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ESG Performance and Economic Growth in Europe

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ABSTRACT

This study evaluates environmental, social, and governance (ESG) performance at the country level as well as the relationship between this factor and economic growth by reference to a large sample of European countries over the period 2011–2020. As the measurement of ESG performance is an emerging concept, we consider a range of indicators that can be used to evaluate this factor on the basis of alternative methodologies, thus allowing us to check the robustness of the results. This approach reveals that countries that joined the European Union (EU) in 2004 or later exhibited lower levels of ESG performance than did countries in Western Europe; however, the decisive factors in this context are social and governance issues rather than environmental issues. These indications are robust across various settings. Further results reveal the existence of Granger causality between ESG performance and economic growth; however, ESG performance is revealed to impact economic growth only in the middle to long term.

JEL Classification: E01, O11, Q01

1 | Introduction

In general, sustainability is linked to the notion of a green economy, i.e., an economy that improves human well-being, mitigates environmental risk, reduces ecological scarcity, and improves social justice (Yang et al. 2022; An et al. 2021; Merino-Saum et al. 2018). Green finance, clean energy, and the green economy should be viewed as important, albeit not primary, determinants of sustainable development, as indicated by Qiao et al. (2021) and Ling et al. (2021). The goal of the environmental, social, and governance (ESG) action taken at the country level is to ensure sustainable economic growth. Although the concept of ESG performance is closely associated with observed climate change and is widely understood across different governments and societies, it is still difficult to measure and evaluate ESG performance at both the micro- and macroeconomic levels.

The issue of ESG performance and the impact of this factor on a country's economic growth is an important topic in contemporary research, and different potential transmission mechanisms have been considered in this context in light of the heterogeneous character of the dimensions of ESG. On the one hand, countries that exhibit good ESG performance are perceived as more reliable and associated with lower risk and better conditions for development. This claim has been confirmed by research conducted by, among other scholars, Capelle-Blancard et al. (2019), Yang et al. (2022), Chatzitheodorou et al. (2019), Revelli (2017), Ballestero et al. (2012), Berg et al. (2022), Ehlers et al. (2022), Erhart (2022), Drempetic et al. (2020), Yu and Van Luu (2021), and Hoepner et al. (2016). Such countries might attract investors and confirm that the relevant financial markets take ESG performance into account. Additionally, efforts to achieve

sustainable growth require innovations—i.e., the application of innovative technologies and the development of new technologies—which should result in increased production on the basis of the given inputs, thus leading to increased growth. On the other hand, the empirical results reported in previous research have not been unambiguous in this respect. Such studies have reported that sustainability has both positive (e.g., Diaye et al. 2022; Ho et al. 2023) and negative (e.g., Yang et al. 2021; Acheampong 2018; Rahman 2020) effects on economic growth. Moreover, the results of such research have revealed that the relationship between ESG performance and a country's economic growth depends on the ESG segment under investigation. As a result of policies that limit the use of natural resources, environmental issues often lead to economic growth via the enforced development of new technologies. However, in the short term, limiting companies' ability to exploit natural resources might have the opposite effect, especially in less developed economies, due to cost limitations. Social and governance issues have usually been reported to have positive effects on gross domestic product (GDP) growth, as the development of these issues does not typically entail the same costs that are encountered in the context of environmental ones. Few studies have addressed the issue of growth while taking all ESG segments into account. Our study expands this stream of research by accounting for all ESG segments on the basis of various measures of ESG performance by reference to a large group of European countries.

European countries, especially those in the European Union (EU), are closely involved in the process of meeting ESG commitments at the political and regulatory levels, particularly with respect to the Paris Agreement. Moreover, the level of economic development in Europe varies by country, especially between postcommunist countries and Western European countries as well as between Northern and Southern European countries. Therefore, Europe is an interesting example of a group of diverse countries that have implemented the same ESG policy. Therefore, we analyze EU member states[1] as well as Norway and Switzerland, which implemented regulatory ESG standards that are similar to those that have been implemented in the EU and which are treated by many observers as "green" countries over the period 2011–2020; we also analyze the UK (which was formerly a member of the EU; its membership lasted until the end of January 2020) in this context. Our focus on such a defined research group ensures, on the one hand, the homogeneity of the countries in terms of their regulatory framework and, on the other hand, internal differentiation in terms of the level of economic development and commitment to the implementation of this ESG strategy. Notably, these countries are highly developed countries that address ESG issues more carefully. The 2024 Sustainable Development Report confirmed that Finland, Sweden, Denmark, Germany, and France are world leaders in terms of their total progress towards the achievement of all 17 Sustainable Development Goals (SDGs) (Sachs et al. 2024). This status is likely due to the fact that the introduction of environmentally friendly technologies is costly, while the goal of promoting most social aspects of ESG objectives is often viewed as a secondary target that is less important than, for example, the quality of health services. As a result, the economic situation of a country might be one factor that can limit the country's involvement in ESG, which may motivate the possible influence of economic growth on various indicators of ESG.

As previous studies have indicated (e.g., Walter 2020; Abhayawansa and Tyagi 2021; Ahmed et al. 2021; Berg et al. 2022; Erhart 2022; Sahin et al. 2023), companies' ESG ratings may differ significantly due to the diverse methodologies used by various rating agencies to examine ESG performance. The literature on companies' ESG performance and its importance with respect to financial performance is abundant, whereas only a few studies have evaluated ESG performance at the country level. The methodologies that have been employed in this context have also differed (e.g., Capelle-Blancard et al. 2019; Pineau et al. 2022). We claim that it is easier to evaluate ESG performance at the company level than at the country level due to the fact that the former level is characterized by lower complexity and usually specialization. This study focuses on the country level, as we explore the importance of ESG performance to economic growth, which is evaluated at the country level. Moreover, regulatory measures are defined and implemented at the country level. From the country-level perspective, various aspects must be considered, including government spending, the tax system, the structure of the economy, foreign trade, and society features. Thus, the task of identifying an aggregate measure that can be used to evaluate ESG performance is challenging. Moreover, previous research on this topic has provided no clear evidence regarding the causal link between ESG performance and economic growth. Therefore, this field of research features a great deal of room for further studies and experiments, which may bring us closer to the goal of developing a standard for ESG performance evaluation at the country level.

The objective of this study is to evaluate ESG performance as well as the link between this factor and economic growth. Our contribution to the literature is twofold. First, we rely on the approach developed by Capelle-Blancard et al. (2019) as a benchmark and suggest an alternative way of estimating ESG performance measures (i.e., indicators). Second, we identify the patterns that characterize the relationship between ESG performance and GDP-based measures in the group of countries under consideration in this research; other studies on this topic have not covered such a wide range of European countries. As noted, the causal relationship between these factors may occur in both directions. Therefore, we propose the following two research questions: (1) Does a country's economic growth depend on its ESG performance? (2) Does a country's ESG performance depend on its GDP?

The remainder of the paper is organized as follows. In the next section, a review of the relevant literature is presented. In Section 3, we explain the data sources and methodology used in this study; while in Section 4, we present and discuss its results. The final section concludes the paper.

2 | Literature Review

The literature review is divided into two sections. In the first section, we review the extant literature on sustainability, especially with respect to ESG and economic growth. Against this

backdrop, we develop our research questions. In the second section, we review the approaches that have been used to select and aggregate specific ESG indicators and highlight the limitations of these approaches.

2.1 | ESG And Economic Growth—Does It Work in Both Directions?

Studies on the role played by ESG performance in economic growth have been based on two opposing views. The first such view assumes that countries that obtain good ESG scores achieve higher levels of economic growth by using natural resources more efficiently and implementing social and economic policies. This view has been confirmed by, e.g., Adams et al. (2020) and Long et al. (2015). The second view posits that countries that obtain good ESG scores curb economic growth by limiting the use of natural resources and implementing social and economic policies. This view has been confirmed by Yang et al. (2021), Acheampong (2018) and Rahman (2020). These opposing results have indicated that the role of ESG performance may vary due to different levels of economic development, the investigation of different groups of countries in specific studies, the period under analysis, and, finally, the manner in which ESG performance is measured.

The role played by ESG performance in economic growth pertains mostly to selected elements of the ESG, namely, single "letters" (E, S or G) of this notion, and few studies have considered all aspects of ESG.

Studies that have focused on environmental factors (e.g., Long et al. 2015; Acheampong 2018; Adams et al. 2020; Rahman 2020; Yang et al. 2021) have revealed either positive or negative feedback between "E" and economic growth in this context. These studies have focused mainly on carbon dioxide emissions (CO_2) and other energy-related issues.

A positive bidirectional link between environmental protection policies and economic growth was reported by Adams et al. (2020) in countries that are characterized by high levels of geopolitical risk (for the period 1996–2017) as well as by Long et al. (2015) in the case of China (for the period 1952–2012).

On the other hand, a negative relationship between the environment and economic growth was reported by Yang et al. (2021), Acheampong (2018) and Rahman (2020). Yang et al. (2021) studied the impacts of renewable and nonrenewable energy, capital accumulation, and economic growth on CO_2 emissions in emerging economies associated with China's Silk Road Economic Belt (SREB) initiative from 1995 to 2014. The results revealed that the use of renewable energy at high levels significantly reduces CO_2 emissions in both the long and short terms. An inverted U-shaped relationship between economic growth and CO_2 emissions was observed.

A study conducted by Acheampong (2018) covered 116 countries from 1990 to 2014 and presented data at both the global and regional levels. The most important findings of this study indicated that at the global and regional levels, economic growth does not increase energy consumption but rather reduces CO_2 emissions; moreover, in most regions, with the exception of Sub-Saharan Africa, energy consumption negatively influences economic growth.

Finally, Rahman (2020) investigated the impacts of electricity consumption, economic growth, and globalization on CO_2 emissions in the 10 countries that exhibited the highest levels of electricity consumption from 1971 to 2013. The results revealed a long-term bidirectional relationship between the variables explored in this context and indicated that electricity consumption has a significant harmful effect on the environment.

Studies have reported either a positive or a neutral relationship between the social factor ("S") and economic growth. Various specific indicators have been selected to represent "S", such as the literacy rate, life expectancy, and healthcare spending. Researchers who have focused on this factor have not used a broader set of indicators to highlight various perspectives on social aspects. A strong bidirectional relationship between GDP and life expectancy was reported by Cracolici et al. (2010) in developing countries (timeframe 1980–1999). In contrast, Cracolici et al. (2010) reported that most developing countries are not able to transform higher levels of educational skills into higher GDP or to improve the level of education with the goal of transitioning to a higher-productivity economy. The absence of a causal relationship between this factor and economic growth in the long term was confirmed by Rodriguez and Valdes (2019), who studied the role of healthcare spending in the context of a group of Latin American and OECD countries (1995–2014). Tanjung (2021), who examined 9 Asian countries over the period 2010–2018, did not confirm the link between social development and sustainability.

With respect to the "G" component, studies have provided mixed evidence regarding how governance contributes to economic growth (e.g., Fayissa and Nsiah 2013; Huang and Ho 2017; Hadj Fraj et al. 2018; Kim et al. 2018). Fayissa and Nsiah (2013) concluded that the role played by governance in economic growth as well as the importance of sustainable development depends on the level of income obtained by countries in Sub-Saharan Africa. Huang and Ho (2017), however, reported that governance effectiveness and the rule of law play a role in economic growth in Asian countries.

The studies conducted by Hadj Fraj et al. (2018) and Kim et al. (2018) included governance as a factor to be explored from the perspective of economic growth; in both cases, the significance of this factor was not confirmed. With regard to a group of 50 countries (including 21 developed countries and 29 emerging countries) from 1996 to 2012, Hadj Fraj et al. (2018) reported that a flexible exchange rate regime can considerably destabilize emerging markets; this factor can also accelerate economic growth in developed countries. Kim et al. (2018) identified a threshold at which the ability of countries to benefit from increased government size and better governance is limited.

Finally, a country-level ESG study that included all the components was conducted by Diaye et al. (2022). These authors examined the economic impacts of ESG performance in 29 OECD countries from 1996 to 2014. The results revealed a positive relationship between ESG performance and GDP per capita in the long term; however, no such relationship was observed in

the short term, with the exceptions of the cases of Iceland and South Korea (taking into account heterogeneity in short-term dynamics). These authors used a set of indicators developed by Capelle-Blancard et al. (2019) to measure ESG performance. According to these authors, "*the set of indicators was considered original and unusual, because it adopts a quantitative approach to the nonfinancial policy of a given country. In addition, it comes from reliable noncommercial suppliers and is based on a large dataset*".

Another study conducted by Ho et al. (2023) covered 118 countries, which were divided into three groups on the basis of their levels of economic development; this study focused on the period 1999–2015. The findings reported by these authors confirmed bidirectional causality in the relationships between both environmental (negative role) and social (positive role) performance and economic growth. The positive influence of governance on economic growth, in contrast, was shown to be characterized by unidirectional causality.

Overall, few studies have addressed the issue of countries' economic growth and sustainable development across all ESG segments. Most studies have focused on a particular ESG segment. Moreover, the results of such research have revealed that the relationship between ESG performance and a country's economic growth depends on the ESG segment under examination. Studies that have focused on the "E" segment have reported a bidirectional positive (Adams et al. 2020; Long et al. 2015) or negative impact (Yang et al. 2021; Acheampong 2018; Rahman 2020). Studies that have investigated the "S" segment have highlighted its positive (Cracolici et al. 2010) or neutral role (Rodriguez and Valdes 2019; Tanjung 2021), whereas studies that have emphasized the "G" segment have reported that it plays a positive (Huang and Ho 2017; Fayissa and Nsiah 2013; Kim et al. 2018) or neutral role (Hadj Fraj et al. 2018). Studies that have investigated all ESG segments have reported a bidirectional positive impact in the long term, as in the study conducted by Diaye et al. (2022), or a bidirectional positive impact for the E and S segments, as indicated by Ho et al. (2023).

In this context, the relationship between a country's economic growth and ESG performance remains unclear; few studies have explored all three segments of ESG performance. Therefore, two research questions were proposed:

1. Does a country's economic growth depend on its ESG performance?
2. Does a country's ESG performance depend on its GDP?

Moreover, the extant research on this topic has not explored a large group of European countries, despite the fact that these countries are the most heavily involved in the process of implementing the EU's sustainable development strategy.

2.2 | ESG Performance Evaluation at the Country Level

The ESG ratings provided by rating agencies are based on both financial and nonfinancial information. The designs of such ESG ratings vary, thus making it difficult to compare the results across different rating systems. Different sources of discrepancies in ESG ratings, such as scope, definitions, measurements, weights, risk scales, and commensurability, have been identified (e.g., Drempetic et al. 2020; Abhayawansa and Tyagi 2021; Ahmed et al. 2021; Yu and Van Luu 2021; Berg et al. 2022; Erhart 2022; Sahin et al. 2023). Authors have usually highlighted the problem of postpublication revision, which is employed by ESG Refinitiv. Such an approach undermines the reliability and usefulness of these assessments. Moreover, Genc and Basar (2019) examined the economic, social, and political factors that have been used to determine the debt sustainability of countries by three rating agencies: Standard and Poor's, Moody's, and Fitch. These authors concluded that among these three rating agencies, Moody's reports the most optimistic estimates of country ratings, whereas Fitch reports the most pessimistic estimates. This highlights the fact that ratings may differ considerably as a result of the methodology used to produce them.

Angelova et al. (2021) reviewed the credit rating methodologies employed by three rating agencies—i.e., Moody's, Standard and Poor's, and Fitch—in the context of ESG risk considerations and proposed ways of improving these approaches by reference to indicator selection, normalization, aggregation, and weighting procedures, as well as through the use of the sovereign rating indicator in conjunction with climate change scenarios.

As noted by Hoti and McAleer (2004), however, the largest problem that emerges in this context pertains to the scope of baseline indicators that can be used to evaluate ESG performance. This problem is also relevant to academics who seek to develop alternative measures of ESG performance.

Accordingly, it can be concluded that rating agencies do not offer ESG ratings that may be treated as objective and comparable; therefore, academics have started to develop alternative approaches to the task of evaluating ESG performance. One of the first attempts in this regard was made by Capelle-Blancard et al. (2019). Their approach has also been adopted by other researchers (Diaye et al. 2022; Pineau et al. 2022; Hübel 2022).

Capelle-Blancard et al. (2019) focused on a set of 18 indicators, which were divided into three groups, namely, an environmental quality index (E index), a social development index (S index), a governance quality index (G index), as well as finally, a total composite index (ESG index). This set of indicators can be used to assess the most important areas of sustainable development in line with the SDGs. Notably, the total number of indicators that are included in the global SDG framework is 248. It would be difficult to use so many indicators to achieve the objectives of research on this topic because of the repeatability that characterizes this group, the mutual interactions among them, and issues pertaining to data gaps. Capelle-Blancard et al. (2019) considered the importance of these indicators with respect to a country's default risk and government bond spreads. These authors reported that social and environmental issues are characterized by much higher levels of variation than governance issues. The list of indices considered by these authors is presented in Table 1.

TABLE 1 | Components of the ESG indices developed by Capelle-Blancard, Crifo, Diaye, Oueghlissi and Scholtens.

Index	Measuring items	Interpretation of the results
E index	Air quality—Controlling air pollution Water and sanitation—Wastewater treatment Forests—Forest area (% of land area) Renewable energy—Combustible renewable energy (% of total energy), renewable electricity output (% of total electricity), and renewable energy consumption (% of total energy)	High scores indicate strong environmental performance
S index	Human capital—School enrolment, secondary (% gross) Demography—Life expectancy Health—Health expenditure, public (% of total health expenditure) Gender equality—Ratio of the female labour force participation rate to the male labour force participation rate (%), gender parity index Employment—Nonvulnerable employment (% of total employment)	This index includes measures of countries' levels of social development
G index	Democratic institution—Control of corruption, rule of law, voice and accountability Safety policy—Country effectiveness, political stability, regulatory quality	High scores indicate a high level of legal quality
ESG index (total index)	This index consists of the subindices produced by aggregating detailed indicators through the use of weights estimated via factor analysis	This index measures a country's sustainability performance and is the result of a factor analysis of the ESG indices

Abbreviations: E, environment; G, governance; S, social.
Source: Author's own compilation on the basis of Capelle-Blancard et al. (2019).

Pineau et al. (2022) used measures that are similar to some extent to those employed by Capelle-Blancard et al. (2019); however, the former authors did not use the ESG composite index (see Table 2). Rather, these authors used ESG and non-ESG (macroeconomic) meta-variables to explore the relative importance of ESG and non-ESG factors with respect to the assessment of sovereign creditworthiness. We claim that the set of indicators proposed by Capelle-Blancard et al. (2019) can facilitate a better assessment of the degree to which the SDGs have been achieved.

A much more limited number of indices (see Table 3) were used by Yang et al. (2022) and Ogundajo et al. (2022). These sets therefore do not reflect countries' levels of commitment to the SDGs and cannot be treated as representative. Moreover, Ogundajo et al. (2022) highlighted the need to improve the methodology used in research on this topic, including both the selection and definition of indicators as well as the introduction of rules for data collection and updating.

Overall, a variety of approaches to the task of rating or evaluating ESG performance have been developed, and no approach can be treated as a widely accepted standard. Against this backdrop, we use the approach developed by Capelle-Blancard et al. (2019), which has become increasingly popular, as a benchmark to propose our own methodology for the evaluation of ESG performance. We maintain that the approach developed by those authors is most closely related to the SDGs and may thus be treated as a point of reference in this research.

3 | Data and Methodology

In this section, we explain the scope of our dataset, the methodology that we used with regard to the ESG indices, and the causality analysis that we performed.

3.1 | Data

We collected country-level data from publicly available sources, i.e., Eurostat, the World Bank (WB) and the International Monetary Fund (IMF), for EU member countries as well as Norway, Switzerland, and the UK for the period 2006–2021. Due to missing values, we used 300 country-year observations and reduced the time frame to 2011–2020[2]. In the process of selecting variables, we employed the methods developed by Capelle-Blancard et al. (2019) and Pineau et al. (2022), with certain exceptions, especially for the "E" segment. The list of variables included in this research is presented in Table 4. We used fewer variables (15) than Capelle-Blancard et al. (2019) or Pineau et al. (2022).

With respect to the "E" component, Capelle-Blancard et al. (2019) focused on air quality, wastewater, forests, and renewable energy, whereas Pineau et al. (2022) selected CO_2 emissions, natural resource depletion, forests, and three variables that represented the role of agriculture. We selected variables that represented the sectors of the economy that play crucial

TABLE 2 | Components of the ESG indices developed by Pineau, Le, and Estran.

Category	Factor
Environmental (E)	CO_2 emissions (metric tons per capita)
	Agricultural land (% of land area)
	Food production index
	Agriculture, value added (% of GDP)
	Forest area (% of land area)
	Adjusted savings: Natural resource depletion (% of GNI)
Social (S)	Access to electricity (% of population)
	Life expectancy at birth, total (years)
	Population aged 65 years or older (% of total population)
	Mortality rate, under 5 years of age (per 1000 live births)
	Unemployment, total (% of total labour force)
Governance (G)	GDP growth (annual %)
	Proportion of seats held by women in national parliaments (%)
	Ratio of the female labour force participation rate to the male labour force participation rate (%)
	Patent applications
	Regulatory quality (meta-variable)

Source: Author's own compilation on the basis of Pineau et al. (2022).

roles in environmental protection. Therefore, we included (1) the construction industry and (2) agriculture, forestry, and fishing. We then considered the role played by the country in (1) the trade of environmental goods and (2) low-carbon technology products. Finally, we accounted for the country's expenditure on environmental protection. All these variables may be treated as proxies for a country's environmental policy.

Regarding the "S" component, we replaced "access to electricity" with "voice and accountability", as a variable that reflected societal freedom, and "individuals using the internet", which plays an important role in social quality of life, with the goal of capturing a broader context.

Even if two series increase over time, this fact does not entail that one of these series causes the increase in the other series. Even if such causality could be confirmed, it would remain far from obvious which of these factors represents the cause and which represents the effect, and bidirectional causality may be a frequent occurrence. Since our primary objective is to identify the patterns that characterize the relationships between ESG performance and GDP-based measures with regard to the group of countries considered in this research, we believe that this causal relationship may occur in both directions.

3.2 | ESG Indices

To address our research questions, a composite measure for each dimension (or component) of ESG must first be constructed. This stage of the process is difficult because numerous indicators can be considered as descriptors of each dimension of ESG performance; thus, these indicators must be efficiently merged into a single figure. Capelle-Blancard et al. (2019) suggested that principal component analysis (PCA) is an adequate tool that can be used to address this issue; these authors used a total of 18 variables that were divided into three groups consisting of 6 indicators each for the three dimensions of ESG and employed PCA to construct compound E, S, and G indicators (furthermore, they subsequently constructed a final measure of ESG as a weighted average of these three dimensions). Although this approach seems to be an attractive alternative, several problems remain unsolved. The key element of this process is that PCA extracts the common components as long as the variables of interest are strongly correlated in the sense of Pearson's linear correlation. However, we maintain that this approach is inadequate with regard to the task of identifying such correlations among the candidate variables. First, strong correlations among the variables that are used to measure the same dimension do not necessarily emerge. For example, environmental dimension descriptors such as forest area (as a percentage of the total area) and renewable electricity output (as a percentage of the total energy) are both clearly valid; however, these descriptors are not necessarily strongly correlated because they represent different aspects of the same environmental dimension. Second, even if the measures in question are closely related, this fact does not necessarily imply a linear correlation. The strong correlations observed among the variables used to measure the same dimension of ESG highlight their redundancy and may also be viewed as a reason to reconstruct the set of measures in question as well as to propose new measures that would be orthogonal to a greater extent. It is not entirely clear whether the correlation condition is met in the analysis conducted by Capelle-Blancard et al. (2019); while these authors mentioned the Kayser–Meier–Olkin (KMO) requirement that corresponds to the aforementioned correlations[3], they did not provide the actual KMO values. Although this point was not clearly noted, these authors supposedly performed the analysis by using time series for the countries under consideration rather than employing a single observation per country (e.g., averaged over time). Since these authors did not mention any verification of the stationarity assumption, this approach entails a high risk of nonstationarity (e.g., the increasing popularity of renewable energy may result in an increased share of renewable energy in the energy mix). Given that the nonstationarity of more than one time series may result in spurious correlations, the application of PCA on the basis of time series data requires a different approach (Hamilton and Xi 2023). Furthermore, these authors performed a PCA by considering all 18 measures of all three dimensions of ESG jointly. However, assigning particular variables to different dimensions is somewhat arbitrary and not supported by the data. The analysis of the PCA loadings[4] reveals that the first component loading (which is interpreted as the "G" group loading) on school enrollment is actually greater than the second component loading (which is interpreted as the "S" group loading), thus raising the question of where this variable belongs if the data-driven algorithm is applied. Conversely, the loading of the third component

TABLE 3 | Components of the ESG indices developed by Yang et al. (2022) and Ogundajo et al. (2022).

Category	Factors	Measurement
ESG indices developed by Yang et al. (2022)		
Environmental (E)	Clean energy	Renewable energy consumption
Social (S)	Growth of the green economy	Green growth
Governance (G)	Green financing	Green bonds
Country-level governance factors developed by Ogundajo et al. (2022)		
Governance (G)	Voice and accountability	Scores range from 1 (low) to 100 (high); positive polarity
	Political stability and lack of violence	Scores range from 1 (low) to 100 (high); positive polarity
	Government effectiveness	Scores range from 1 (low) to 100 (high); positive polarity
	Regulatory quality	Scores range from 1 (low) to 100 (high); positive polarity
	Rule of law	Scores range from 1 (low) to 100 (high); positive polarity
	Control of corruption	Scores range from 1 (low control of corruption) to 100 (high control of corruption)

Source: Author's own compilation on the basis of Yang et al. (2022) and Ogundajo et al. (2022).

associated with political stability (i.e., the "E" group loading) is greater than the loading of the third component pertaining to wastewater treatment. Given that further analysis is based on the assumption that the 18 variables of interest essentially include 6 representatives of each dimension of ESG and that each of the measures in question belongs to exactly one group, which is quite arbitrary, such an approach raises doubts. In contrast, the variables that focus on measuring the same reaction may be related to one another. As a result, we follow the conventional approach by constructing indices through the use of PCA; however, we modify the work of Capelle-Blancard et al. (2019) in several ways. First, we assign each of the variables under consideration to one of the groups and perform separate PCAs for each of the dimensions. Second, we use averaged data from the period 2011–2020 to avoid problems with nonstationarity, which can result in spurious (i.e., overoptimistic) correlations. Third, we replace the level data with first differences if the KMO statistics would benefit from such an approach. Table 4 provides the set of variables used in the PCA as well as their form (in terms of level/difference), the divisions among the three dimensions, and the corresponding KMO statistics.

This step of the procedure may be viewed as encompassing model selection. We determine the final set of the E, S, and G indicators used in this context and their final forms on the basis of the KMO statistics regarding the averaged data for 2011–2020: the initial candidate variables are selected/rejected in terms of levels/differences such that the KMO values for each dimension are maximized. As indicated in Table 4, the KMO values pertaining to the G dimension are quite high; those regarding the S dimension are acceptable; and those concerning the E dimension are at the edge of acceptability. This finding is understandable and typical in light of the different levels of heterogeneity exhibited by these dimensions, in which context the environmental indicators are the most heterogeneous: thus, while the governance indices are higher for some countries and lower for other countries, the different environmental aspects may ensure that the same country receives the highest rank in terms of one measure but a much lower rank in terms of another measure. These values are substantially greater when nonstationary series are used (i.e., when the values are not averaged across countries). However, this approach would likely yield spurious correlations and should thus be avoided. The final step in this part of the procedure is to reperform the PCA for the shape selected (as described above) for each year between 2011 and 2020. Then, for each year and country, we obtain the three main PCA components[5] (as the sum of products of the particular loading factors for the PCA and the corresponding values of the variables pertaining to the given country in the focal year). The three components thus attained (with regard to the given country and year) are then weighted on the basis of the total amount of variance in the given factor that is explained by the components in question. As a result, we obtain three indicators (E, S and G) for each country in each year from 2011 to 2020:

$$\mathrm{PC}_{i,d,t} = l1_{i,d,t}x1_{d,t} + \ \ldots \ + l5_{i,d,t}x5_{d,t} \tag{1}$$

where $i = 1, 2, 3$ is the number of principal components, $d = \{\mathrm{E, S, G}\}$ is the dimension of ESG under consideration, $lj_{i,d,t}$ are the factor loadings for the jth factor ($j = 1, \ldots, 5$) of dimension d for the ith principal component computed for year t ($t = 2011, \ldots, 2020$), and $xj_{i,d,t}$ is the jth factor (descriptor) of dimension d in year t. Furthermore, the PCA-based index of dimension d is obtained as follows:

TABLE 4 | Variables used in the analysis and their transformations.

Descriptor	Source	Form	KMO[a]
Environmental			0.5575
Expenditure on environment protection (% of GDP)	IMF	Level	0.5015
Agriculture, forestry, and fishing, value added (% of GDP)	WB	Difference	0.5341
Environmental goods trade balance (% of GDP)	IMF	Difference	0.5331
Trade balance in low-carbon technology products (% of GDP)	IMF	Difference	0.5308
Construction, value added (% of GDP)	Eurostat	Difference	0.7444
Social			0.6312
Unemployment, total (% of total labour force)	WB	Level	0.8876
Individuals using the internet (% of population)	WB	Level	0.5899
Population aged 65 years or older (% of total population)	WB	Difference	0.7154
School enrolment, secondary (% gross)	WB	Difference	0.691
Voice and accountability (estimate)	WB	Level	0.6001
Governance			0.8722
Control of corruption (estimate)	WB	Level	0.8668
Regulatory quality (estimate)	WB	Level	0.8851
Rule of law (estimate)	WB	Level	0.8453
Government effectiveness (estimate)	WB	Level	0.8519
Political stability and the absence of violence/terrorism (estimate)	WB	Level	0.9556

[a]The KMO statistics pertain to the PCA that was conducted on the basis of the averaged data for the period 2011–2020.
Source: Author's own calculations.

$$I_{d,t,\mathrm{PCA}} = \sum_{i=1}^{3} \mathrm{PC}_{i,d,t} \cdot E_{i,d,t} \,/\, \left(E_{1,d,t} + E_{2,d,t} + E_{3,d,t}\right) \quad (2)$$

where $E_{i,d,t}$ is the eigenvalue for the ith principal component in the analysis of dimension d as computed on the basis of data from year t.

The low KMO values observed in this context raise doubts regarding the usefulness of the ESG indicators obtained via PCA. Accordingly, we also compute different types of ESG indicators. To ensure the comparability of the results, we continue the analysis on the basis of the same variables that were employed in the PCA procedure. However, we consider two functional forms: (a) variables always in levels (as in the mainstream literature on this topic) and (b) variables converted to differences when the same cases as those employed in the PCA are used (as indicated in Table 4). With regard to the two aforementioned cases, we provide two types of ESG indicators on the basis of the (1) rankings and (2) standardized values of the measures used. The ranking-based indicators are constructed in the following way. For each of the focal descriptors of dimension d in year t, we rank the countries on the basis of the value of the given descriptor; in particular, we assign values of 1, ..., 30 to represent the position of the country within the ranking pertaining to the given descriptor[6]. Let $rj_{d,t}$ be the position of the focal country c in the ranking on the basis of factor j ($j = 1, \ldots, 5$) of dimension d ($d = \{\mathrm{E, S, G}\}$) as computed for year t ($t = 2011, \ldots, 2020$); as long as the values of the factors under consideration are untied, $rj_{d,t}$ is ranked from 1 to 30. The overall ranking-based index of dimension d in year t for a given country is obtained as follows:

$$I_{d,t,\mathrm{RANK}} = \sum_{j=1}^{5} rj_{d,t} \quad (3)$$

The main advantage of the ranking-based indicators is that they are not affected by situations involving atypical values for any variables; regardless of whether the distance in the variable under consideration is small or large, this value is converted to the same difference in the ranking. Conversely, this situation also entails that a given difference in the rankings may imply large or small differences in the values of the descriptors. Thus, an alternative approach that focuses on the values of the ESG factors under consideration is employed. The value-based indicators are constructed by reference to the same variables and the same two variants (in terms of levels and differences[7]) that were used in the case of the ranking-based indicators. The overall value-based index of dimension d in year t for a given country is thus obtained as the sum of the standardized descriptors of dimension d in year t for the country in question[8].

$$I_{d,t,\mathrm{VALUE}} = \sum_{j=1}^{5} xsj_{d,t} \quad (4)$$

Standardization solves the scale problem (i.e., the fact that the use of different scales for different variables may result in inadequate treatment if the absolute values are considered). However, the outstanding performance of a country in one category may

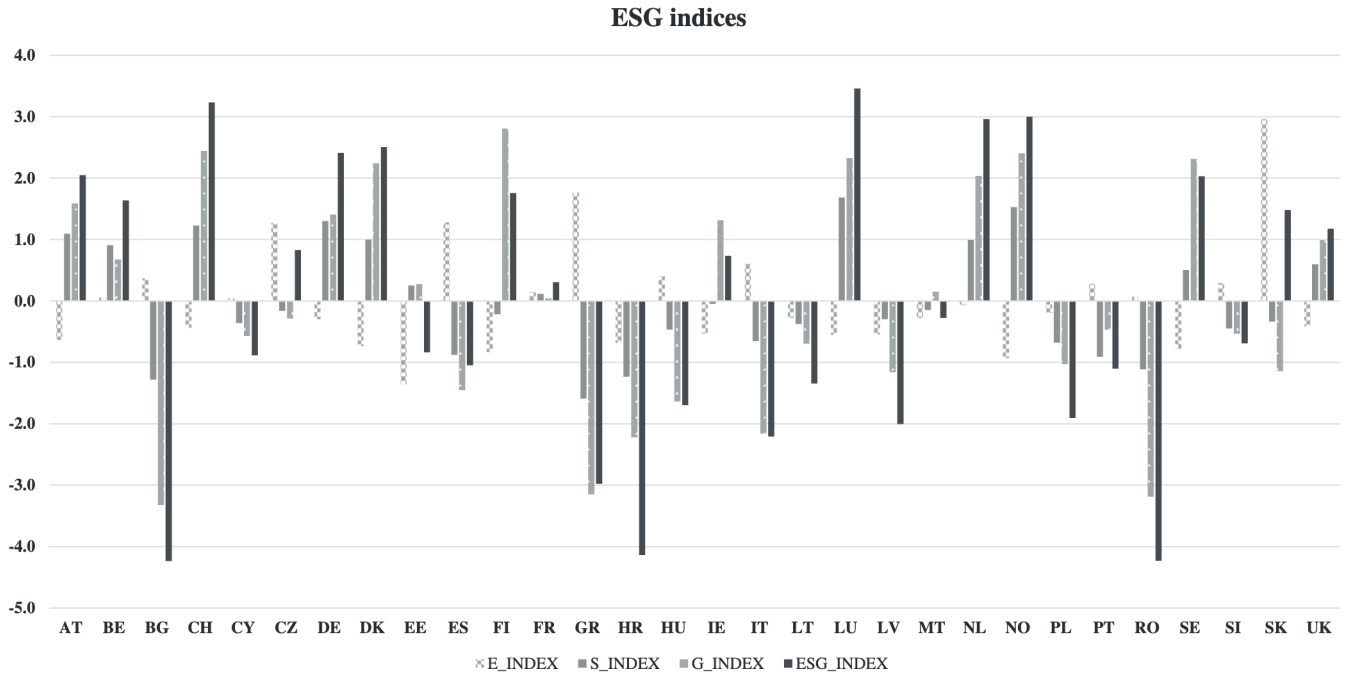

FIGURE 1 | Average "E", "S" and "G" Indices by Country (2011–2020) Based on PCA Approach. E, environment; G, governance; PCA, principal component analysis; S, social.

lead the entire index to be excessively optimistic, despite the fact that the performance of the country in question on other components of the same dimension may be poor.

3.3 | Causality Analysis

One objective of this paper is to determine whether the possible covariation of ESG indicators with economic growth implies causality in any direction. We use the concept of Granger causality to address the concerns of causality and, in light of the doubts described above, to test for causality in both directions. These procedures provide a set of ESG indicators for each country and year; thus, a panel dataset is obtained. We use the half-panel jackknife (HPJ) Wald-type test, which was developed by Juodis et al. (2021), to explore Granger noncausality in this context. Importantly, while under the null hypothesis, the Granger-type tests for panel data indicate the absence of causality in the sense of Granger with respect to any of the series that constitute the panel data, rejecting the null hypothesis does not necessarily indicate that causal relationships are observed with respect to all the series.

We consider three noncausality hypotheses: (H1) the ESG indicator under consideration is not Granger-caused by GDP, (H2) the annual change in real GDP is not Granger-caused by the ESG indicator under consideration, and (H3) 5-year change in real GDP is not Granger-caused by the ESG indicator under consideration (averaged over the 5-year period in question). H2 is provided mostly for the sake of completeness. The nature of GDP dynamics, which are characterized by short-term, incidental fluctuations, suggests that medium-term horizons and 5-year differences should be used rather than annual differences.

Notably, identifying the existence of causality in this context not only has theoretical value but can also play an important role in future studies on this topic. In particular, the existence of a two-way causal relationship between the X and Y variables implies that X is an endogenous regressor in the equation for Y and vice versa. Consequently, it is crucial to apply the proper check in efforts to identify adequate treatment in the context of growth models that may be under consideration.

4 | Results and Discussion

4.1 | ESG Indices at the Country Level

First, we present the results on the basis of the average values that were obtained through the use of the PCA approach (Figure 1); subsequently, we consider the ESG value-based and ranking-based indicators (Figure 2). We also present the value-based and ranking-based indicators for each component in Figure 3. The results pertaining to each country for PCA, value-based and ranking-based approaches are presented in detail in the Appendix S.1.

The indices based on the PCA approach reveal that, on average, the best ESG performance (i.e., the top 5 countries that exhibited the highest values with regard to these indices) was achieved by Switzerland, Norway, the Netherlands, Denmark and Luxemburg, whereas Italy, Greece, Croatia, Romania and Bulgaria exhibited the worst performance. These results are largely consistent between the "S" and "G" indices, although the results differ to some degree with respect to the "E" component. The top 5 performers in the "E" dimension were Slovakia, Czechia, Spain, Italy and Greece, whereas the bottom 5 performers were Estonia, Norway, Sweden, Finland

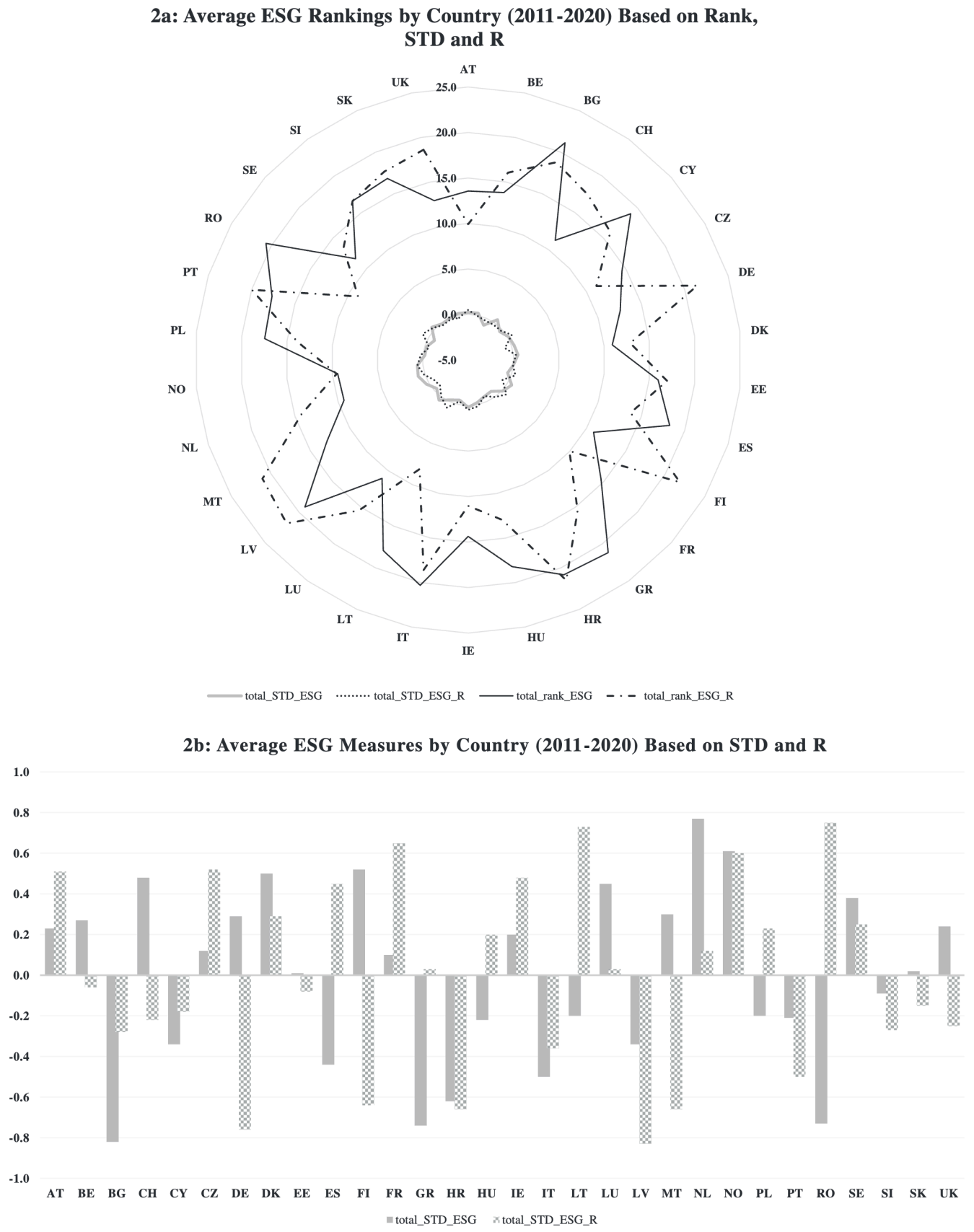

FIGURE 2 | Average ESG Rankings and Average ESG Measures by Country (2011–2020) Based on Rank, STD, and R. E, environment; G, governance; Rank, ranking-based indicators; R, analysis based on the levels of the variables; S, social; STD, value-based indicators.

and Denmark. These results are counterintuitive because Nordic countries are generally viewed as leaders in environmental protection. A tentative explanation for this results may be provided by the use of raw data for these countries (Appendix S.2 contains five detailed environmental indices for each the top- and bottom-performing countries). Among the top-performing countries, this result is due to the downturn in the construction industry that began at the time of the global financial crisis. A lower construction value added (as a percentage of GDP) is, overall, environmentally friendly. In the case of Slovakia and, to some extent, Czechia, the main driver of top performance with regard to the "E" component pertains to the increasing focus of these countries on exports, i.e., the environmental good trade balance (as a percentage of GDP) as well as the trade balance in low-carbon technology products (as a percentage of GDP). The main industrial sector in both Slovakia and Czechia is the automotive industry, which includes the production of both electric cars and special-purpose electric batteries. Thus, the development of electromobility and changes in the automotive market have contributed to improvements in the environmental indicators associated with these countries. Notably, the top 5 performers with regard to the "E" dimension include countries that feature well-developed tourism sectors. Therefore, a large share of agriculture, forestry and fishing in GDP was observed in these countries. These countries also increased their expenditures on environmental protection (as a percentage of GDP) to a slightly greater degree than did other countries.

With respect to the five countries that exhibited the lowest performance in terms of the "E" dimension, first, the situation of the construction industry was stable; however, in most cases,

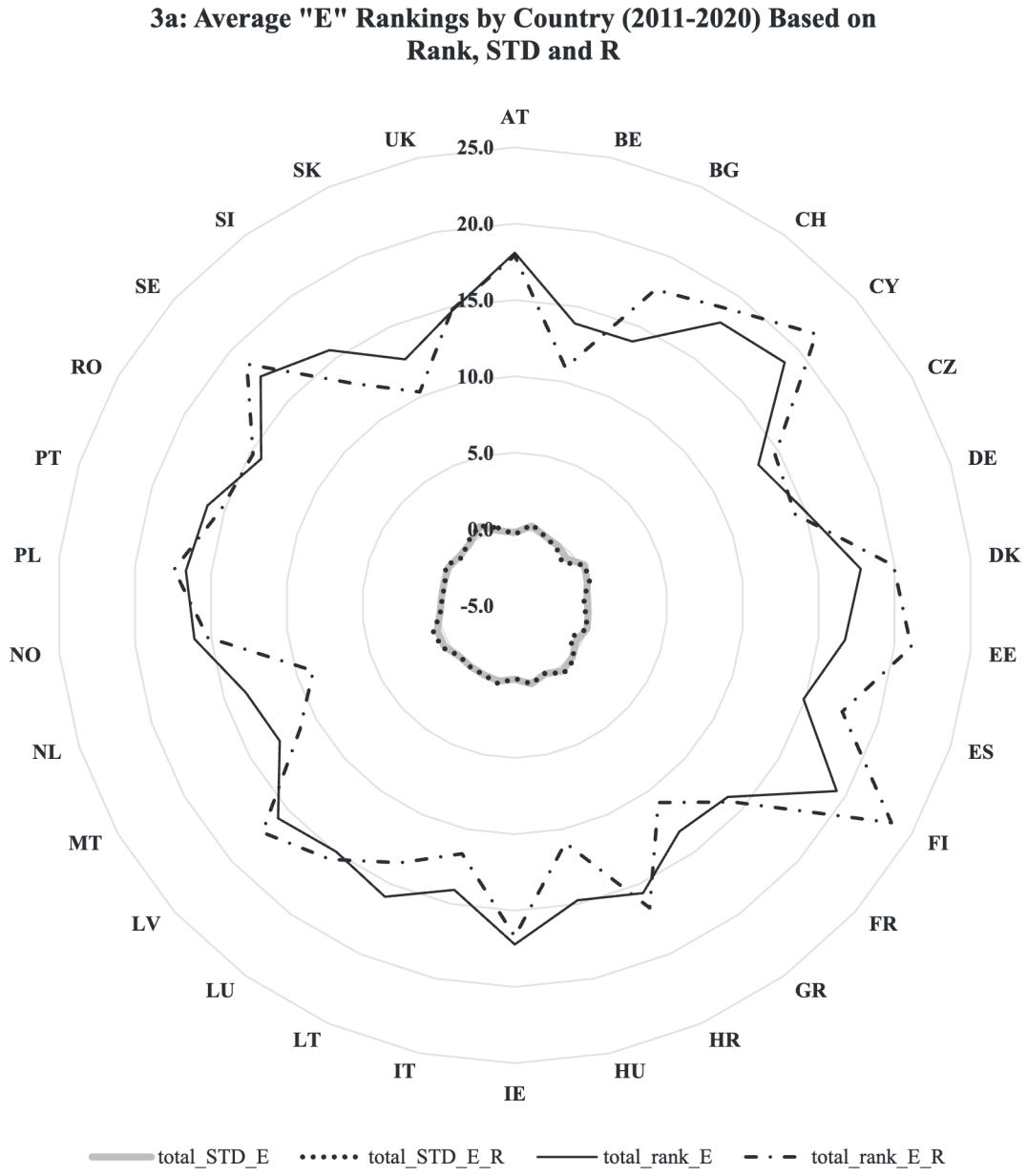

FIGURE 3 | Average "E", "S" and "G" Rankings by Country (2011–2020) Based on Rank, STD, and R. E, environment; G, governance; Rank, ranking-based indicators; R, analysis based on the levels of the variables; S, social; STD, value-based indicators.

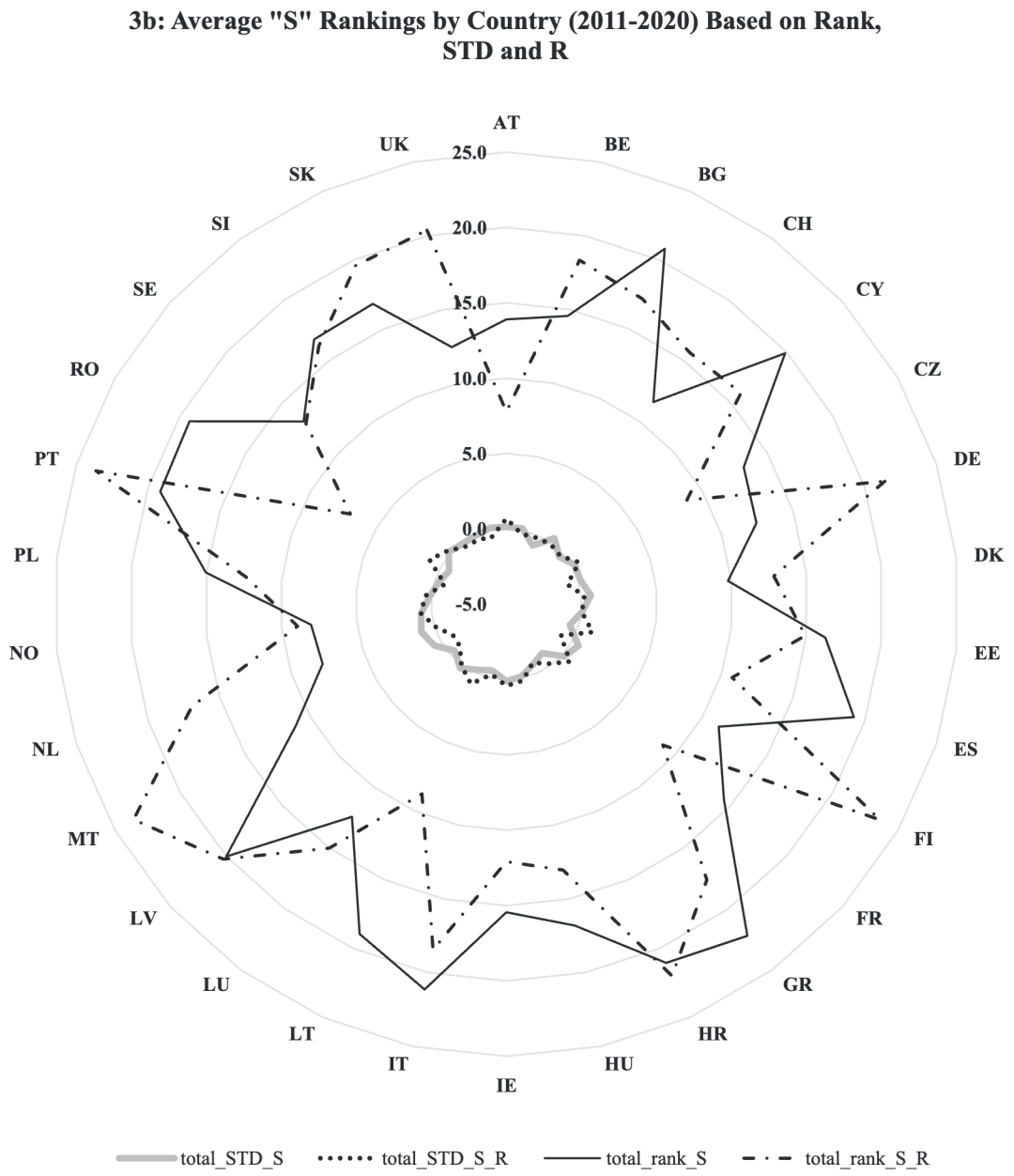

FIGURE 3 | (Continued)

these countries, especially Norway and Denmark, reduced their exports with regard to the trade balance pertaining to environmental goods and low-carbon technology products. Overall, expenditures on environmental protection (as a percentage of GDP) have been stable over time in these countries, with the exception of Belgium, which exhibited an increase from 0.8% to 1.5%.

In the case of value-based indicators, the higher the value is, the better the situation in terms of overall ESG or each component thereof, namely, "E", "S" or "G". With regard to rank-based indicators, the lower the value is, the better the ranking.

The value-based and rank-based measures, in which context the variables that we used were defined in the same way as the variables included in the PCA approach, provided nearly the same results regarding the top and bottom performers. The best ESG performance was achieved by the Netherlands, Norway, Finland, Denmark and Switzerland (Luxembourg was the sixth-ranked country in terms of value-based measures and the fifth-ranked country in terms of rank-based measures, replacing Switzerland). Italy, Croatia, Romania, Greece and Bulgaria were among the worst performers. These results are also comparable to those obtained via the PCA.

Scandinavian countries and Switzerland have been recognized as leaders in the implementation of ESG practices, largely because of the high levels of economic development that they exhibit. This finding may confirm the link between a country's level of economic development and its ESG performance. An analogous conclusion can be drawn with respect to the countries that were identified the worst performers; i.e., Romania and Bulgaria are the least developed European countries.

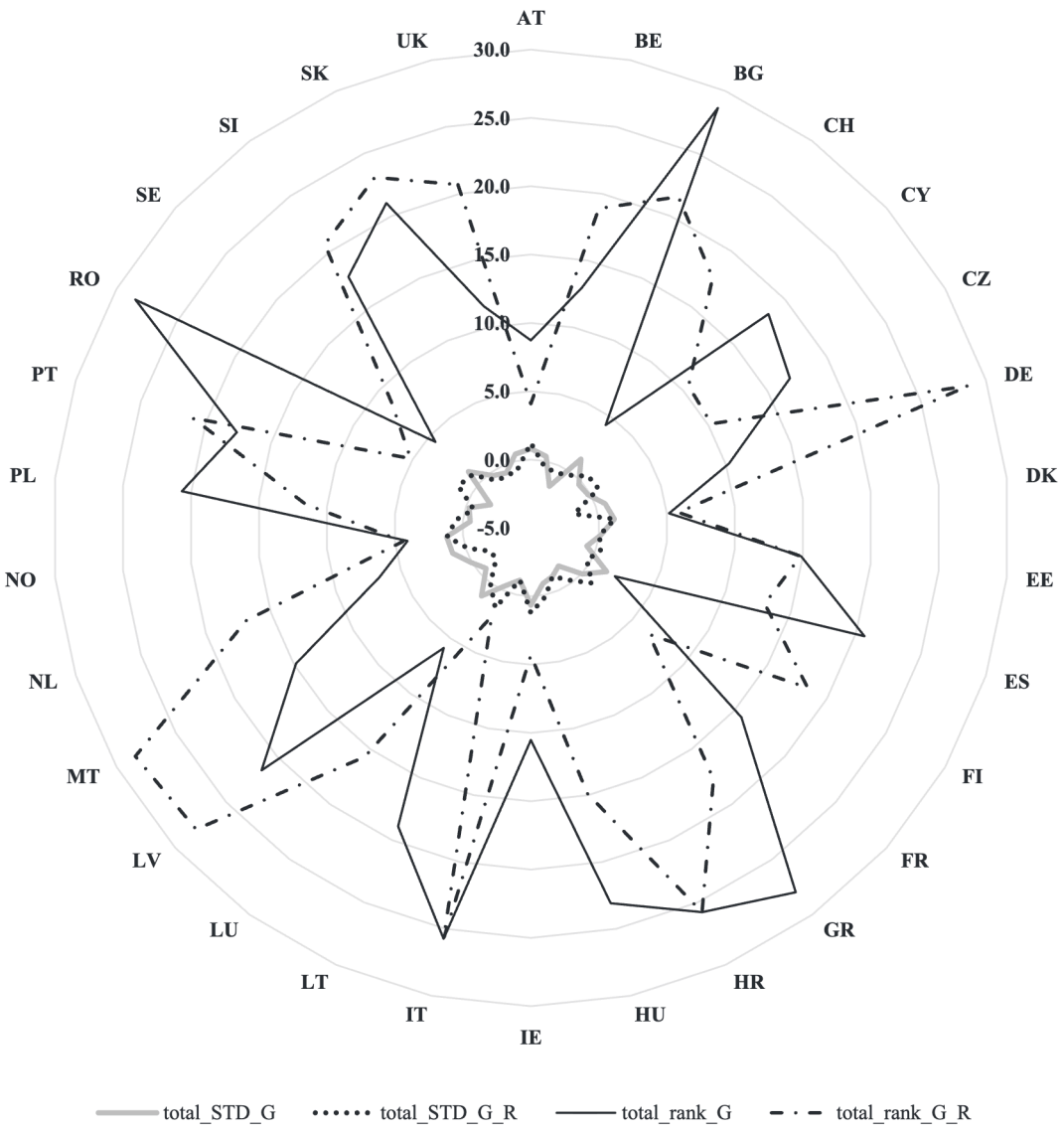

FIGURE 3 | (Continued)

However, when we used only the levels of variables (as indicated by _R), the list of countries differed. Romania, Lithuania, France, Norway, and Czechia were recognized as the top performers (while Austria was ranked 6th), whereas Finland, Malta, Croatia, Deutschland and Latvia were recognized as bottom performers. These differences in the results confirm that the selection of variables and their form may have considerable effects on the final ESG rankings.

A combination of these results with those of the value-based assessment revealed that only Finland and Romania scored in line; i.e., they were assigned to two groups. Finland was identified as the leading country in terms of the implementation of ESG practices, while Romania was identified the least committed country in terms of the implementation of sustainability practices. Finland is a highly industrialized economy that features a GDP per capita that is slightly greater than that of Germany and Belgium. Moreover, Finland is viewed as an innovative country, and it exhibits a dominant share of exports in terms of machinery, mechanical and electrical equipment, and their parts. Romania is a country that is characterized by a large shadow economy and a high level of regional disparities in terms of education, health and transport. The ESG scores obtained by these countries are therefore in line with their levels of economic development. The results confirm the impact of the country's level of economic development on its sustainable development performance as well as the mutual influence of these economic categories. This finding is in line with those reported by Fayissa and Nsiah (2013), Diaye et al. (2022) and Ho et al. (2023).

Figure 3 illustrates the ranking results for each component of ESG.

However, with respect to the "E" dimension, the indices based on transformed and raw data (concerning the levels of variables) indicate similar results, whereas the results pertaining to the "S" and "G" dimensions often differ; these findings reveal that treating data in different ways may lead to different results, even in the case of variables that have long been used in the academic literature on this topic.

With respect to the results reported by Capelle-Blancard et al. (2019), only the countries that were included in both studies could be compared. Thus, our bottom performers, such as Croatia, Romania and Bulgaria, were excluded from this comparison. Greece and Italy also performed poorly in the research conducted by Capelle-Blancard et al. (2019), whereas our top 5 countries were included among the top 10 countries identified by Capelle-Blancard et al. (2019); however, the period analysed by those authors ended in 2014.

Additionally, we compared the ESG results between "new" European countries (i.e., those that joined the EU beginning in 2004; this group mostly includes postcommunist countries) and "old" European countries as well as between Southern and Northern European countries. Across all the settings, the ESG indices pertaining to "old" countries were better than those pertaining "new" countries (see Table 5). Although "new" countries obtained better results in the "E" category, their achievements in the "S" and "G" categories were worse. This finding may indicate that adjusting the economy to market rules is easier than changing societal and political landscapes. The situation observed in countries in Northern Europe was better than that observed in countries in Southern Europe, which is in line with the findings reported by D'Orazio and Thole (2022) with respect to climate-related financial policy. The results are also consistent with the findings reported by Tanjung (2021), which did not confirm the relationship between social development and sustainable development. These findings thus confirm that achieving changes in the social area takes time and can only be accomplished in the long term.

4.2 | The Causal Relationship Between ESG Performance and Economic Growth

The results of the causality analysis are provided in Table 6. The *p* values refer to the hypothesis that no causality characterizes this relationship; i.e., values below the preassumed level of

TABLE 5 | PCA as well as value- and rank-based ESG indicators for different country settings.

Group of countries	ESG_ INDEX	total_ STD_ ESG	total_ STD_ ESG_R	total_ rank_ ESG	total_ rank_ ESG_R
New	−1.53	−0.24	−0.05	17.79	15.81
Old	1.17	0.18	0.04	13.75	15.27
North	0.98	0.21	0.08	13.82	14.71
South	−2.18	−0.42	−0.16	18.86	17.07

Note: Average indices.
Abbreviations: E, environment; G, governance; index, PCA-based; rank, ranking-based indicators; R, analysis on the basis of the levels of the variables; S, social; STD, value-based indicators.

TABLE 6 | Results of the HPJ Granger-type tests of the (delta) GDP–ESG causality.

ESG indicator type	Variable treatment[a]	GDP → ESG	ESG → ΔGDP (annual)	ESG → ΔGDP (5-year-change)
$I_{E,t,PCA}$[b]	Level/difference	0.199	0.040	0.203
$I_{S,t,PCA}$[b]	Level/difference	0.000	0.416	0.046
$I_{G,t,PCA}$[b]	Level/difference	0.000	0.103	0.000
$I_{E,t,RANK}$	Level/difference	0.002	0.728	0.068
$I_{E,t,RANK}$	Level	0.000	0.701	0.006
$I_{S,t,RANK}$	Level/difference	0.577	0.105	0.426
$I_{S,t,RANK}$	Level	0.003	0.736	0.000
$I_{G,t,RANK}$	Level	0.024	0.953	0.001
$I_{E,t,VALUE}$	Level/difference	0.000	0.582	0.000
$I_{E,t,VALUE}$	Level	0.002	0.056	0.039
$I_{S,t,VALUE}$	Level/difference	0.000	0.106	0.081
$I_{S,t,VALUE}$	Level	0.058	0.233	0.000
$I_{G,t,VALUE}$	Level	0.000	0.001	0.000

Abbreviations: E, environment; G, governance; S, social.
[a]Level = analysis on the basis of the levels of variables; level/difference = analysis on the basis of the form of the variables that maximized the KMO values in the averaged PCA. For each of the variables, the corresponding form is provided in the third column of Table 4.
[b]All variables included in the PCA are considered in terms of levels; thus, the level and level/difference results are identical. Accordingly, we do not include a separate level/difference row for the I_G indicators.
Source: Author's own calculations.

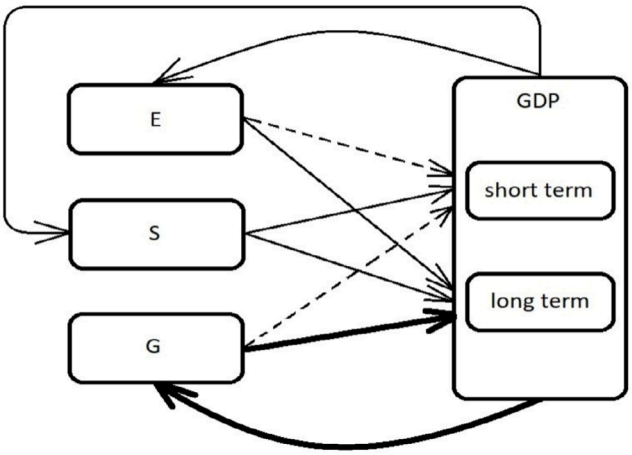

FIGURE 4 | Graphical interpretation of the short- and long-run relationships between ESG and GDP. E, environment; G, governance; GDP, Gross Domestic Product; S, social. *Source:* Author's own calculations; dotted line = some of the I indicators confirm the existence of Granger causality, solid line = most of the I indicators confirm the existence of Granger causality, bold line = all of the I indicators confirm the existence of Granger causality.

significance indicate that, at least in some of the countries under consideration, the Granger causality relationship exists. In the following discussion, when we refer to the significance of a variable, for the sake of brevity, we indicate significance at the 10% level. Three blocks correspond to the three types of noncausality hypotheses considered in this context: (H1) the considered ESG indicator is not Granger-caused by GDP, (H2) the annual change in real GDP is not Granger-caused by the ESG indicator under consideration, and (H3) the 5-year change in real GDP is not Granger-caused by the ESG indicator under consideration (averaged over the 5-year period in question).

H1 and H3 are rejected on the basis of these results. A change in GDP impacts ESG performance (H1), while ESG performance impacts GDP in the medium term (H3) but not in the short term (H2). The role played by the change in GDP in ESG performance, regardless of the time horizon, may be motivated by the attitudes towards investments in new priorities, such as ESG, adopted by the government or the private sector. When economic performance and perspectives are positive, various entities are inclined to invest in new priorities. However, such an investment does not immediately lead to positive results. Conversely, when economic performance or perspectives are poor, the government and the private sector may terminate such investments and readjust their interests to focus on activities that may offer immediate results. Why does ESG performance impact GDP only in the medium term? Changes in each of the three components take time to adjust to new requirements. As our study reveals, in postcommunist countries, such adjustments in the "S" and "G" dimensions are difficult. Even more than 30 years following the collapse of communism, these countries exhibited worse performance than that of their Western counterparts. We claim that the economy may benefit from "E" performance in the medium to long term, as such performance requires structural changes in, e.g., industry, agriculture and society. The results of pro-environmental investments are not immediate; in fact, in the short term, such investments may reduce profitability. Figure 4 provides a brief summary of the results of the causality analysis.

These results are in line with those reported Diaye et al. (2022) and Ho et al. (2023), who analysed different sets of countries across different periods. However, these authors used only the indicators developed by Capelle-Blancard et al. (2019), whereas in this study, we employed a wide set of indicators that were rooted in various methodologies. As the results presented here hold regardless of the type of indicator considered, their robustness has been confirmed. Notably, our conclusions concerning the time horizon of the impact of ESG factors on economic growth are consistent. Similar to Diaye et al. (2022), we believe that a positive impact of sustainable development policy is possible in the long term.

5 | Conclusions

This study focused on the ESG performance of European countries as well as link between this factor and economic growth for the period 2011–2020. We relied on the approach developed by Capelle-Blancard et al. (2019) but also suggested alternative solutions that can be used to estimate ESG indices. Our estimations revealed that ESG performance is lower in postcommunist countries and new EU entrants than in "old" European market economy countries. However, these differences are associated with the "S" and "G" dimensions but not the "E" dimension, which may indicate that societal and political changes are more difficult to achieve than is economic change.

Additionally, the differences observed between Northern and Southern Europe in this context were explored, revealing that ESG performance was better in Northern Europe than in Southern Europe. Our results regarding the top and bottom performers are robust, regardless of the approach used to calculate the ESG indicators. Exceptions to this claim, however, are the indicators that were estimated for the levels of different variables (marked as _R). We identified the Netherlands, Norway, Finland, Denmark and Switzerland (all of which are countries in Northern Europe) as the top performers, whereas the bottom performers were Italy, Croatia, Romania, Greece and Bulgaria (all of which are countries in Southern Europe).

We explored the causal relationship between ESG performance and GDP-based measures in European countries with respect to all the ESG indicators included in our study. The results revealed that a change in GDP is meaningful with respect to ESG performance, whereas ESG performance is meaningful with regard to economic growth only in the medium term (i.e., 5 years). These findings are in line with those of the studies conducted by Diaye et al. (2022) and Ho et al. (2023), thus confirming that ESG performance may improve economic growth prospects, albeit with some degree of time lag.

Our study has several limitations. First, the limited availability of long-term series of variables that fall within the scope of ESG should be noted. To ensure comparability among countries, researchers may not include variables that could explain

ESG activities more effectively as a result of gaps. Therefore, the inclusion of ESG performance in economic growth models remains limited. Second, measuring ESG performance at the country level is a relatively new concept that lacks a well-grounded theoretical background. On the one hand, ESG regulations may be analysed at the country level, as many countries have publicly made commitments to ESG (see, e.g., D'Orazio and Thole 2022). On the other hand, actual ESG commitment should be evaluated in terms of activities and changes in policy rather than through words and declarations. We claim that the impact of the activities undertaken with the aim of meeting countries' ESG commitments is difficult to measure. Thus, the implementation of the EU taxonomy can help overcome this obstacle in the future.

Future research should also explore the selection of ESG variables in empirical studies with the aim of evaluating ESG performance, thereby developing a widely accepted standard in this respect and reducing the degree of divergence.

With regard to the process of policy making in the EU, we posit that the differences among countries in terms of their economic and social situations should be considered when designing EU-wide ESG policies. Once again, a one-size-fits-all approach seems not to be an optimal solution in this context and may not yield the necessary results.

Endnotes

[1] The EU includes Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

[2] Overall, 17 values associated with variables under consideration were imputed in the period 2011–2020. Sixteen of the values thus imputed were related to the school enrolment variable, accounting for approximately 5% of the values of this variable within the sample.

[3] Please see Capelle-Blancard et al. (2019), appendix, note to tab. A.1.3. (p. 166).

[4] Please see Capelle-Blancard et al. (2019), appendix, tab. A.1.5. (p. 166).

[5] The number of principal components is selected on the basis of Kaiser's criterion.

[6] With the exception of the unemployment rate, an increase in the value of a given descriptor increases the value of the corresponding ESG indicator. Accordingly, countries are ranked in ascending order in all the descriptors but in descending order in the case of the unemployment rate. This procedure is the same as in the case of the descriptors that are presented in terms of levels and in after the case following the transformations that are described in Table 4.

[7] See Table 4.

[8] As in the case of the ranking-based indicators, a minor amendment is required in the case of the unemployment rate: its values are subtracted instead of added with the aim of reflecting the opposite influence on the value of the indicator to that of the unemployment rate.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information.