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Research Article

Materiality Conditions in the Interplay between Environment and Financial Performance: A Graphical Modeling Approach for EEA Oil and Gas Companies

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The recovery after the unprecedented pandemic crisis that Europe has currently been facing is strengthening the strong dependence between social, economic, and environmental fields, maintaining green investments and innovation at the core of the European strategies. Shifting to clean industries is a challenging mission that a complex network of stakeholders and their different interests must take into account. Within this network, the interplay between environmental and financial performance of a company represents a common point with a growing emphasis on the transparency and the materiality capacity of the disclosed information. This paper uses the Structural Equation Modeling and the Gaussian Graphical Models as graphical analysis approaches and offers a first insight about the interaction between environmental materiality measures and financial performance. A preliminary step of the scientific research consisted of a hand-mapping investigation about materiality conditions. Starting from the Materiality Map developed by the Sustainability Accounting Standards Board (SASB), this paper extends the main concept about materiality and investigates it on three different content ranges, which focus on the general environmental policy of the company, the targets set, and its concrete footprint. The methodology approaches were grounded on a newly compiled dataset provided by the Thomson Reuters database for 194 Economic European Area (EEA) oil and gas companies. The results provide significant evidences for the manifestation of materiality and emphasize the informational content of the individual environmental measures as an important condition for its financial impact. Adding to the environmental-financial performance relationship, our findings have both practical and academic relevance for the economic field and sustainable growth goals.

1. Introduction

The environmentally sustainable growth represents essential benchmarks for the European Economy, particularly for all countries inside the Economic European Area (EEA). The Annual Sustainable Growth Strategy for 2020 "puts the sustainability, in all of its sense, at the centre of all actions: an economy must work for the people and the planet" [1] (p.2). Environmental protection has progressively been considered as a core issue of societies, governments, and international organizations, with major economic and financial implications. To become more environmentally friendly, the European companies need to manage a significant increase in their operating costs. Consequently, the pursuing of the financial goals has been transformed into an ongoing sustainable challenge race. The unprecedented pandemic crisis that Europe is currently facing is strengthening the strong dependence between social, environmental, and economic fields, making this connection even more imperative. As the environmental concerns of key stakeholders have increased, climate change and environmentally sustainable growth have become pressing financial and social issues [2]. Besides the regulatory concerns, there is a growing interest regarding the mandatory involvement of companies in green strategies. Furthermore, at the end of 2019, in "The European Green Deal" [3] (p.2), it has been postulated that the European Union (EU) economy will register "no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use." In April 2020, the European Council reinforced the central role of "Green transition and Digital transformation in relaunching and modernising the economy" [4] (p.3).

The interaction between environmental performance and financial performance of companies plays an important role within the process of transforming European industries into being environmentally neutral. As a result of the environment regulations and the socioeconomic pressure, a growing number of companies has encompassed their global warming strategies within the core policies [2, 5], and has redounded to the mitigation of the environmental footprint, generated by their economic activities. Within the business literature, these strategies are deemed as "signals of firms' environmental performance" [6] (p.2) and they are enclosed by a large number of studies [7–12], with ambiguous findings. The main arguments of the inconclusive results are based on the diversity of tools used to express the environmental performance, the diminished attention paid to the heterogeneity and the complex nature of such nonfinancial dimensions, and also on the scientific techniques applied [12]. This research goes beyond these arguments and raises a new and complementary approach, grounded on in-depth empirical contributions. The environmental and the financial performance is important both for managerial team and for stakeholders. In the light of this approach, the theory of environmental performance materiality has arisen, with a focus on the importance and the usefulness of the measures related to ecological behavior into decision-making process. The new concept is a part of the Environment Social Governance' (ESG) materiality framework. The definition of the materiality of such nonfinancial issues is centered on whether omitting or misstating of this information would change the decisions of the relevant stakeholders [13, 14]. The Sustainability Accounting Standards Board (SASB) views the financially material issues as those "that are reasonably likely to impact the financial condition or operating performance of a company and therefore are most important to investors" [15]. Taking the investors position, SASB has developed the "Materiality Map" [16] that indicates industry by industry (e.g., Extractives and Mineral processing) and sector by sector (Coal operations, Construction materials, and so on), as to "which ESG issues are likely to be financial material, and to affect the financial condition or operating performance of companies" [15].

In this frame of fact, the main objective of our research is to assess the interaction between environmental measures and financial performance, by applying the conditions of materiality manifestation. For this purpose, we have used the recommendations developed by the SASB in the Materiality Map and extended them to a more integrative analysis. Considering the managing of the environmental impact as an extremely significant component of business strategy [17] for extractive companies, the entire design research of our paper is developed for the case of oil and gas companies (a final sample of 194 companies) located in the EEA Member States. The data sample is extracted from the Thomson Reuters/Refinitiv database [18], for the period 2009–2018. Studying the overall (direct, indirect, and total) implications of the environmental materiality measures on corporate financial performance (through structural equations modeling-SEM), and the network association between environmental performance (EP) and financial performance (FP) (by applying the Gaussian Graphical Models-GGM) is paramount to supplement previous conclusions and to support the managing of environmental issues into the business strategy of a company. The entire graphical modeling approach is built as an integrative system in order to gain scientific insights into the complex interactions between all considered variables, and to identify the most capable ones to have a financial impact. The SEM and the GGM are complementary methods that provide a powerful methodological combination that "allows for confirmative testing of network structures both with and without latent variables" [19] (p.3) and provides accuracy and robustness to the final observations. The SEM estimates the interlinkages (direct, indirect, and total) jointly with standardized path coefficients from variables belonging to the environmental materiality measures on corporate financial performance variables, and the GGM is used to estimate the intensity influences of environmental performance (EP) variables on FP, representing a complementary analysis to the SEM models.

The rest of this paper is structured as follows: after the literature review on the field of the EP-FP relationship and the materiality framework, the description of research methods, data preparation, and variables follow. The econometric processing provides the detailed results further presented, jointly with discussions of their relevance related to the mainstream literature underpinnings. The concluding remarks and the information enclosed in the Appendices complete this paper.

2. Literature Review

2.1. Relationship between Environmental Performance and Financial Performance. Understanding the nature of the connection between the environmental and the financial issues represents an important step in achieving sustainable growth goals. As the public and private concerns with regard to the unfavorable impact of the environment on the economy have increased, scholars have focused their attention on the relationship between the environmental performance (EP) and the financial performance (FP) of companies. Despite the impressive body of empirical evidences, this interaction is greatly nuanced, very complex, and set within a provocative framework. The company's environmental performance is not a gentle concept to grasp. This concept covers a broad variety of quantification techniques of different strategies, policies, targets, or regulations implemented by a company, in its effort to preserve the natural environment. An important number of studies has empirically analyzed the impact of environmental performance on corporate financial performance, including carbon disclosure tools [5–12], emissions/pollution impact [7], or environmental corporate social responsibility [9, 10]. A summary of these scholars' findings is drawn up as two-sense outputs: a positive relationship between the EP and the FP, on the one hand, and a negative one, on the other hand. The evidences of a positive relationship are numerically superior [5, 7, 8] to those of a negative association [10], meaning that the financial efforts of companies to invest in green technologies or green-actions are appreciated by the key stakeholders, and rewarded through a higher financial performance. Moreover, some findings did not reveal any relations between the environmental performance and the financial performance [9].

The divergent empirical outputs are presumably generated by a variety of measures with different ecological content [20]. However, the gap between the academic world and the practitioners seems to become deeper with the evolution of these measurement tools. From a practical point of view, the situation is likely to be more complicated, and we need to understand and to integrate it into the empirical research. The companies operate in a competitive economy with real and ongoing environmental constraints. Management teams act in response to environmental regulations, and the stakeholders make their decisions on the information available regarding the risk and opportunities related to the ecological footprints faced by the company. Thereby, not any type of nonfinancial environmental issues is important for the decision process and so, it is susceptible to influence the financial performance of the company. The primary studies on the environmental-financial performance relationship mainly omitted this fact.

2.2. The Materiality Framework. The growing informational value of incorporating nonfinancial data into the business decision process has been revealed as the "financial materiality" framework. This concept captures the usefulness or practical relevance of a piece of information as if "omitting or misstating of it could influence the decisions that users make on the basis of the financial information of a specific reporting entity" [21] (p. 66). International institutes, such as the United Nations (UN) [13] and the Global Reporting Initiative (GRI) [14], have based their description of the materiality of nonfinancial information, like environmental, social, and governance indicators, on the financial information, whether or not the information would change the decision made by the relevant stakeholders [22]. The practical significance of such nonfinancial disclosure has driven the necessity of comprising the financial report of the company including both quantitative and qualitative data, which are closely related to their operating activities. As the SASB suggests, in the research [15], the companies need to identify and invest in environmental and social issues that are strategically connected to their business. A disclosed measure can be material as long as its content is relevant both at the company level and for the business sector. In line with these remarks, we can say that materiality can be observed only in the context of the decision process, as an additional factor that has the capacity for influencing the operating conditions of a company and even its financial performance level. There is a considerable amount of Environment Social Governance (ESG) public information available, but the difficulty consists in identifying the piece of information that has the highest utility in the decision process. Going further, the nonfinancial measures (ESG) may contain both material (decisional relevant) and immaterial (decisional irrelevant) information and, to gain insights into their complex materiality manifestations, new and exploratory approaches are needed to be put in place.

An important tool in understanding materiality is the Map Materiality developed by the SASB. Focusing on material issues, this Map encloses five sustainable Dimensions (Environment, Social Capital, Human Capital, Business Model and Innovation, and Leadership and Governance), each of them being secondary detailed into three to seven General Issue Categories [16]. The SASB includes the environmental impact of a company into the Environmental Dimension "either through the use of non-renewable natural resources as imputes to the factor of production or through harmful releases into the environment that may result in impacts on the company's financial condition or operating performance" [15]. The Environmental Dimension is further detailed into six general issue categories: GHG Emissions, Air Quality, Energy Management, Water and Wastewater Management, Waste and Hazardous Materials Management, and Ecological Impact [16].

As a standpoint on the current level of knowledge, we stipulate the following research assumption: the environmental measures of oil and gas companies have a significant influence on the financial performance level, based on their materiality capacity.

3. Materials and Methods

3.1. Graphical Model Settings. The graphical modeling is a merge between the probability theory and the graph theory, and provides the framework necessary for the design and analysis of a new system. The fundamental goal of a graphical model is to capture and visualize, as a network representation, the conditional dependencies between a set of variables (Figure 1). In essence, a graph is a network made up of nodes (variables, or referred to as items or vertices) and linkages (dependencies among nodes, or referred to as lines or edges), defined as [23]

$$G = \{V, E\}, \quad (1)$$

where G is a graph model representing the network, in general terms; V is the set of variables or nodes (a-e) in the network; and E represents the set of links between nodes (indicating the direction and strength of the casual relationships).

Theoretically, a graphical analysis refers to a considered system of variables and the relationship between them,

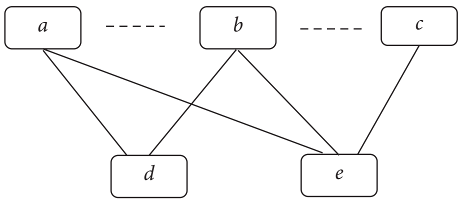

Figure 1: Generalized graphical model as a Bayesian network. Source: own conception.

estimated on a wide range of analytical techniques. In this paper, we have used two graphical approaches, namely, the Structural Equation Modeling (SEM) and the Gaussian Graphical Model (GGM), so as to provide accurate and robust evidences regarding the interaction between material environmental measures and the financial performance. The SEM and GGM are advanced methods, which complete against each other "by using the strength of one framework to overcome the shortcomings of the other framework" [19] (pp. 2). While SEM is focusing on the variance that is shared across all variables, the GGM highlights the variance that is unique to pairs of variables [24]. In particular, both methods rely on the assumption that "the covariances between observed variables are not caused by any latent or unobserved variable" [19] (pp.7).

3.1.1. Structural Equation Modeling (SEM). Structural Equation Modeling (SEM) is an advanced multivariate technique, which embodies mathematical models, statistical methods, and graphical representation that allows for the analysis and representation of the pattern of causal processes. The SEM method is used in social sciences and economics to define "a theoretical causal model consisting of a set of predicted covariances between variables and then test whether it is plausible when compared to the observed data" [25, 26].

As an "integrative procedure that appraises overall interlinkages among considered variables, direct, indirect, and total" [27] (p. 9), a structural equation model (SEM) is a system of linear equations among variables, similar to multiple regressions, but much more complex in their building, because in multiple regressions there is a limited number of dependent variables, while within the SEM pathway models there may be several dependent variables, as we enclosed in our analysis. Mainly, the SEM comprises two parts: a structural part, expressing the endogenous or dependent constructs as linear functions of the exogenous, or independent, constructs, and a measurement part, linking the constructs to observed measurements [28].

The SEM models are based on the general representation as depicted by [29] (p. 8)

$$\begin{cases} b_{11}y_{2t} + \cdots + b_{1m}y_{mt} + c_{11}x_{1t} + \cdots + c_{1n}x_{nt} = \varepsilon_{1t}, \\ b_{21}y_{2t} + \cdots + b_{2m}y_{mt} + c_{21}x_{1t} + \cdots + c_{2n}x_{nt} = \varepsilon_{2t}, \\ \vdots \\ b_{m1}y_{mt} + \cdots + b_{mm}y_{mt} + c_{m1}x_{nt} + \cdots + c_{mn}x_{nt} = \varepsilon_{mt}, \end{cases} \quad (2)$$

"where t is the number of observed time periods, b_{ij} represents the y_{ij} endogenous variable's parameters, c_{ij} are the x_{ij} exogenous variable's parameters, $i = 1, \ldots, m$, $j = 1, \ldots, n$, and ε comprises the error term (residuals)" [29] (p. 8).

Structural coefficients of SEM models are represented by the regression coefficients in equation (2), and indicate *two types of effects* [30, 31]: structural effects of endogenous variables (y_{ij}) on other endogenous variables (x_{ij}) (coefficients denoted by b); structural effects of exogenous variables (x_{ij}) on endogenous variables (coefficients denoted by c).

The basic principle of the function of the SEM is that the linear equations system proceeds in a specific casual order, which can be used to generate an implied covariance matrix [32]. Furthermore, the difference between the observed covariance structure and the covariance related to the path model included in the SEM is minimized by modifying "the path coefficients and residual variances iteratively until there is no further improvement in fit" [33] (p.6). For this, the maximum likelihood estimator technique or the weighted least-squares method can be used as tools to indicate a fit criterion in order to be maximized. Due to the estimation of the unobserved (latent) variables from the observed variables in the case of the SEM, the method permits the creation of composites by taking into account an explicit measurement error. Finally, the full model is estimated from a data set and can be tested to fit the sample data. Assessment of the model inference in the SEM is made by "comparing the goodness-of-fit between the model implied covariance matrix and the empirical covariance matrix" [33] (p.6). Hence, the rigorous explanation of the SEM results are grounded, firstly, on specific tests that assess the conformity of the models for the data used, namely, the *confidence tests*, such as Cronbach's alpha test (that measure the total scale of the coefficient Alpha), the Wald test (that provide the p value for each equation enclosed within the model), and *the goodness-of-fit tests* (mainly used are likelihood ratio (LR), Akaike's information criterion (AIC), Bayesian information criterion (BIC), comparative fit index (CFI), and Tucker–Lewis index (TLI)).

The STATA 16 software was used to develop and assess the SEM, capable of reflecting the natural dependency between the environmental measures (implied the materiality conditions) and the financial performance. To validate the SEM′ results, we have run several tests, namely, Cronbach's alpha, Wald tests for equations associated with the SEM models, and the goodness-of-fit tests.

3.1.2. Gaussian Graphical Model (GGM). Gaussian Graphical Modeling is a network analysis technique that provides an "easy to grasp overview of the relationships between items and variables included in a study" [34] (p.2). A visual representation, as a network structure of these relationships, helps researchers to gain insights about the casual dependency and interaction mechanism among modeled variables.

Considered as a partial correlation graph network, the GGM is different "from typical exploratory analysis based on partial correlational coefficients" [19] (p.8), with a more interesting structure and is easier to interpret. A GGM consists of a set of variables (items or nodes), represented by circles, and a set of links between them that takes the form of lines or edges and visualizes the relationship between the items or variables [35–37]. The size and color of the lines (edges) comprise information about the strength and the direction of the relationship between the variables (items or nodes). The thickness of the lines reflects the strength of the association between the variables, while the colored blue or green lines usually represent the positive relationship and red lines represent a negative relationship. Notably, the absence of a line "implies no or very weak relationship between the relevant items or variables" [34] (p.2). Consequently, the GGM allows for the assessment of the intensity of the links between the variables, as well as the evaluation of their structure within the network.

Within a GGM, the relationships between each pair of variables are estimated as partial correlation coefficients, which reduce the risk of finding a spurious correlation (i.e., the correlation between variables that are not directly related but are correlated through an unknown variable). Avoiding spurious correlation is a key advantage of partial correlation. As such, the partial correlation coefficient is sufficient to test the relationship as a degree of conditional independence between two items or variables, after conditioning all the other variables included in the data set [19, 34].

By assuming multivariate normality, a partial correlation network encodes a "*p x p, weight matrix, Ω*, in which element ω_{jk} represents the edge weight between node j and node k" [19] (p.7), as we can see in the following equation:

$$\mathrm{Cor}\left(y_j, y_k | \mathbf{y}^{-(j,k)}\right) = \omega_{jk} = \omega_{kj}. \tag{3}$$

The partial correlation coefficients used to express the strength of the connection between two variables in the GGM can be obtained according to the equation (4) [38] from the standardization of the *precision matrix* $(\widehat{K})$:

$$\mathrm{Cor}\left(y_j, y_k | \mathbf{y}^{-(j,k)}\right) = -\frac{k_{jk}}{\sqrt{k_{kk}}\sqrt{k_{jj}}}. \tag{4}$$

Two variables or nodes are connected through an edge of the network if "there is covariance between those nodes that cannot be explained by any other variables in the network" [37] (p.307). If the estimated partial correlation coefficient is zero, "there is conditional independence and hence no edge in the network" [19] (p.7).

To account for all the interdependencies between the considered variables, embodying the environmental and financial performance, we have developed three GGMs. The estimation of the models is based on the partial correlation (PCOR) methodology, provided by the *R* Studio 4 program.

3.2. Data Preparation, Variables, and Hypotheses. To get the set of variables, we have conducted an empirical investigation at the level of 194 oil and gas companies within the EEA countries. The data have been collected from the Thomson Reuters/Refinitiv database [18] and include all the information available in the Environmental measurement field. At the level of the oil and gas industry, there are 2,197 constituents in the Refinitiv database. The constituent companies available cover all the geographical regions, but in order to ensure the homogeneity and the comparability of the data sampled, we have selected only companies within the EEA (namely, the EU MS, Iceland, Liechtenstein, and Norway), and we have obtained a final sample of 194 companies. We justify and link our selection criteria to the common interests and regulations of these countries in achieving the environmentally sustainable green growth and a circular economy [39].

The Refinitiv database offers a company's ESG performance general score across three pillars, namely, Environment (E), Social (S), and Governance (*G*); 10 themes; and 178 relevant measures. All measures are based on considerations around materiality, data availability, and industry relevance [18, 40]. The Environmental issues are available both as a multidimensional measure (Environmental Pillar Score) and as one-dimension measures (95 relevant metrics organized in three themes: Resource Use, totaling 33 measures; Emissions, totaling 40 measures; and Innovation, totaling 22 measures) [41]. There is an important body of scientific research based on the data provided by specialized databases (such as Thomson Reuters/Refinitiv, MSCI, Vigeo, Bloomberg), the ESG score being the variable predominantly approached from these sources by the scholars [42, 43].

The first stage of our research has consisted in a hand-mapping investigation carried out by overlapping the SASB's Environmental Dimension Categories on Environmental issues, provided by Thomson Reuters/Refinitiv database. We followed the earlier literature's technique of Khan, Serafeim and Yoon [44] in adopting the SASB's guidance to identify relevant environmental measures. As in the case of Khan [45], there is no perfect match between their two contents of SASB and Thomson Reuters regarding the environmental issues. In fact, no matter how different scholars named it or used it [17, 21, 22, 44, 45], the hand-mapping investigation technique requires the identification of ESG factors.

Going further with this investigation technique, we have transposed the content of all six recommended categories into the Refinitiv's Environmental measures. Our first notice was that, in the case of oil and gas companies, the intensity of the financial materiality's impact varies across the six SASB's Environmental Categories. We have selected 95 environmental indicators that are the most appropriate ones. The entire hand-mapping investigation process has been based on the information usefulness of the indicators into the decision-making process, as their relevance for investors (according with SASB's guidance). Following the empirical evidences of materiality's existence and its manifestation, especially the findings of Serafeim regarding that "not all social and environmental initiatives are created equal, or similar related to the business" [17] (p.3), we have decided to introduce an additional selection criterion, namely, the cover range of the environmental measures' content. If the disclosed issues consist of mixed information's content, the stakeholders need to have the opportunity to make a distinction.

The nonfinancial indicators add value to the decision process as long as they contribute to a widening of the risks and opportunities spreadsheet. Offering different types and dimensions for corporate environmental behavior measures, the key stakeholders and especially the investors will have the opportunity to decide which measure is the most suitable to the business case and widely to the financial impact of the company's operating activity.

As one of the main contributions of the research, we have introduced three different degrees of information content to be considered as a potential condition, in order to achieve a financial impact of the environmental performance at the operating activity level. Thus, we have defined three subcategories of environmental measures, covering the content range from general to particular, namely:

(i) Policy environmental measures that give information about the presence or absence of a general policy of the company in the environmental field (a general content range)

(ii) Target environmental measures that provide information about the general targets set by the company in the environmental field (a medium general content range)

(iii) Concrete environmental measures that offer information about the footprint of the company on the environment (a particular content range)

For each of the six SASB's Environmental Categories, three measures were selected, a total of 18 measures (see Table 1), which were used as independent variables. To these environmental performance's measures, we have added the financial performance indicators, namely, the Return on assets (ROA), Return on equity (ROE), and Total Assets (see Table 2), and used them as dependent variables.

Each of the 18 environmental measures reveals information about the decisions and actions taken by a company, out of legal compliance, in order to achieve pollution reduction. We assess these efforts through six different categories, essential for environment protection, namely, GHG Emissions, Air quality, Energy, Water and Wastewater, Waste and Hazardous Materials, and Ecological Impact. The first step in becoming environmentally sustainable is to establish clear and adequate policies (Policy measures). Their objectives must be reflected in measurable targets (Target measures). Step two is to implement these policies and to track deviations from the targets outlined. Based on this analysis, step three consists in measuring the concrete achievements (Concrete measures) and settle the future actions in the field. The Refinitiv's Environmental measures disclose whether the company reports (True = 1) or not (False = 0) environmental policies, targets, and concrete measures in connection with the six essential ecological categories. Any action taken by a company to reduce the GHG emissions, the waste, and the ecological impact of its activity, or to improve the air quality, the energy, and the water efficiency will impact the operational and financial outputs of the company. The intensity of such influence may be different if a specific ecological action is at the policy stage, at pursuing the target stage, or it has generated concrete achievements.

Both categories of the selected variables (independent and dependent) are in line with the paramount perspective of the environmental-financial performance' relationship, according to which "building a sustainable business is difficult if the business is ultimately unable to provide an appropriate long-run return on shareholders' savings" [44] (p.105). Based on this, the financial performance measures are mainly expressed in the literature, through the Return on Assets (ROA), Return on Equity (ROE), or Tobin's Q ratio [6–8, 11, 20]. For the large companies (such as the sample analyzed in this study), the value of Total Assets is a defining indicator, and therefore its association with the environmental measure is used to control and validate the EP-FP economic implications.

The SASB's guidance was used to analyse the materiality impact of the selected environmental measures on the financial performance. Furthermore, three more dimensions were included within the study, namely, the policy, the target, and the concrete level. Through this, we stipulate, as an assumption to be tested, the necessity of measuring and disclosing the same environmental issue from an ongoing integrative point of view: the policy implemented by the managerial team, the targets set out, and the results of the implemented actions.

In line with the literature review, the paper follows the link between the environmental performance and the financial performance and employs, as a new research hypothesis background, the materiality theory. The principle of this theory was interplayed in the analysis of the EP-FP association, and we assume the following research hypotheses:

Hypothesis 1. The policy environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance.

Hypothesis 2. The target environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance.

Hypothesis 3. The concrete environmental measures belonging to SASB's Environmental Categories are connected with the financial performance.

As we have pointed out previously, the research hypotheses cumulate the basic SASB's materiality theory with some new potential conditions for the materiality manifestation (individual and ongoing stages of measuring the environmental performance of a company).

4. Results and Discussion

The main findings, obtained by applying the materiality manifestation conditions (policy/target/concrete as different content levels) on the environmental-financial performance

Table 1: Independent variables included within the econometric models.

Acronym	Details	Unit of measure	Category
P_emiss	*Policy Emissions*, if the company has a policy to improve emission reduction. *Policy measure*	Binary	EP (greenhouse gas, GHG, emissions category)
T_emiss	*Targets Emissions*, if the company has set concrete targets to achieve emissions' reduction. *Target measure*	Binary	
CO_2	*CO_2 Equivalent Emissions Total*, the total amount of carbon dioxide (CO_2) and CO_2 equivalents emitted. *Concrete measure*	Tones	
Nox	*NOx and SOx Emissions Reduction*, if the company reports any initiative to reduce, reuse, recycle, or cut out the NOx or the SOx emissions. *Policy measure*	Binary	EP (air quality category)
Voc_emiss	*VOC or Particulate Matter Emissions Reduction*, if the company reports any objectives to reduce or cut out the volatile organic compounds (VOC). *Target measure*	Binary	
Emiss	*NOx Emissions*, the amount of NOx emissions emitted. *Concrete measure*	Tones	
P_energy	*Policy Energy Efficiency,* if the company has a policy to improve energy efficiency. *Policy measure*	Binary	EP (energy management category)
T_energy	*Targets Energy Efficiency,* if the company has set targets to achieve energy efficiency. *Target measure*	Binary	
Energy	*Energy Use Total,* as total direct and indirect energy consumption. *Concrete measure*	Gigajoules	
P_water	*Policy Water Efficiency,* if the company has a policy to improve water efficiency. *Policy measure*	Binary	EP (water and wastewater management category)
T_water	*Targets Water Efficiency*, if the company has set targets to achieve water efficiency. *Target measure*	Binary	
Water	*Water Withdrawal Total,* the volume of water withdrawn. *Concrete measure*	Cubic meters	
P_waste	*Waste Reduction Initiatives,* if the company reports any initiative to reduce, reuse, recycle, or cut out the waste *Policy measure*	Binary	EP (waste and hazardous materials management category)
E-waste	*e-Waste Reduction*, if the company reports any initiative to reduce, reuse, recycle, or cut out the e-waste. *Target measure*	Binary	
Waste	*Hazardous Waste,* the amount of hazardous waste produced. *Concrete measure*	Tones	
P_chemic	*Toxic Chemicals Reduction,* if the company reports any initiative to reduce, reuse, recycle, or cut out the toxic chemicals. *Policy measure*	Binary	EP (ecological impact category)
Land_env	*Land Environmental Impact Reduction,* if the company reports any initiative to reduce environmental impact on land owned. *Target measure*	Binary	
Env_exp	*Environmental Expenditures,* total amount of environmental expenditures reported. *Concrete measure*	Monetary units	

Binary: true = 1; false = 0. Source: own contribution.

Table 2: Dependents variables included within the econometric models.

Acronym	Details	Unit of measure	Category
ROA	Return on assets (net income/total assets)	%	FP
ROE	Return on equity (net income/book value of equity)	%	FP
Total assets	The amount of total assets	Monetary units	Controlling variable

Source: own contribution.

relationship, are presented in this section. In this respect, we have deployed two graphical approaches, namely, the Structural Equations Modeling (SEM) and the Gaussian Graphical Models (GGM).

4.1. The Results of Structural Equations Modeling (SEM). We have assessed the overall interlinkages (direct, indirect, and total) between EP-FP from a dual presumption (determinants-impact interplay), by applying the Structural Equations Modeling with latent class analysis (SEM-LCA) procedure in a gradual approach, following each research hypothesis.

4.1.1. The Impact of Policy's Environmental Measures on the Financial Performance. The policy panel contains measures with a general content range regarding the policies adopted by a company in the environmental field. The measures replay only the presence or absence of such policies within the company's general management. In the case of oil and gas companies from the EEA MS, according to our first hypothesis, Hypothesis 1: *The policy environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance*, we assess if these measures could induce or not a material impact on the financial performance level. The results shown in Figure 2 point out that four of the six environmental measures influence both the ROA and the ROE.

The Policy environmental measures with statistically relevant influences on the ROA level are the *P_emiss* (−0.66), the *P_water* (−0.39), and the *P_waste* (0.31). The ROE level is statistically influenced by the following environmental policy measures: The *P_emiss* (−0.69), the *Nox* (0.32), the *P_water* (−0.5), and the *P_waste* (0.35). The Total Assets level is positively influenced by the *P_emiss* (0.84), the *P_energy* (1.6), the *P_water* (0.89), and negatively influenced by the *P_chimic* (−0.62).

The overall impact of the policy environmental measures upon the financial performance reveals the following economic implications. The *P_emiss*, from the GHG Emissions' category, and the *P_water*, belonging to the Water and Wastewater Management's category, have generated a negative impact, showing a reduction in both the ROA and the ROE levels. These outputs suggest that the managerial policy of the company to improve both the emissions reduction and the water efficiency generate important operating expenses, which lowers down the financial performance level of the company. The *P_waste*, from the Waste and Hazardous Materials Management's category, has positively influenced both the ROA and the ROE. Any reported initiative of the company to reduce, reuse, recycle, or cut out the waste generated represents an increase in the operating efficiency and the productivity. Based on this factor, the company's financial performance (ROA and ROE) has generated sustainable growth.

The policy acting for the NOx and the SOx Emissions Reduction (*Nox*) has performed as an incentive factor for the financial performance of oil and gas companies, on the one hand. Thus, the *Nox*, belonging to Air quality's category, has no impact on the ROA level, but it is positively influencing the ROE level. The reported intent of the company in reducing or cutting out the NOx or the *Sox* emissions contributes to a better image of the company in investors' perception, and through this, to an increasing of the ROE value, as a measure of owners' remuneration.

The controlling variable (Total Assets) is positively influenced by *P_emiss*, *P_energy*, and *P_water* environmental variables, confirming the fact that, in order to improve the environmental behavior, large investments into the tangible assets of the company have to be made. The *P_chemic* measure, from the Ecological Impact's category, has a negative influence on the Total Assets level, but it has no statistically relevant impact on the financial performance (both the ROA and the ROE).

Based on the SEM findings, we can summarize that the measures regarding the environmental policy of the oil and gas companies have a material impact on the financial performance, which confirms our *1st Hypothesis: The policy environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance*. At the same time, the findings obtained from the SEM technique support the SASB materiality's theory regarding the environmental impact upon financial performance. Although, it is considered only the first step in achieving sustainable development, the integration of the environmental policy within the overall business strategy is the stage with the highest decisional impact. During this phase, the future operational and financial implications are taken into consideration and budgeted. Stakeholders know the importance of this step and incorporate it in their evaluation.

4.1.2. The Impact of Target Environmental Measures on the Financial Performance. By assaying more in-depth measures than the general policy of a company regarding the environment protection, namely, the indicators that reflect the targets set by the company from the oil and gas field, we test the material impact within the six categories by Hypothesis 2: The target environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance.

The overall impact of the target environmental measures on the financial performance, assessed by the SEM procedure, show statistical relevant influences in the case of three environmental categories on the ROA and the ROE (Figure 3). These three categories with material impact are not the same for the ROA and the ROE levels. In the case of the ROA, its level is negatively influenced by the *T_emiss* measure (−0.43), belonging to the GHG Emissions' category, and is positively influenced by *T_water* (0.37) and *Land_env* (0.26) measures, belonging to Water and Wastewater Management and the Ecological Impact. The targets set by a company to get emission reduction put pressure on the operating costs and thereby diminish its financial performance reflected by the ROA. At the same time, targeting an increase in water efficiency and a reduction in the environmental impact on the company's land leads to cost cuts, with a direct impact on the increase in ROA.

In the case of the ROE, the SEM findings have revealed that its level is negatively impacted by the *T_emiss* (−0.48) and *Voc_emiss* (−0.15) measures, and positively impacted by the *T_energy* (0.39) measure. The negative impact reflected by the correlation coefficients of the measures from the categories of GHG Emissions and Air quality suggests that the concrete targets assumed by a company to reduce air pollution are appreciated by stakeholders as a factor in reducing their remuneration (ROE). At the same time, achieving energy efficiency at the oil and gas companies' level represents important reductions of operational costs, and thereby an increase in the ROE level.

Total Assets, as a controlling variable, are positively associated with three of the previous environmental measures, namely, *T_emiss* (1.1), *T_energy* (0.46), and *Land_env* (1.3), confirming the economic implications of these variables upon financial performance. Any target assumed by oil and gas companies closely related to their environmentally

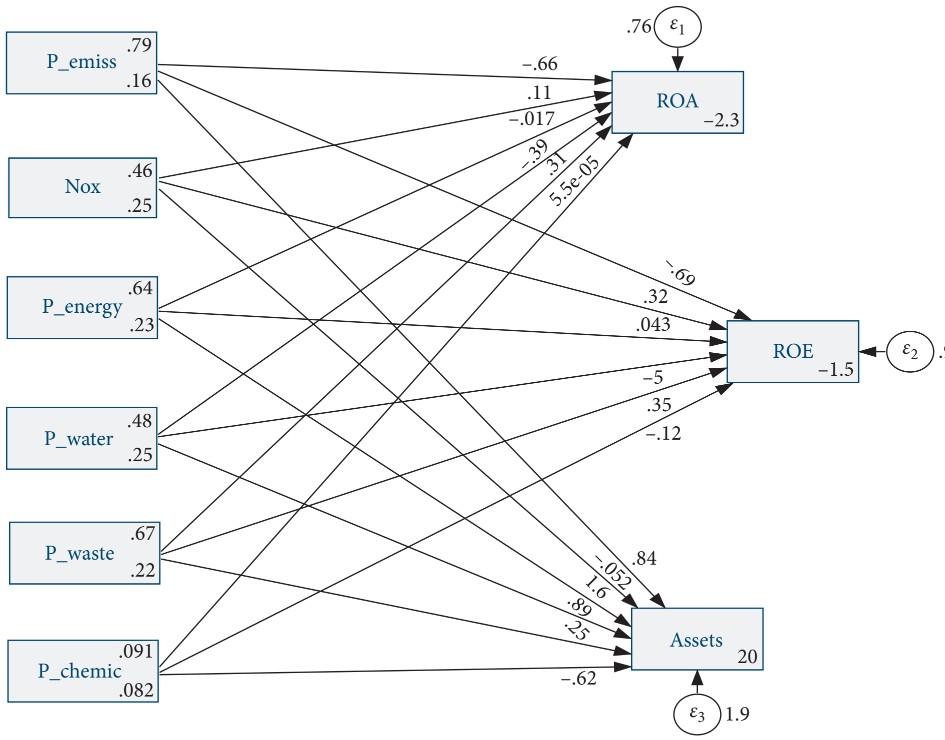

Figure 2: The association between policy measures and the financial performance (SEM-LCA), for oil and gas companies from the EEA, 2009–2018. Source: own contribution in Stata 16.

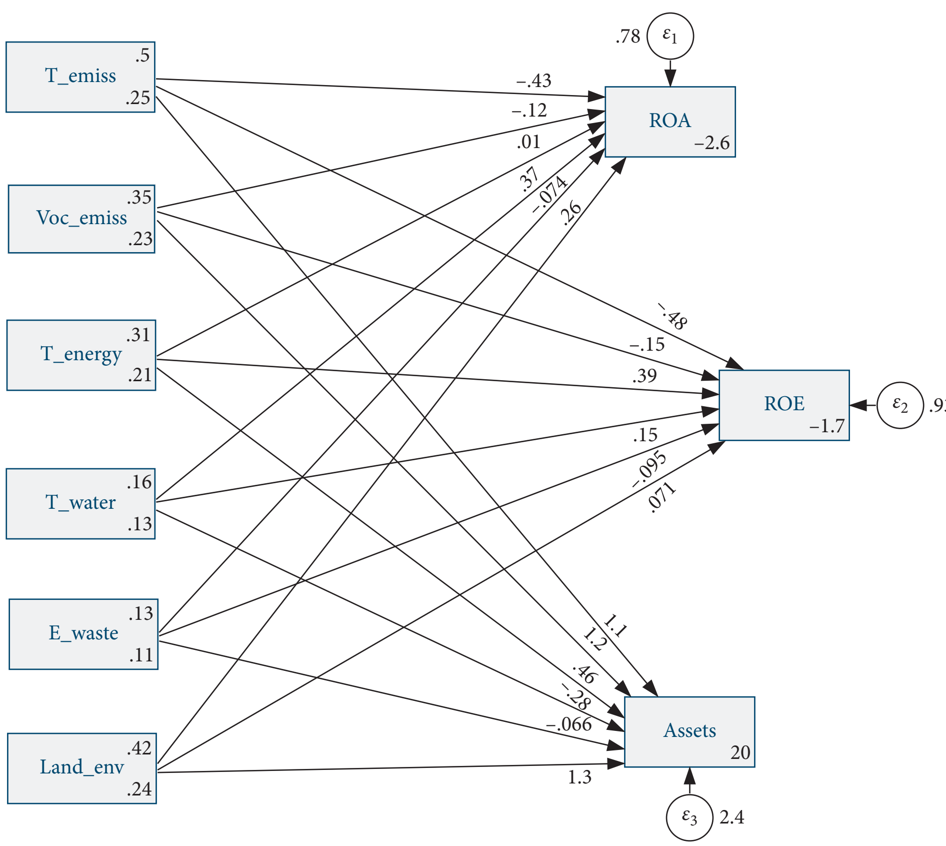

Figure 3: The association between targets measures and the financial performance (SEM), for oil and gas companies from the EEA, 2009–2018. Source: own contribution in Stata 16.

sustainable goals will lead to large investments in operational assets.

As a conclusive remark, only the target measures belonging to three of the six SASB categories impact the financial performance. Thus, in the case of SEM results, *our 2nd Hypothesis: The target environmental measures, belonging to SASB's Environmental Categories are connected with the financial performance* is partially confirmed. The lower relevance that the stakeholders give to the targets set out for each environmental category can be seen as the main reason behind the empirical findings. The presence or the absence of the environmental targets can be appreciated as a consequence of the policy stage, and therefore, is less important for the stakeholders. At the same time, a company can have an environmental policy but without adequate targets to pursue. This situation needs a much deeper analysis.

4.1.3. The Impact of Concrete Environmental Measures on the Financial Performance. The environmental measures with the most detailed information content have been identified as the specific metrics that express, in particular units, the effective amount of natural resources used or the emissions released. Different units of measurement have been harmonized through a logarithm's action.

The association between the environmental measures with concrete content and the financial performance reveals a very low materiality manifestation (Figure 4). The financial performance variables (ROA and ROE) are influenced by two different environmental measures. The ROA level is negatively influenced by CO_2 (−0.059), as a measure belonging to GHG Emissions' category, which cumulates the total amount of CO_2 and CO_2 equivalents emitted by the company's activity, on the one hand, and is positively influenced by the Waste (0.36), as a measure belonging to the Waste and Hazardous Materials Management category, which accumulates the total amount of waste produced by the company, on the other hand.

The ROE level is negatively influenced by two concrete measures, namely, Emiss (−0.05), as a measure belonging to the Air quality category that cumulates the amount of NOx emissions emitted by the company's activity; and Energy (−0.59), as a measure belonging to the Energy Management category that cumulates the amount of total direct and indirect energy consumption.

The Total Assets level is influenced by four concrete measures (CO2 (−0.58), Water (0.082), Waste (−0.075), and Env_exp (0.067)), confirming the importance of this indicator in the case of large companies' management.

In the case of environmental measures covering the concrete level of the ecological impact of a company, their materiality impact on the financial performance is poorly supported in the case of SEM findings. Thus, our 3rd Hypothesis: *The concrete environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance* is rejected. The concrete level of the company's ecological footprint, a very important step in the sustainable goal's achievement, has no significant connection with the financial performance (ROA and ROE). A practical argument for these findings can also be put on the account of the relevance of the decision-process. The financial decisions are adopted during the policy-making stage and the implementation stage. Consequently, the stakeholders are more interested in assessing the metrics related to these stages.

The graphical modeling outputs, generated by the SEM technique, validate the integrating role played by the materiality theory within the association of EP- FP variables. New insights of this association are postulated by the conditions assumed for the materiality manifestation, which are less supported by the findings (only the individual environmental measures covering the Policy and the Target of the company influence the financial performance). At the same time, the mixed association (positive and negative) between individual environmental variables (with different range of content) and financial performance confirms a new literature supposition that materiality manifestation varies between different settings [12, 22].

4.2. The Results of the Gaussian Graphical Models (GGM). To further enhance the graphical visualization of the network structure between the environmental metrics and the financial performance of oil and gas companies, we have deployed the Gaussian Graphical Model procedures. The estimation of the models was configured based on the Partial correlation technique (PCOR), separately for each of the three content levels of the environmental measures, namely, policy, target, and concrete.

4.2.1. The Impact of Policy's Environmental Measures on the Financial Performance. Furthermore, we can see that the results of the GGM procedure support the findings of the SEM analysis and offer, at the same time, a much deeper insight into the manifestation in the EP-FP relationship, regarding the general policy in the field of environment (Figure 5).

Within the estimated Gaussian graphical network (Figure 5), it can be observed that the ROA is intensely negative associated with P_Emiss and P_Chemic variables, and intensely positive correlated with P_Waste. There is also a positive connection with P_Water, but the intensity is lower. In the case of the ROE, there are intensive and negative connections with P_Water and P_Waste variables, and an intensive and positive connection with P_Energy. A positive but lower connection with NOx_Sox variable can be noticed. The control variable (Total Assets) is intensively connected with four environment variables (negatively with NOx_Sox, P_Chemic, and P_Water, and positively with P_Energy), supporting the relevance of the GGM findings.

Reported through the annual statement of the company or the social media channels, the presence or the absence from the general management policy of the issues related to the environmental concerns represents an essential stage in the assessment of environmental performance. The operational activity of oil and gas companies generates a considerable environmental footprint. Hence, the environmentally sustainable core policy is strongly

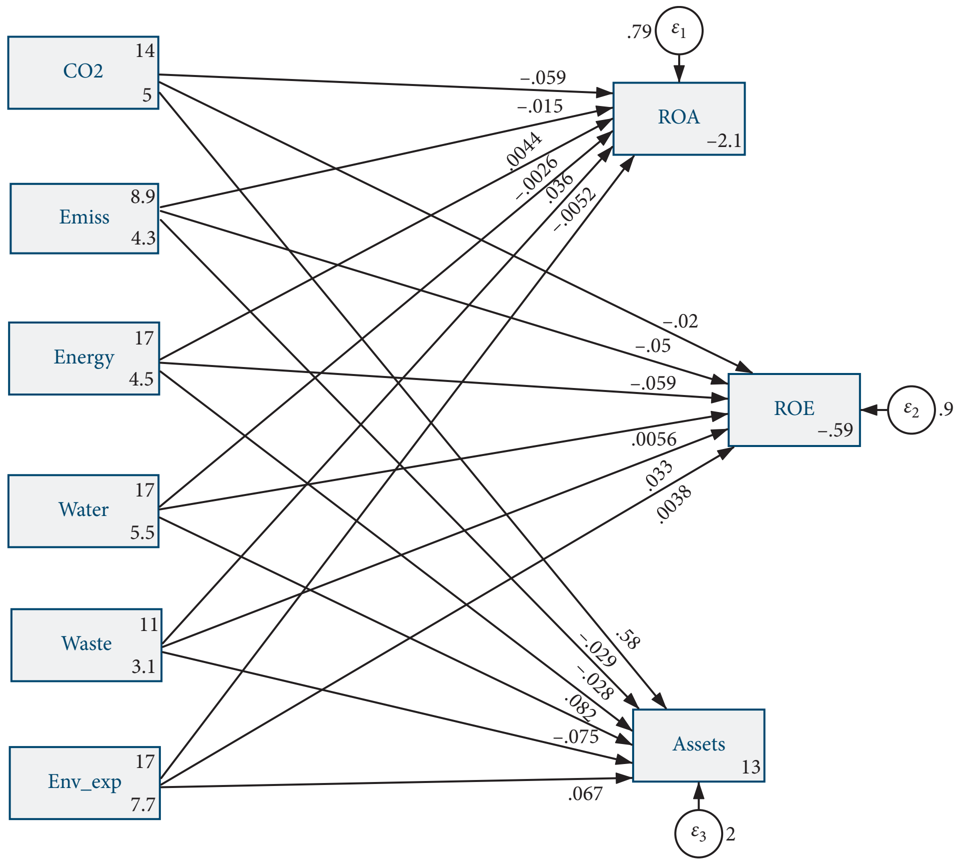

Figure 4: The association between concrete measures and the financial performance (SEM), for oil and gas companies from the EEA, 2009–2018. Source: own contribution in Stata 16.

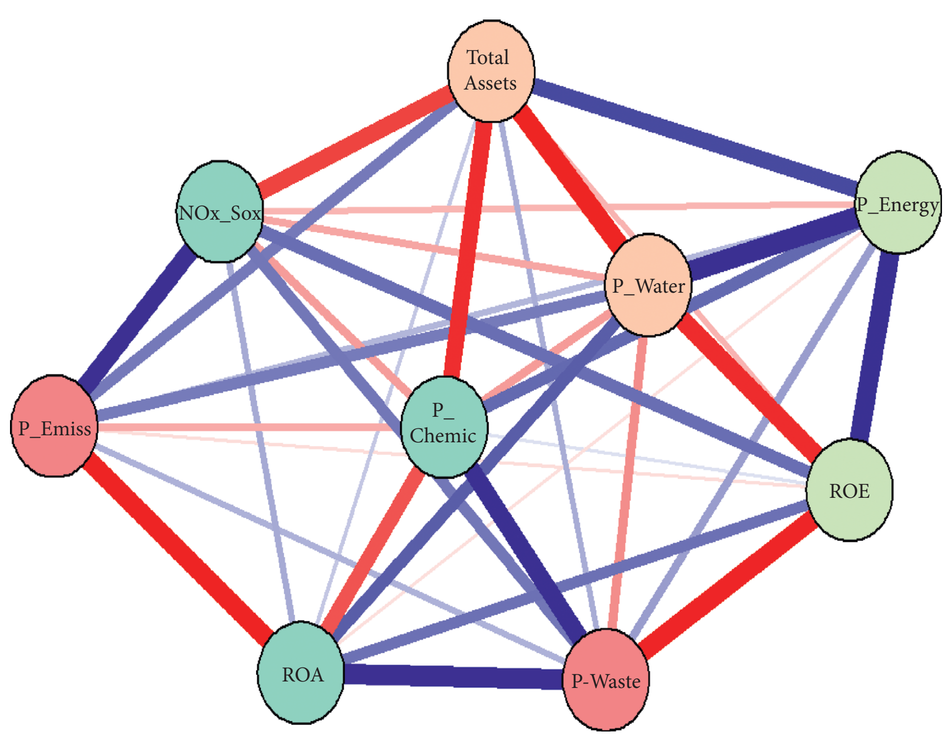

Figure 5: The association between policy measures and the financial performance (GGM), for the oil and gas companies from the EEA, 2009–2018. Source: own contribution in R program.

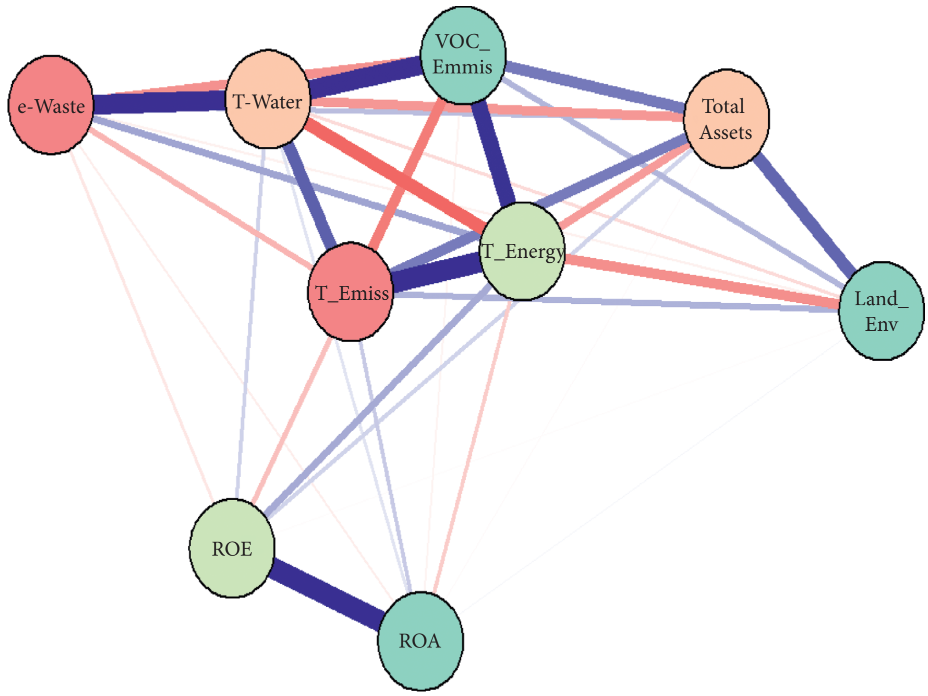

Figure 6: The association between the policy measures and the financial performance (GGM), for the oil and gas companies from the EEA, 2009–2018. Source: own contribution in R program.

connected to their financial performance. The SASB's materiality references are validated, *and our 1st Hypothesis: The policy environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance* is reinforced.

4.2.2. The Impact of Target Environmental Measures on the Financial Performance. The GGM estimated in the case of the environmental targets assumed by the oil and gas companies expresses, in a conclusive network visualization, the decrease of the intensity with which the materiality manifested within EP-FP relationship. The GGM findings (see Figure 6) reflect a lower connection between the financial performance (both the ROA and the ROE) and the environmental measures. A stronger connection can be seen between the control variable (Total Assets) and the variables that make up this category, supporting their economic implications.

Looking for more effective targets set out to preserve the environment, we have noticed that the materiality impacts of this type of measures are lower than the previous ones.

The opposite findings between the more-detailed information analyzed and the low predicting power of the financial performance evolution can be justified by the fact that the general policy covering environmental issues is not supported by the targets set out for environmentally sustainable growth. Similarly, to the SEM analysis, our 2nd Hypothesis: *The target environmental measures, belonging to SASB's Environmental Categories, are connected with the financial performance* is partially confirmed.

4.2.3. The Impact of the Concrete Environmental Measures on the Financial Performance. Going further, we have estimated the GGM in order to visualize the network between the financial performance and the measures with concrete content about the environmental footprint of a company (Figure 7).

The GGM findings support an even weaker association between the ROA and the ROE, on the one hand, and the environmental concrete measures, on the other hand. The controlling variable remains connected to the independent variables. According to both the SEM and the GGM outputs, the concrete panel of environmental measures has the lowest level of association with the financial performance. Thus, our 3rd Hypothesis: *The concrete environmental measures belonging to SASB's Environmental Categories are connected with the financial performance* is rejected.

A summary of the Gaussian Graphical Models provides a visual representation of a strong network interconnection only in the case of the policy environmental measures and the financial performance. The employment of a managerial policy regarding the ecological issues comprises financial and operational decisions. Based on the various financial implications from the policy-making stage, the measures belonging to this category have the most intense influences upon financial performance (the ROA and the ROE). As the environmental measures express a more particular content, namely, the targets set for the different environment issues or the concrete ecological achievements of a company, the intensity of the network interconnection with the financial performance is becoming weaker. The GGM outputs not only support the SEM conclusions but also provide a complementary analysis to its models. Similar to the remarks

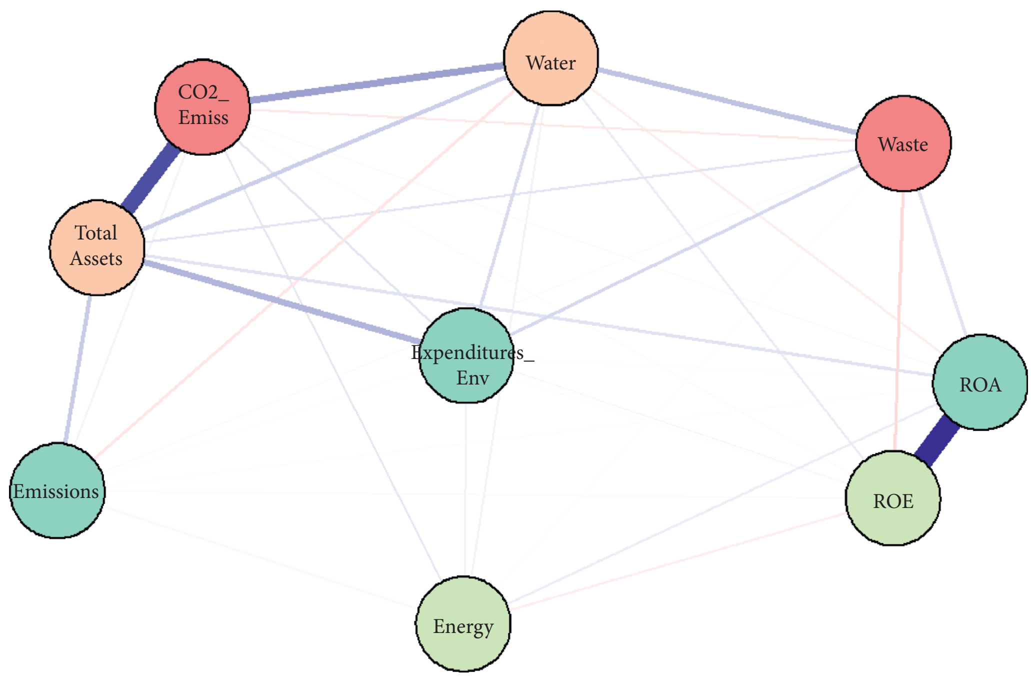

Figure 7: The association between the policy measures and the financial performance–GGM, for the oil and gas companies from the EEA, 2009–2018 *Source*: Own contribution in R program.

Table 3: Summary of the hypotheses and their results.

Hypothesis	Results	
	SEM	GGM
Hypothesis 1: the policy environmental measures, belonging to SASB's environmental categories, are connected with the financial performance.	Validated, with mixed findings (positive and negative links between EP-FP)	Validated, with mixed findings (positive and negative links between EP-FP)
Hypothesis 2: the target environmental measures, belonging to SASB's environmental categories, are connected with the financial performance.	Partially validated, with mixed findings (positive and negative links between EP-FP)	Partially validated, with mixed findings (positive and negative links between EP-FP)
Hypothesis 3: the concrete environmental measures, belonging to SASB's environmental categories, are connected with the financial performance is rejected.	Not validated	Not validated

Source: own contribution.

drawn from the SEM technique, the integrative role of the materiality theory is supported by the GGM outputs, while the new conditions assumed for such a materiality manifestation are partially validated.

5. Conclusions

Using the sample of the oil and gas companies from the EEA, this study brings to the fore the growing body of knowledge regarding the impact of environmental material issues on the financial performance. By applying two graphical integrative and complementary approaches (Structural Equations Modeling with latent class analysis and Gaussian Graphical Models) on the environmental-financial performance relationship, the research offers meaningful and robust evidences about the conditions of materiality's manifestation inside the network of variables.

Companies operating within the oil and gas industry are interested in achieving environmental footprint reduction and benefit from their green image, as "The European Green Deal" strategy set out for the year 2050 [3]. Strategically understanding the environmental-financial performance relationship represents a practical necessity, as it is an academic one. The research is relevant, robust, and extends the SASB's Map of Materiality recommendations to an integrative analysis, based on a different content range of the environmental measures. We have proposed a separation of the measures regarding the environmental behavior into three pillars, or informational levels (covering the general policy of the company, the targets set out, and its concrete footprint), as conditions of the materiality manifestation. Our empirical analysis relied on two approaches to modeling longitudinal and panel data, namely, the Gaussian graphical models (GGMs) and the structural equations (SEM). Both techniques imply a variance-covariance matrix, aiming to identify how variables are related to each other, namely, the direct and indirect effects of one variable on another, having their origin in path analysis. The SEM brings forward our research since it rejoins path analysis, factor analysis, and regression, thus allowing to specify multiple causal associations between our constructs, while the main advantage of the GGMs is the ability to handle different types of variables, as comprised in our dataset, since the variables included in the empirical analysis had different measurement units (e.g. binary, multi-category). The GGMs configured in our research were drawn as a network based on partial correlations (both positive and negative) graphically reflected through the absolute strengths (the width and the saturation of the edges between the nodes), thus being a network model of conditional associations. Therefore, we were able to model conditional associations, namely, the degree to which the variables are independent after conditioning on all other variables in the data set. This feature was essential in our empirical research endeavor since we focused on 18 environmental measures that capture, in a gradual frame, policies adopted by companies to achieve pollution reduction, targets set, and the deviations and the concrete measures as the final achievements. All of these credentials need to be assessed in their tight interdependence and sequential approach, as a complex network (performed in this paper through the GGMs) and through causal relationships (as enhanced by the SEM models designed to achieve the complicated model setup).

Based on a summary of the hypotheses and their results (Table 3), the overall research observation consists in the fact that the materiality manifestation varies both between individual environmental measures and the range of their informational content, just as Heijningen [22] also highlighted.

Based on the research outputs, we have noticed that materiality plays an active role in linking the financial performance with environmental, nonfinancial issues in the case of the oil and gas companies. The intensity of the connection reaches the highest point at the policy level and decreases as the informational content of the indicators evolves from general to particular. Considering the strong connection between the operational activity and the natural resources in the case of this industry, the presence of a clear environmental policy is appreciated as the core of the sustainable performance. Our findings support this affirmation.

The individual influences reveal both a positive and negative impact on the financial performance, and confirm the particularity of materiality theory as well as the conclusion of [12, 46]. However, mixed results can bring relevant observations. It is the case of the Water and Wastewater Management category, within which the measure disclosed as policy has a negative influence on the financial performance, while the target measures have a positive influence only on the ROA (according to the SEM outputs). The general information about the company policy to improve water efficiency can be appreciated by the stakeholders as a potential increase on costs volume, with a negative effect on the profitability. At the same time, the information about the concrete measures set out to achieve water efficiency (in the short term or the long term) seems to lead to operational efficiency and increased profitability. These findings have relevant practical implications for the policy-makers of the company, suitable to improve both its financial and environmental performance.

From all the six environmental categories identified by the SASB with a material impact, only the measure belonging to the GHG Emissions category has influenced the financial performance (the ROA and the ROE) at the level of all the three pillars (according to the SEM findings). The issues related to carbon dioxide (CO_2) and CO_2 equivalent emissions have a negative influence on the ROA and the ROE levels (even if they are disclosed as a general policy of the company, as targets set to achieve emission reduction or as the concrete amount of emissions). The negative relationship between the GHG emissions and the financial performance, in accordance with the findings of other scholars [16], suggests that all actions for becoming more environmentally friendly will increase the operational costs of the companies, leading to a decrease in their financial performance level.

The limits of our research may rely on the degree of certainty of the estimation of the binary data (subjective data), and the fact that the environmental performance is rather difficult to assess, since it can be influenced by a plethora of factors, "with unknown variables that cannot yet be captured as proxies in macro-econometric models (such as catastrophic events due to climate change)" [47] (p.20), or pandemic disease [2–4, 48]. Relying on the differences observed in the materiality manifestation, and having in mind their high importance for the oil and gas industry, we suggest that the future research should investigate the same environmental measures and the same organizations on the content range, but at the level of an industry with a lower environmental impact. Achieving the goal of an environmentally sustainable economy depends on the common efforts and the constant assessment of the implementation stages. In maintaining the correct direction, an important role is played by the relevance and the usefulness of the environmental measures within the decision process. A better understanding of these characteristics means a better understanding of the materiality and its impact on the financial performance.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

[1] European Commission, "Annual sustainable growth strategy 2020, com," 2019, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013D1386.

[2] S. Cadez, A. Czerny, and P. Letmathe, “Stakeholder pressures and corporate climate change mitigation strategies,” *Business Strategy and the Environment*, vol. 28, no. 1, pp. 1–14, 2019.
[3] European Commission, “The european green deal, com,” 2019, https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.
[4] European Commission, “A roadmap for recovery towards a more resilient, sustainable and fair Europe,” https://www.consilium.europa.eu/media/43384/roadmap-for-recovery-final-21-04-2020.pdf.
[5] K. Alsaifi, M. Elnahass, and A. Salama, “Carbon disclosure and financial performance: UK environmental policy,” *Business Strategy and the Environment*, vol. 29, no. 2, pp. 711–726, 2020.
[6] S. Manrique and C.-P. Martí-Ballester, “Analyzing the effect of corporate environmental performance on corporate financial performance in developed and developing countries,” *Sustainability*, vol. 9, no. 1957, 2017.
[7] M. Robaina and M. Madaleno, “The relationship between emissions reduction and financial performance: are Portuguese companies in a sustainable development path?,” *Corporate Social Responsibility and Environmental Management*, vol. 27, no. 3, pp. 1213–1226, 2020.
[8] I. Gallego-Álvarez, L. Segura, and J. Martínez-Ferrero, “Carbon emission reduction: the impact on the financial and operational performance of international companies,” *Journal of Cleaner Production*, vol. 103, no. 1, pp. 149–159, 2015.
[9] Y. Qiu, A. Shaukat, and R. Tharyan, “Environmental and social disclosures: link with corporate financial performance,” *The British Accounting Review*, vol. 48, no. 1, pp. 102–116, 2016.
[10] A. Lioui and Z. Sharma, “Environmental corporate social responsibility and financial performance: disentangling direct and indirect effects,” *Ecological Economics*, vol. 78, pp. 100–111, 2012.
[11] N. Muhammad, F. Scrimgeour, K. Reddy, and S. Abidin, “The relationship between environmental performance and financial performance in periods of growth and contraction: evidence from Australian publicly listed companies,” *Journal of Cleaner Production*, vol. 102, no. 1, pp. 324–332, 2015.
[12] M. Hang, J. Geyer-Klingeberg, and A. W. Rathgeber, “It is merely a matter of time: a meta-analysis of the causality between environmental performance and financial performance,” *Business Strategy and the Environment*, vol. 28, no. 2, pp. 257–273, 2019.
[13] United Nations, “Corporate guidance for international public sector accounting standards materiality framework,” 2016, https://www.un.org/ipsas/Corporate%20Guidance/Corporate_Guidance_Materiality_Framework.pdf.
[14] Global Reporting Initiative (GRI), “The Materiality Principle: A Deep Dive. Webinar 6 of the Six-Part GRI Standards in Practice Series. 2018,” https://www.globalreporting.org/SiteCollectionDocuments/2018/CSE/Materiality%20Webinar%2029%20Nov%202018.pdf.
[15] Sustainability Accounting Standards Board, “Standards overview,” 2020, https://www.sasb.org/standards-overview/.
[16] Sustainability Accounting Standards Board (SASB), “Materiality map,” 2020, https://materiality.sasb.org/.
[17] G. Serafeim, “The type of socially responsible investments that make firms more profitable,” *Harvard Business*, https://www.hbs.edu/faculty/pages/item.aspx?num=49088, 2020.
[18] Thomson Reuters/Refinitiv. https://emea1.apps.cp.thomsonreuters.com.
[19] S. Epskamp, M. T. Rhemtulla, and D. Borsboom, “Generalized network psychometrics: combining network and lantent variable models,” *Psychometrica*, vol. 16, pp. 1–72, 2017.
[20] D. Earnhart, “The Effect of corporate environmental performance on corporate financial performance,” *Annual Review of Resource Economics*, vol. 10, no. 1, pp. 425–444, 2018.
[21] R. G. Eccles, M. P. Krzus, J. Rogers, and G. Serafeim, “The need for sector-specific materiality and sustainability reporting standards,” *Journal of Applied Corporate Finance*, vol. 24, no. 2, pp. 65–71, 2012.
[22] K. Heijningen, “The impact of ESG factor materiality on stock performance of firms,” *Erasmus Platform For Sustainable Value Creation*, 2019, https://www.rsm.nl/fileadmin/Images_NEW/Erasmus_Platform_for_Sustainable_Value_Creation/The_impact_of_ESG_factor_materiality_on_stock_performance_of_firms_Heijningen.pdf, In press.
[23] J. B. Grace, D. R. Schoolmaster, G. R. Guntenspergen et al., “Guidelines for a graph-theoretic implementation of structural equation modelling,” *Ecosphere*, vol. 3, no. 8, pp. 1–44, 2012.
[24] G. Costantini, J. Richetin, D. Borsboom, E. I. Fried, M. Rhemtulla, and M. Perugini, “Development of indirect measures of conscientiousness: combining a facets approach and network analysis,” *European Journal of Personality*, vol. 29, no. 5, pp. 548–567, 2015.
[25] K. G. Jöreskog, “A general method for analysis of covariance structures,” *Biometrika*, vol. 57, no. 2, pp. 239–251, 1970.
[26] S. Wright, “The method of path coefficients,” *The Annals of Mathematical Statistics*, vol. 5, no. 3, pp. 161–215, 1934.
[27] M. Cristea, G. G. Noja, P. Stefea, and A. L. Sala, “The impact of population aging and public health support on EU labor markets,” *International Journal of Environmental Research and Public Health*, vol. 17, no. 1439, 2020.
[28] S. Sinharay, “An overview of statistics in education,” *International Encyclopedia of Education*, vol. 3, pp. 1–11, 2010.
[29] G. Noja, M. S. Cristea, A. Yüksel, C. Pânzaru, and R. Drăcea, “Migrants’ role in enhancing the economic development of host countries: empirical evidence from Europe,” *Sustainability*, vol. 10, no. 894, 2018.
[30] K. Montfort, J. Oud, and A. Satorra, *“Recent Developments on Structural Equation Models: Theory and Applications“*, Springer Science & Business Media, Berlin, Germany, 2004.
[31] J. C. Westland, *Structural Equation Models: From Paths to Networks*, Springer, Berlin, Germany, 2015.
[32] J. J. McArdle and R. P. McDonald, “Some algebraic properties of the Reticular Action Model for moment structures,” *British Journal of Mathematical and Statistical Psychology*, vol. 37, no. 2, pp. 234–251, 1984.
[33] A. R. Beharelle and S. L. Small, “Imaging brain networks for language,” *Neurobiology of Language*, vol. 6, pp. 805–814, 2016.
[34] N. Bhushan, F. Mohnert, D. Sloot, L. Jans, C. Albers, and L. Steg, “Using a Gaussian graphical model to explore relationships between items and variables in environmental psychology research,” *Frontiers in Psychology*, vol. 10, pp. 1–12, 2019.
[35] A. A. Amini, B. Aragam, and Q. Zhou, “On perfectness in Gaussian graphical models,” *Mathematics Statistics Theory*, vol. 3, 2019.
[36] K. Fitch, *Learning Directed Graphical Models from Gaussian Data*, Cornell University, Ithaca, NY, USA, 2019.
[37] D. Hevey, “Network analysis: a brief overview and tutorial,” *Health Psychology and Behavioral Medicine*, vol. 6, no. 1, pp. 301–328, 2018.

[38] S. L. Lauritzen, *Graphical Models*, Oxford University Press, Oxford, UK, 1996.
[39] European Environment Agency, https://www.eea.europa.eu/themes.
[40] T. Reuters, "ESG-views-and-scores-nov-2018.pdf," 2020, https://emea1.apps.cp.thomsonreuters.com/.
[41] T. Reuters, "Refinit_ESG_Scores_Factsheet.pdf," 2020, https://emea1.apps.cp.thomsonreuters.com/.
[42] I. E. Iamandi, L. G. Constantin, S. M. Munteanu, and B. Cernat-Gruici, "Mapping the ESG behavior of European companies. a holistic Kohonen approach," *Sustainability*, vol. 11, no. 3276, 2019.
[43] M. Siminica, M. Cristea, M. Sichigea, G. G. Noja, and I. Anghel, "Well-governed sustainability and financial performance: a new integrative approach," *Sustainability*, vol. 11, no. 17, p. 4562, 2019.
[44] M. Khan, G. Serafeim, and A. Yoon, "Corporate sustainability: first evidence on materiality," *The Accounting Review*, vol. 91, no. 6, pp. 1697–1724, 2016.
[45] M. Khan, "Corporate governance, ESG, and stock returns around the world," *Financial Analysts Journal*, vol. 75, no. 4, pp. 103–123, 2019.
[46] C. Busco, C. Consolandi, R. G. Eccles, and E. Sofra, "A preliminary analysis of SASB reporting: disclosure topics, financial relevance, and the financial intensity of ESG materiality," *Journal of Applied Corporate Finance*, vol. 32, no. 2, pp. 117–125, 2020.
[47] G. Noja, M. Cristea, and A. Yüksel, "Brexit spillovers through international trade and foreign investment: empirical evidence from EU-27 and the UK," *Panoeconomicus*, pp. 1–34, 2020.
[48] J. Khubchandani, T. R. Jordan, and Y. T. Yang, "Ebola, zika, Corona what is next for our world? what is next for our world?," *International Journal of Environmental Research and Public Health*, vol. 17, no. 9, p. 3171, 2020.