web of Science and VOSviewer. *World Neurosurg.* **2020**, *137*, 435–442. [CrossRef]
19. Khan, M.A. ESG disclosure and Firm performance: A bibliometric and meta analysis. *Res. Int. Bus. Financ.* **2022**, *61*, 101668. [CrossRef]
20. Aria, M.; Cuccurullo, C. bibliometrix: An R-tool for comprehensive science mapping analysis. *J. Informetr.* **2017**, *11*, 959–975. [CrossRef]
21. Chai, K.; Xiao, X. Understanding Design Research: A Bibliometric Analysis of Design Studies (1996–2010). *Des. Stud.* **2012**, *33*, 24–43. Available online: https://www.sciencedirect.com/science/article/pii/S0142694X11000524 (accessed on 17 May 2022). [CrossRef]
22. McWilliams, A.; Siegel, D. Corporate social responsibility: A theory of the firm perspective. *Acad. Manag. Rev.* **2001**, *26*, 117–127. [CrossRef]
23. Lee, K.-W.; Yeo, G.H.-H. The association between integrated reporting and firm valuation. *Rev. Quant. Financ. Account.* **2016**, *47*, 1221–1250. [CrossRef]
24. Lodhia, S.; Stone, G. Integrated Reporting in an Internet and Social Media Communication Environment: Conceptual Insights. *Aust Account. Rev.* **2017**, *27*, 17–33. [CrossRef]
25. Welford, R.; Chan, C.; Man, M. Priorities for corporate social responsibility: A survey of businesses and their stakeholders. *Corp. Soc. Responsib. Environ. Manag.* **2008**, *15*, 52–62. [CrossRef]
26. Lyon, T.P.; Maxwell, J.W. Corporate social responsibility and the environment: A theoretical perspective. *Rev. Environ. Econ. Policy* **2008**, *2*, 240–260. [CrossRef]
27. Riccaboni, A.; Neri, E.; Trovarelli, F.; Pulselli, R.M. Sustainability-oriented research and innovation in 'farm to fork' value chains. *Curr. Opin. Food Sci.* **2021**, *42*, 102–112. [CrossRef]
28. Wang, H.; Khan, M.A.S.; Anwar, F.; Shahzad, F.; Adu, D.; Murad, M. Green Innovation Practices and Its Impacts on Environmental and Organizational Performance. *Front. Psychol.* **2021**, *11*, 553625. [CrossRef] [PubMed]

29. Angelo, F.D.; Jabbour, C.J.C.; Galina, S.V. Environmental innovation: In search of a meaning. *World J. Entrep. Manag. Sustain. Dev.* **2012**, *8*, 113–121.
30. Thomson Reuters Eikon. Thomson Reuters ESG Scores. Available online: https://www.thomsonreuters.com/content/dam/openweb/documents/pdf/tr-com-financial/methodology/corporate-responsibility-ratings.pdf (accessed on 19 June 2022).
31. Stamopoulos, D.; Dimas, P.; Tsakanikas, A. Exploring the structural effects of the ICT sector in the Greek economy: A quantitative approach based on input-output and network analysis. *Telecommun. Policy* **2022**, *46*, 102332. [CrossRef]
32. Sawng, Y.-W.; Kim, P.-R.; Park, J. ICT investment and GDP growth: Causality analysis for the case of Korea. *Telecommun. Policy* **2021**, *45*, 102157. [CrossRef]
33. Li, K.; Kim, D.J.; Lang, K.R.; Kauffman, R.J.; Naldi, M. How should we understand the digital economy in Asia? Critical assessment and research agenda. *Electron. Commer. Res. Appl.* **2020**, *44*, 101004. [CrossRef]
34. Eurostat. Energy Data—2020 Edition. 2020; p. 334. Available online: https://ec.europa.eu/eurostat/web/products-statistical-books/-/ks-hb-20-001 (accessed on 19 June 2022).
35. Zuniga, F.; Kozubowski, T.J.; Panorska, A.K. A generalized linear model for multivariate events. *J. Comput. Appl. Math.* **2021**, *398*, 113655. [CrossRef]
36. Idais, O. Locally optimal designs for multivariate generalized linear models. *J. Multivar. Anal.* **2020**, *180*, 104663. [CrossRef]
37. Wedderburn, R.M.W. Quasilikelihood functions, generalized linear models and the Gauss-Newton method. *Biometrika* **1974**, *61*, 439–447.
38. Wang, B.; Qu, J.; Liu, X. A fresh insight on measuring energy productivity and environmental performance incorporating health. *J. Clean Prod.* **2021**, *326*, 129425. [CrossRef]
39. Niu, J.; Chang, C.-P.; Yang, X.-Y.; Wang, J.-S. The long-run relationships between energy efficiency and environmental performance: Global evidence. *Energy Environ.* **2017**, *28*, 706–724. [CrossRef]
40. Xue, Y.; Mohsin, M.; Taghizadeh-Hesary, F.; Iqbal, N. Environmental Performance Assessment of Energy-Consuming Sectors Through Novel Data Envelopment Analysis. *Front. Energy Res.* **2022**, *9*, 713546. [CrossRef]
41. Liao, Z.; Zhang, M. The influence of responsible leadership on environmental innovation and environmental performance: The moderating role of managerial discretion. *Corp. Soc. Responsib. Environ. Manag.* **2020**, *27*, 2016–2027. [CrossRef]
42. Konadu, R.; Ahinful, G.S.; Boakye, D.J.; Elbardan, H. Board gender diversity, environmental innovation and corporate carbon emissions. *Technol. Forecast. Soc. Chang.* **2021**, *174*, 121279. [CrossRef]
43. Jin, J.; Chen, Z.; Li, S. How ICT capability affects the environmental performance of manufacturing firms?—Evidence from the World Bank Enterprise Survey in China. *J. Manuf. Technol. Manag.* **2022**, *33*, 334–354. [CrossRef]
44. Liu, D.; Zhang, Y.; Hafeez, M.; Ullah, S. Financial inclusion and its influence on economic-environmental performance: Demand and supply perspectives. *Environ. Sci. Pollut. Res.* **2022**. [CrossRef]
45. Chuang, S.-P.; Huang, S.-J. The Effect of Environmental Corporate Social Responsibility on Environmental Performance and Business Competitiveness: The Mediation of Green Information Technology Capital. *J. Bus. Ethics* **2018**, *150*, 991–1009. [CrossRef]
46. Amari, M.; Mouakhar, K.; Jarboui, A. ICT development, governance quality and the environmental performance: Avoidable thresholds from the lower and lower-middle-income countries. *Manag. Environ. Qual. Int. J.* **2022**, *33*, 125–140. [CrossRef]
47. Glass, C.; Cook, A.; Ingersoll, A.R. Do Women Leaders Promote Sustainability? Analyzing the Effect of Corporate Governance Composition on Environmental Performance. *Bus. Strateg. Environ.* **2016**, *25*, 495–511. [CrossRef]
48. Walls, J.L.; Berrone, P.; Phan, P.H. Corporate governance and environmental performance: Is there really a link? *Strateg. Manag. J.* **2012**, *33*, 885–913. [CrossRef]
49. Musa, M.S.; Jelilov, G.; Iorember, P.T.; Usman, O. Effects of tourism, financial development, and renewable energy on environmental performance in EU-28: Does institutional quality matter? *Environ. Sci. Pollut. Res.* **2021**, *28*, 53328–53339. [CrossRef]
50. Khan, S.A.R.; Zhang, Y.; Kumar, A.; Zavadskas, E.; Streimikiene, D. Measuring the impact of renewable energy, public health expenditure, logistics, and environmental performance on sustainable economic growth. *Sustain. Dev.* **2020**, *28*, 833–843. [CrossRef]
51. Li, M.; Hamawandy, N.M.; Wahid, F.; Rjoub, H.; Bao, Z. Renewable energy resources investment and green finance: Evidence from China. *Resour. Policy* **2021**, *74*, 102402. [CrossRef]
52. Behera, B.S.; Panda, B.; Behera, R.A.; Nayak, N.; Behera, A.C.; Jena, S.K. Information communication technology promoting retail marketing in agriculture sector in india as a study. *Procedia Comput. Sci.* **2015**, *48*, 652–659. [CrossRef]
53. Díaz-Chao, Á.; Ficapal-Cusí, P.; Torrent-Sellens, J. Environmental assets, industry 4.0 technologies and firm performance in Spain: A dynamic capabilities path to reward sustainability. *J. Clean Prod.* **2021**, *281*, 125264. [CrossRef]
54. Qing, L.; Chun, D.; Ock, Y.-S.; Dagestani, A.A.; Ma, X. What Myths about Green Technology Innovation and Financial Performance's Relationship? A Bibliometric Analysis Review. *Economies* **2022**, *10*, 92. [CrossRef]
55. Singhania, D.M.; Saini, D.N. Systems approach to environment, social and governance (ESG): Case of Reliance industries. *Sustain. Oper. Comput.* **2022**, *3*, 103–117. [CrossRef]