Human Capital, Technological Innovation and Firm Performance

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FEAA

Modelling the Deterring Factors of Firm Financial Performance

Topics approached:

1. **The impact of energy innovations and environmental performance on firm financial performance**
2. **Econometric modelling of the interlinkages between ESG credentials, CSR actions and the financial performance of companies**

Research objectives

- To examine the role of energy innovations, and environmental performance in enhancing the financial performance of companies
- To appraise the implications (direct and overall) of the ESG actions, including extended human resources landmarks, on the financial performance of companies from the energy field, in a comparative approach between the conventional sectors and renewable ones
- To perform advanced empirical analysis on a cross-sectional dataset of 503 companies from the conventional energy fields, and other 39 companies from the renewable energy sectors based on several modern econometric procedures, namely robust regression, network analysis and structural equation modelling (SEM)

Contents

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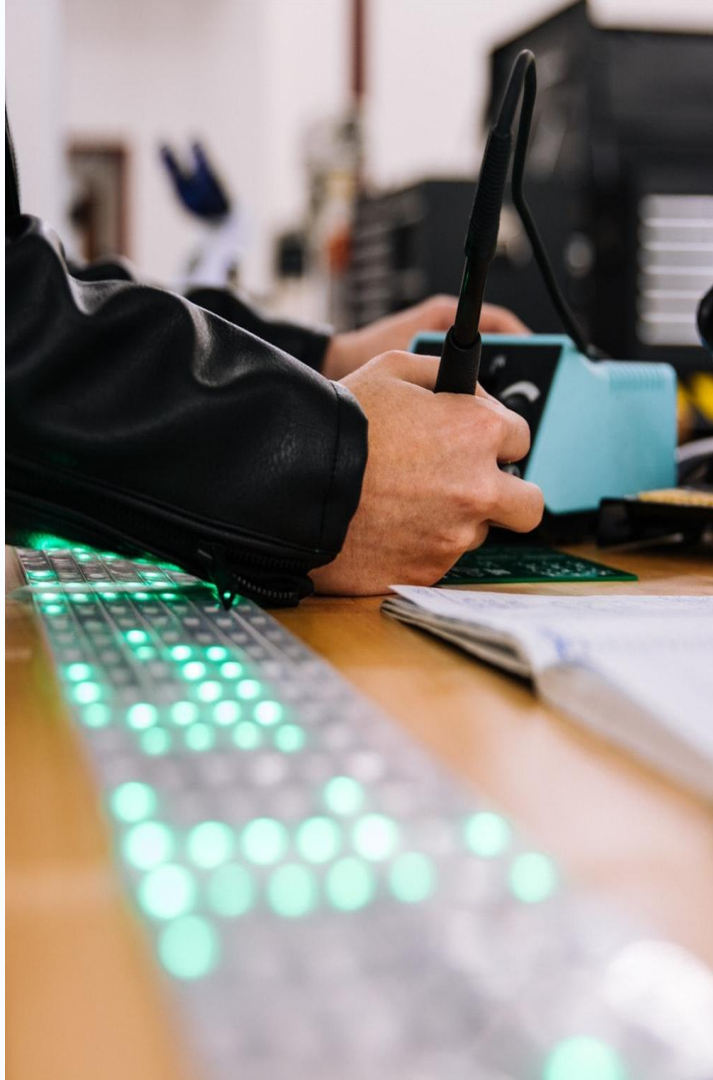
1. Introduction

- The need to manage climate change has generated a new energy transition, which poses many economic, social, environmental and technical challenges and creates multiple opportunities for energy companies and other categories of stakeholders, such as local communities, financial institutions or consumers.

- The energy sector, at the global level, is currently in the process of transitioning to “green energy”, the challenges being generated, on the one hand, by the effort to reduce greenhouse gas emissions and the promotion of renewable sources, and, on the other hand, by ensuring the security of electricity supply at affordable costs for final consumers.

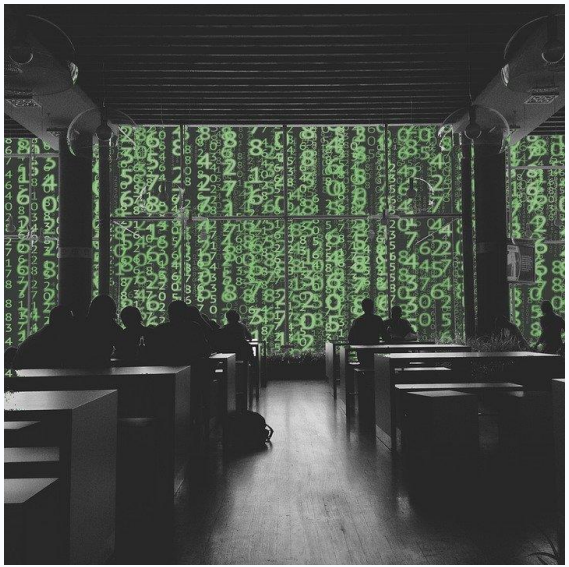


2. Brief literature review

According to the “slack resource theory” (Waddock & Graves, 1997), which relates the stakeholders’ interests with the level of companies’ resources, more responsive pressure to stakeholders is registered in the case of companies with significant resources than for those with limited ones.

A number of scholars (Georgopoulou et al., 2003; Streimikiene et al., 2009; Borozan & Starcevic, 2016; Xiao et al., 2018; Agudelo et al., 2020; Pirtea et al., 2021) have put forward the inclusion of corporate social responsiveness in the financial performance assessment of companies from different sectors, countries and regions.

On the synergy between the CSR actions and the financial performance, many authors (Pätäri et al., 2014; Arslan-Ayaydin & Thewissen, 2016; Gonenc & Scholtens, 2017; Jiang et al., 2018; Kludacz-Alessandri & Cyganska, 2021; Baran et al., 2022) examined how the CSR actions can produce effects (directly or indirectly) on the financial performance of companies operating in the energy sector.



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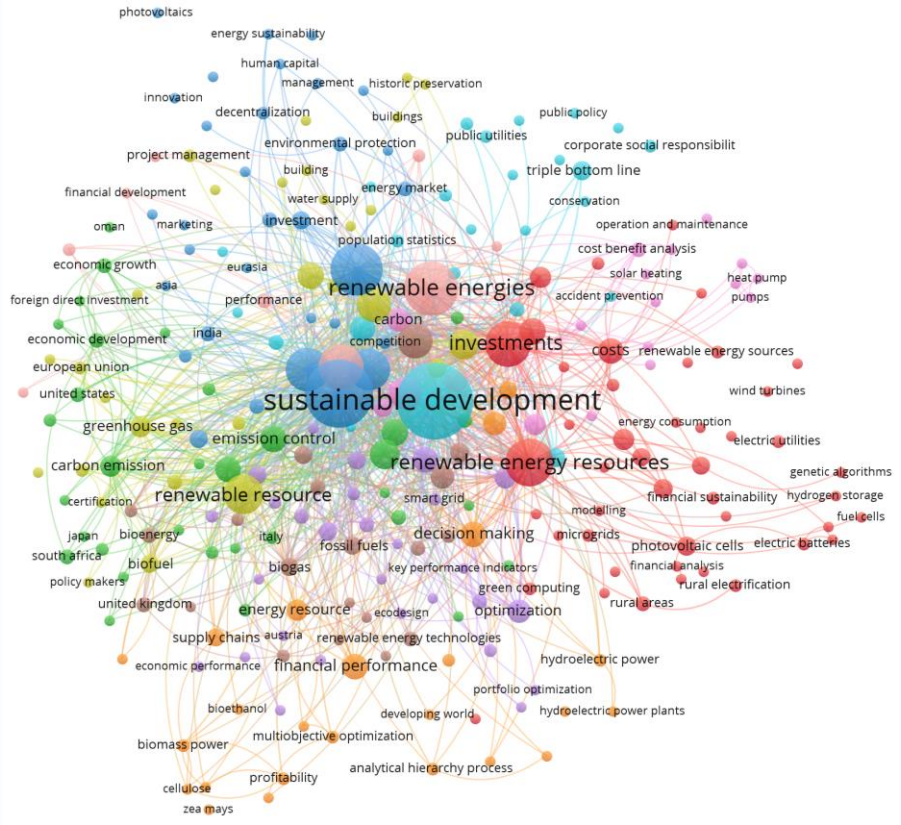

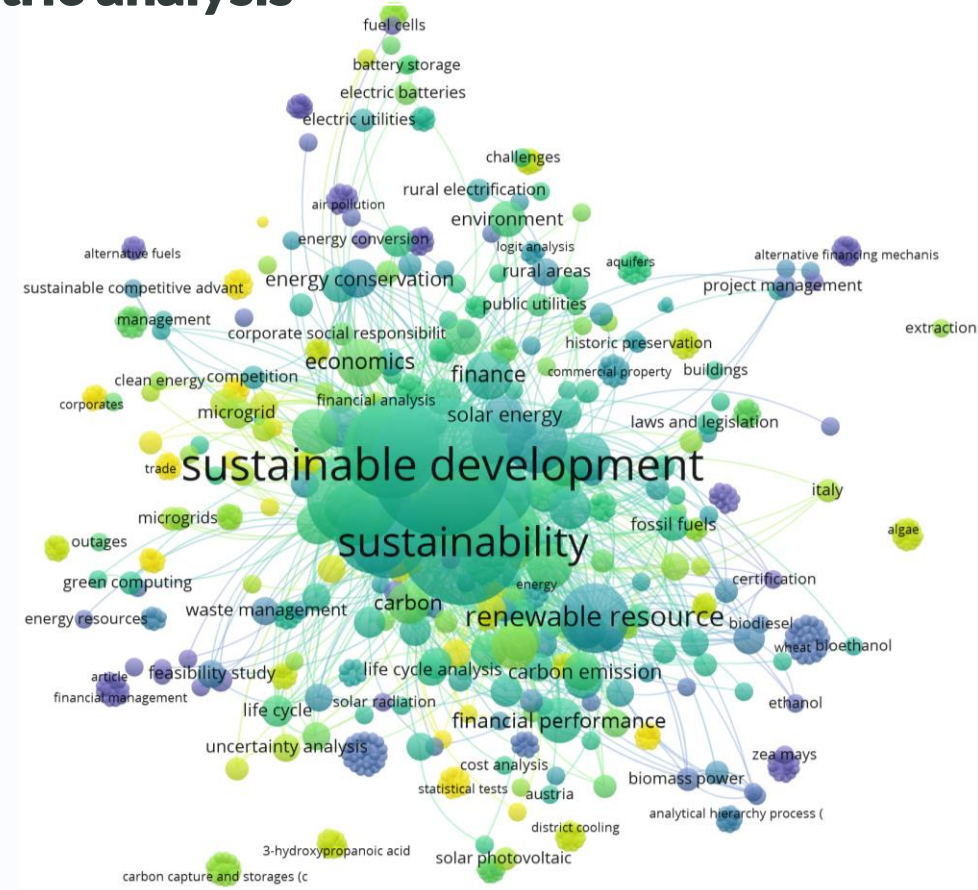

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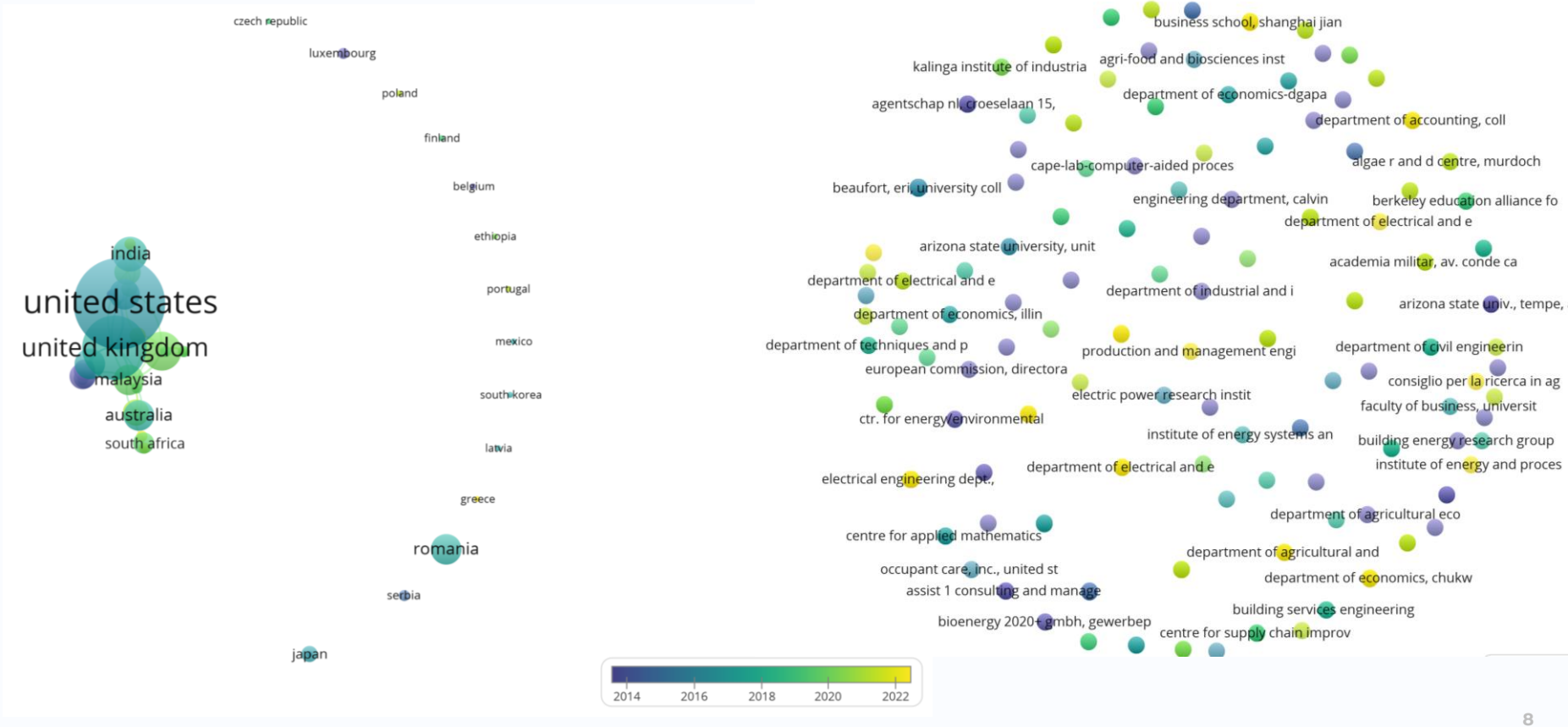

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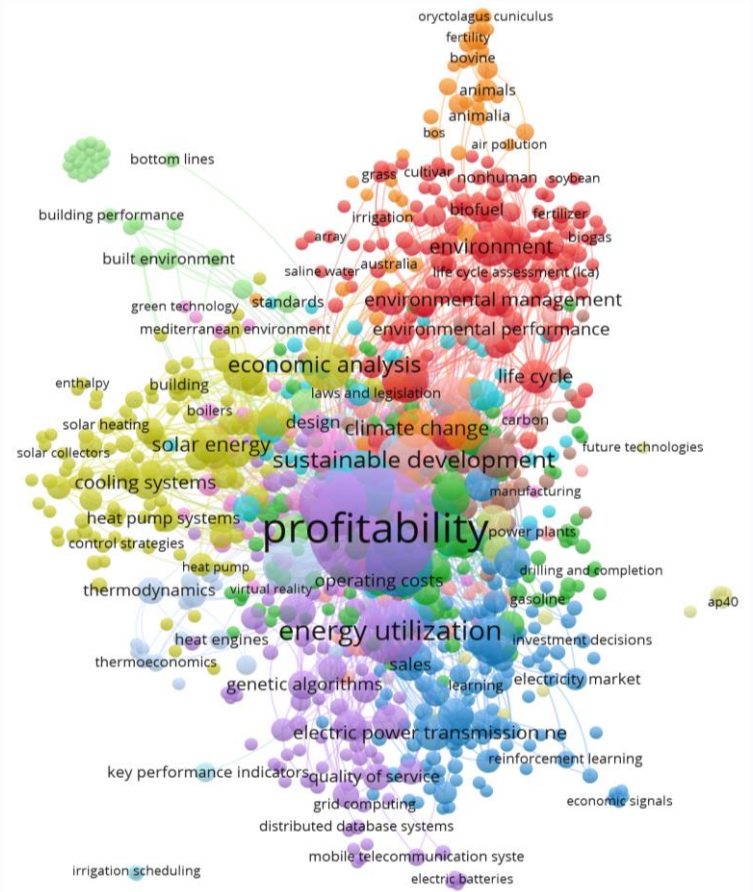
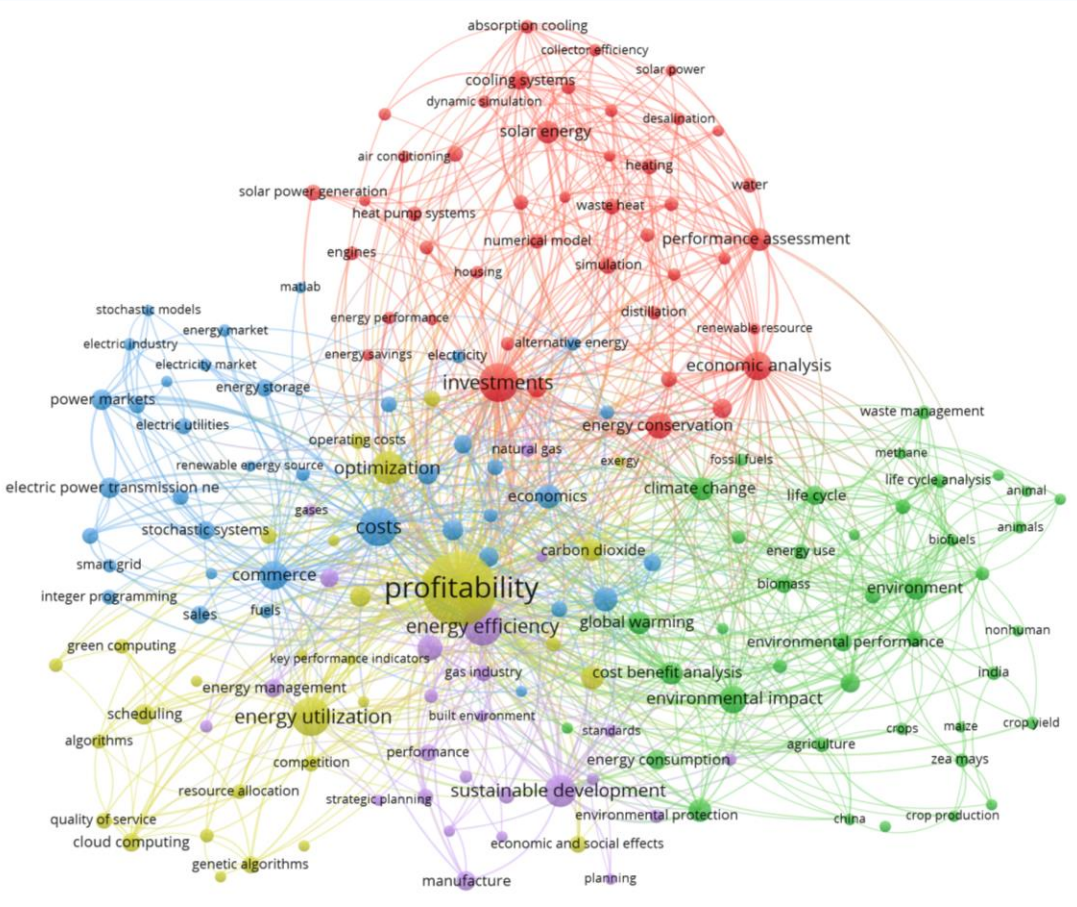




2. Brief literature review

In addition, several studies show that energy companies have different strategies to meet ESG requirements and identify the impact of the ESG determinants on financial performance (Arslan-Ayaydin & Thewissen, 2016; Gonenc & Scholtens, 2017; Jiang et al., 2018).

Arslan-Ayaydin & Thewissen (2016) analyzed the impact of environmental performance on the financial performance of companies from the stock market on a two-fold approach, energy companies vs. non-energy ones.

Gonenc & Scholtens (2017) focused on bidirectional implications between the environmental credentials (measured by CO2 emissions, resource reduction, and product innovation) and the financial performance (expressed by ROE and Tobin's Q) of international fossil fuel firms (from chemicals, oil, gas, and coal fields), within a comparative analysis with non-fossil ones.

Reflection

As a summary, the literature underpinnings in the subject of the conjunction between CSR measures, ESG credentials and the financial performance of the energy companies revealed that:

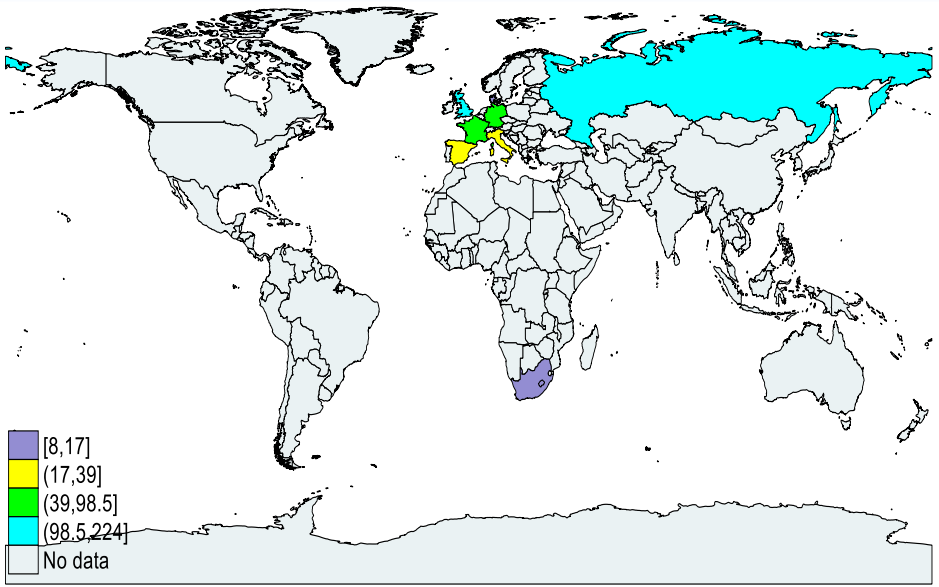
- there are studies that approached this synergy for distinctive energy sectors (fossil fuels or renewable energy) or in a comparative approach, energy companies vs. non-energy companies, but none of them tackled the conventional vs. alternative energy samples;
- as regards the implication of CSR actions/ ESG dimensions on firm financial performance, the literature reveals diverse findings, ranging from favorable, unfavorable or even no implications at all;
- the indicators used for measuring the CSR actions/ESG dimensions and the financial performance are diverse;
- board attributes (meetings, diversity or size) have positive implications on CSR policies and firm performance.

3. Data and methodology

- **Data**

- Data were collected from the Refinitiv Eikon (2021) database and encloses companies operating in the energy fields, distinctively for the two sides (conventional and renewable), for one fiscal year (2020). Therefore, we have configured two samples, one from the conventional energy fields, and the other for the renewable energy sector.

- Two cross-sectional datasets:
- The sample of the **conventional energy firms** comprises 503 companies, with headquarters geographical located as follows: the United Kingdom (138), Germany (38), France (33), Italy (32), Spain (15) and Denmark (6), Russia (224) and South Africa (17).
- The sample of **renewable energy companies** includes the following allocation sectors: renewable fuels; and renewable energy equipment and services. The sample of the renewable energy companies gets together a total number of 39 companies, with headquarters geographically located in: France (9), Denmark (2), Germany (15), Italy (4), Spain (3), and the United Kingdom (6).



3. Data and methodology

- **Data**

- The selected variables were grouped on three categories of indicators (relying on financial performance and ESG pillars), as follows:
  - **(1)** **Financial performance indicators** (absolute and relative size): earnings before interest and taxes (EBIT) (USD, millions); return on assets (ROA) (%); return on equity (ROE) (%);
  - **(2)** **ESG measures and indicators** (scores 1-100): targets diversity and opportunity score (Targets_Diversity); policy bribery and corruption score (Bribery_corrupt); bribery, corruption and fraud controversies score (Bribery_corrupt_fraud); CSR sustainability reporting score (CSR_report); CSR strategy score (CSR_strategy); ESG score (ESG); total CO2 equivalent emissions to revenues (CO2_emissions); targets emissions score (Targets_emissions); policy emissions score (Policy_emissions); environmental products score (Env_Products);
  - **(3)** **Human capital indicators** – board and employees: board size (Board_size) (number); number of board meetings (No_board_meet) (number); board gender diversity (Board_diversity) (percent score); women employees score (Women_empl) (score 1 to 100); average training hours score (Training_h) (score 1 to 100); compensation committee independence score (Compens_com_indep) (score 1 to 100).

Summary statistics

Conventional energy companies

Variables	Count	Mean	Standard deviation	Minimum	Maximum
EBIT	458	221.6629	1449.829	-13306	21641.77
ROA	503	.4022664	4.005386	-35.79	51.67
ROE	503	1.221909	12.93769	-188.44	89.05
CO2_emissions	87	54.46092	28.46184	1.85	98.99
Targets_emissions	101	50.52762	39.64419	0	90
Policy_emissions	102	55.86441	20.22077	0	70.21
Targets_diversity	84	29.625	43.32106	0	95.31
Env_products	101	39.25446	35.22349	0	89.08
Training_h	57	48.76123	26.44682	1.6	92.02
CSR_report	102	53.76235	12.69261	0	64.71
Women_empl	90	55.023	28.4286	3.29	98.44
Bribery_corrupt	102	52.44412	19.6516	0	70
Bribery_corrupt_fraud	102	50.33794	24.18083	.05	62.26
Compens_com_indep	92	51.49772	27.76211	.24	96.1
No_board_meet	87	11.35632	9.284868	2	53
Board_size	102	10.21569	2.741783	5	19
Board_diversity	102	43.23137	28.9219	1.44	98.73
CSR_strategy	102	57.69824	29.06292	0	97.56
ESG	102	57.33059	21.74808	5.15	92.17
N total	503				

Summary statistics

Renewable energy companies

Variables	Count	Mean	Standard deviation	Minimum	Maximum
EBIT	30	-1.072002	220.8397	-557.78	929.41
ROA	22	1.407273	5.35201	-11.83	15.5
ROE	22	-9.240909	40.51504	-159.38	35.45
CO2_emissions	7	54.10571	34.73445	14.71	97.06
Targets_emissions	11	60.93364	39.30547	0	88.1
Policy_emissions	11	52.62545	33.98971	0	74.36
Targets_diversity	0	.	.	.	.
Env_products	11	45.78636	22.84233	0	64.71
CSR_report	11	36.44091	28.98142	0	62.35
CSR_strategy	11	33.75364	25.95532	0	87.35
ESG	11	47.84545	22.70815	18.08	78.51
Training_h	4	43.66	32.10307	7.14	81.25
Women_empl	7	63.17429	24.53596	19.44	85
Board_diversity	11	37.49909	31.52429	7.46	90.59
Board_size	11	7.818182	3.429816	3	13
No_board_meet	8	11.25	7.146428	5	25
Bribery_corrupt	11	43.79454	34.72715	0	70.59
Bribery_corrupt_fraud	11	62.04818	.5391991	60.7	62.93
Compens_com_indep	4	22.3175	25.13491	1.87	58.89
N total	39				

Methodology

Robust regression

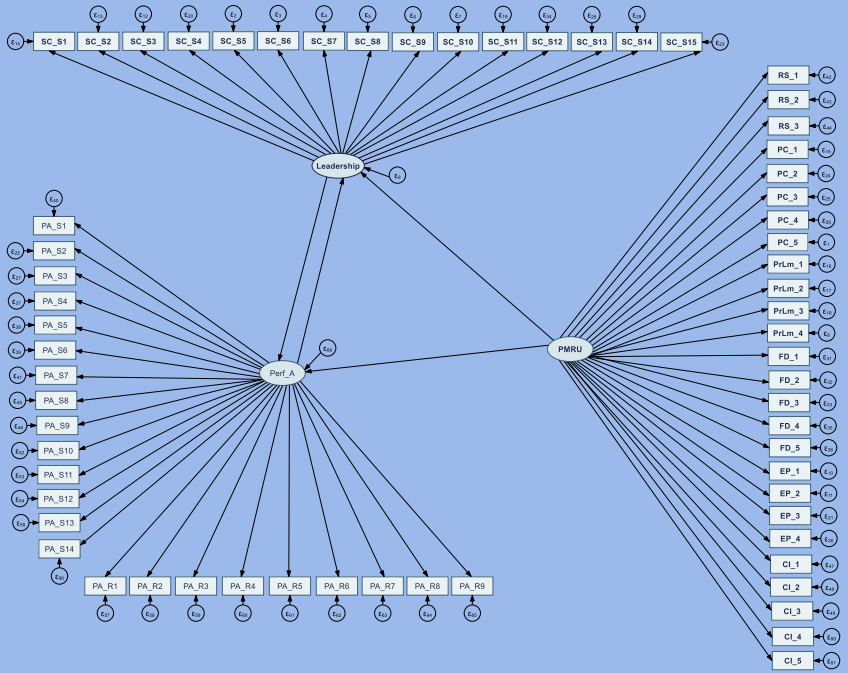
Models of robust regression are shown in Equation 1, including as dependent variable each of the considered indicators of financial performance, namely EBIT (in absolute size), ROA and ROE (in relative size), thus, resulting in 6 econometric models overall, for both panels (conventional and renewable energy companies):

$$EBIT/ROA/ROE = \beta_0 + \beta_1 CO2\_emissions + \beta_2 Targets\_emissions + \beta_3 Policy\_emissions +$$
$$+ \beta_4 CSR_{strategy} + \beta_5 Training_h + \beta_6 Women_{empl} + \beta_7 Board_{diversity} + \beta_8 No_{board_{meet}} +$$
$$+ \beta_9 Bribery\_corrupt + \beta_{10} Compens\_com\_indep + \theta_i + \varepsilon \quad (1)$$

Robust regression enhances the advantage of providing robust estimates by removing the outliers within the sample through two types of iterations, namely Huber and biweight iterations, thus coping with potential distortions in the estimated coefficients.

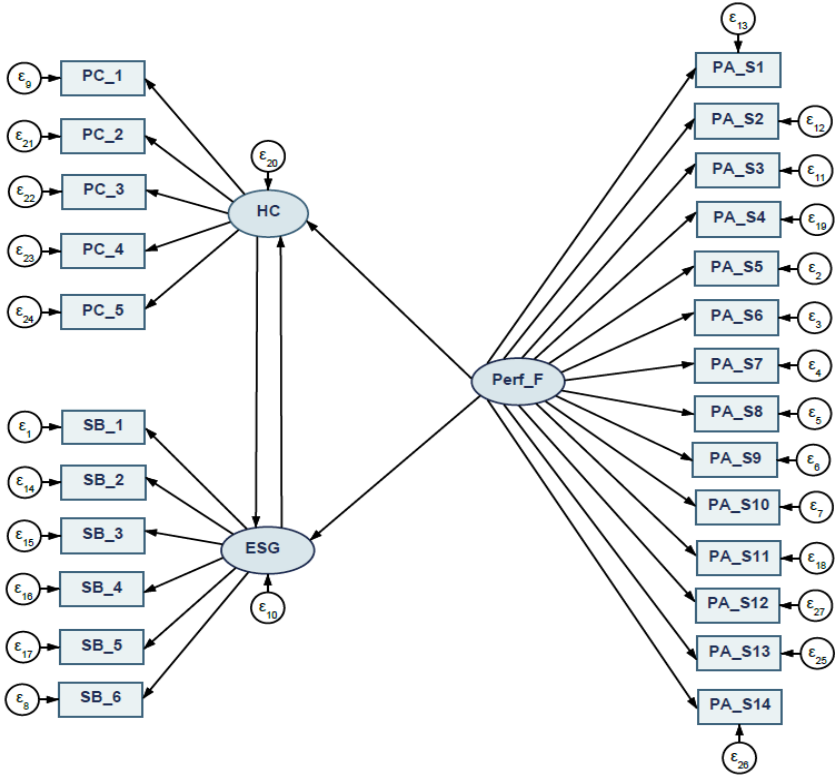
Methodology

Structural equation modelling (SEM)



Methodology

- **Structural equation modelling (SEM)**

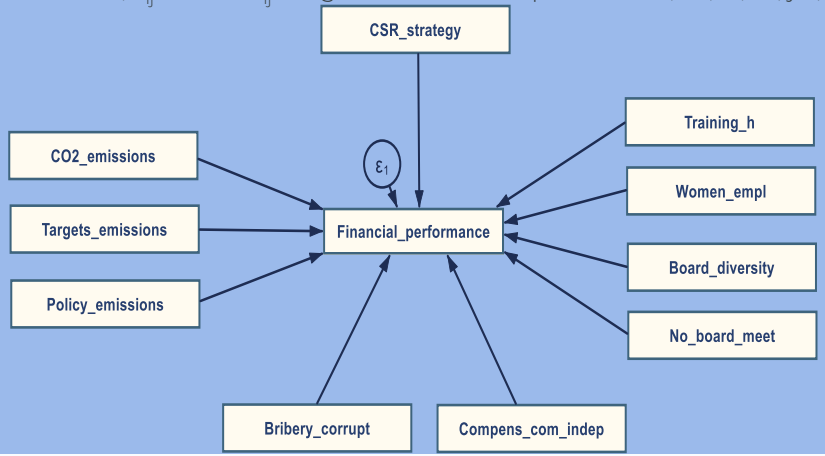


Methodology

Structural equation modelling (SEM)

$$\begin{cases} b_{11}y_{2t} + ... + b_{1m}y_{mt} + c_{11}x_{1t} + ... + c_{1n}x_{nt} = \varepsilon_{1t} \\ b_{21}y_{2t} + ... + b_{2m}y_{mt} + c_{21}x_{1t} + ... + c_{2n}x_{nt} = \varepsilon_{2t} \\ ..... \\ b_{m1}y_{1t} + ... + b_{mm}y_{mt} + c_{m1}x_{nt} + ... + c_{mn}x_{nt} = \varepsilon_{mt} \end{cases}$$

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, ... , m; j=1, ..., n.



Methodology

Gaussian graphical models (GGMs)

The undirected graph „$G = (V, E)$ includes a vertex set $V = \{1, \ldots, p\}$ as well as an edge set $E \subset V \times V$" (Williams, 2019, p. 3). Let "$\Omega_d = (\omega_{ij,d}) = \Sigma_d^{-1}$ for d = 1,2 be the precision matrix for $X = [x^1, \ldots, x^{n1}]^T \in R^{n1xp}$ and $Y = [y^1, \ldots, y^{n2}]^T \in R^{n2xp}$. X and Y denote the data matrices.

The precision matrix (inverse covariance matrix) $\Omega = \Sigma^{-1}$ represents a GGM. A GGM associated with X is a graph, where the node set $V = \{x_1, x_2, \ldots\ldots, x_p\}$ has p components and the edge set E such that any edge between xk and xj if and only if xk and xj are conditional dependent given all other variables. Similarly, a GGM associated with Y is also a graph" (He et al., 2019, p. 1; Sichigea et al., 2021).

Methodology

Research hypotheses

H1. Sustainability (ESG) actions directly and notably shape the financial performance of energy companies, both for conventional and renewable ones;

H2. Human capital (board and employees) dimensions directly and significantly influence the financial performance of energy companies, both for conventional and renewable ones;

H3. Sustainability (ESG) actions, within global interlinkages with human capital dimensions, notably influence the financial performance of energy companies, both for conventional and renewable ones.

4. Results and discussion – robust regression

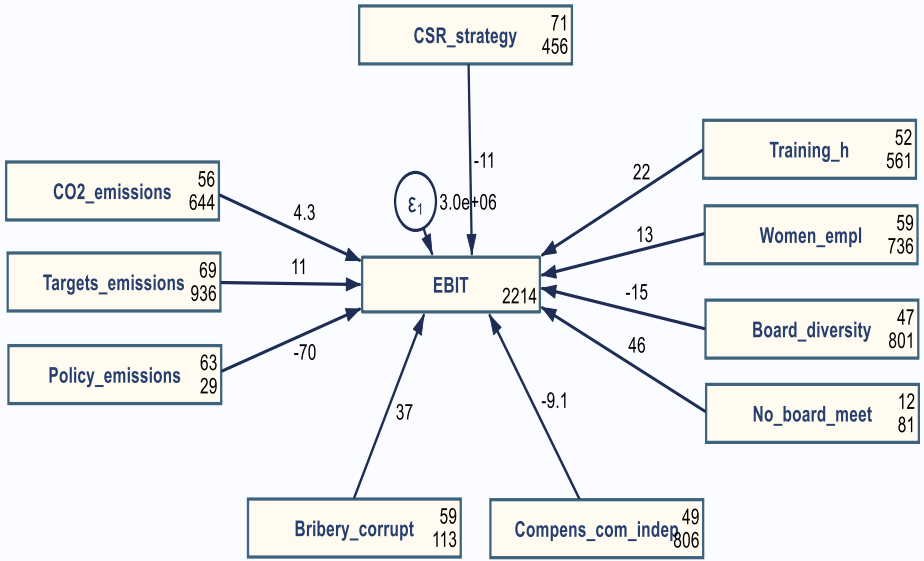
Conventional panel

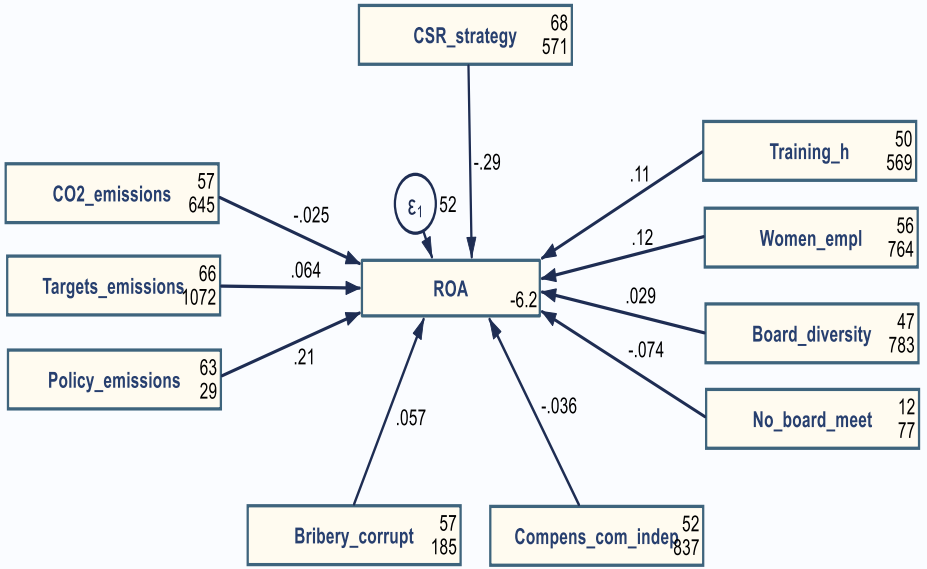
	(1)	(2)	(3)
	EBIT	ROA	ROE
CO2_Emissions	36.16***	0.0142	-0.0367
	(8.703)	(0.0161)	(0.0884)
Targets_Emissions	36.43**	0.0410	0.361**
	(10.98)	(0.0199)	(0.109)
Policy_Emissions	140.3*	0.0946	-0.310
	(53.78)	(0.0977)	(0.537)
Targets_Diversity	-2.946	-0.0383**	-0.0588
	(6.124)	(0.0111)	(0.0611)
Env_Products	-32.97**	-0.0574**	0.0129
	(8.784)	(0.0155)	(0.0854)
CSR_report	-460.4***	-1.015***	1.138
	(110.3)	(0.202)	(1.111)
CSR_strategy	6.187	-0.0395	-0.167
	(14.03)	(0.0234)	(0.129)
ESG	-36.31	0.0706	-0.390
	(31.51)	(0.0567)	(0.312)
Training_h	13.04	0.0948***	-0.0233
	(10.98)	(0.0192)	(0.105)
Women_empl	57.82***	0.0964***	0.0874
	(9.418)	(0.0161)	(0.0886)
Board_diversity	-69.48***	-0.0324*	0.0273
	(7.572)	(0.0137)	(0.0754)
Board_size	14.05	-0.814***	-1.380
	(92.34)	(0.164)	(0.901)
No_board_meet	-30.70	-0.156*	-0.121
	(33.73)	(0.0584)	(0.321)
Bribery_corrupt	22.59	0.0136	0.0159
	(21.24)	(0.0310)	(0.171)
Bribery_corrupt_fraud	-21.08*	-0.0157	-0.107
	(8.805)	(0.0159)	(0.0873)
Compens_com_indep	-36.56**	-0.0587**	0.122
	(9.683)	(0.0157)	(0.0865)
_cons	18321.9*	58.13***	-5.699
	(7992.8)	(14.63)	(80.41)
N	32	36	36
R^2	0.925	0.893	0.613

Renewable panel

	(1)	(2)	(3)
	EBIT	ROA	ROE
CO2_emissions	-0.0824	-0.0240	0.127
	(0.235)	(0.0499)	(0.127)
Targets_emissions	0.460	-0.0353	1.090***
	(0.245)	(0.0519)	(0.132)
Policy_emissions	-0.384	0.0426	-0.603***
	(0.284)	(0.0602)	(0.153)
CSR_strategy	-3.545***	-0.484**	-4.674***
	(0.629)	(0.133)	(0.340)
Training_h	2.176**	0.597***	-3.088***
	(0.721)	(0.153)	(0.390)
Women_empl	2.459***	0.507**	-3.901***
	(0.655)	(0.139)	(0.354)
Board_diversity	-0.781***	0.0240	0.378**
	(0.198)	(0.0420)	(0.107)
No_board_meet	-5.909***	-0.704***	-1.480**
	(0.773)	(0.164)	(0.418)
Bribery_corrupt	3.838***	0.397***	2.013***
	(0.481)	(0.102)	(0.260)
Compens_com_indep	-0.544*	0.131*	1.588***
	(0.245)	(0.0520)	(0.132)
_cons	-173.4*	-50.62**	309.2***
	(67.52)	(14.32)	(36.46)
N	39	39	39
R^2	0.908	0.803	0.997

4. Results SEM – energy companies – conventional fields





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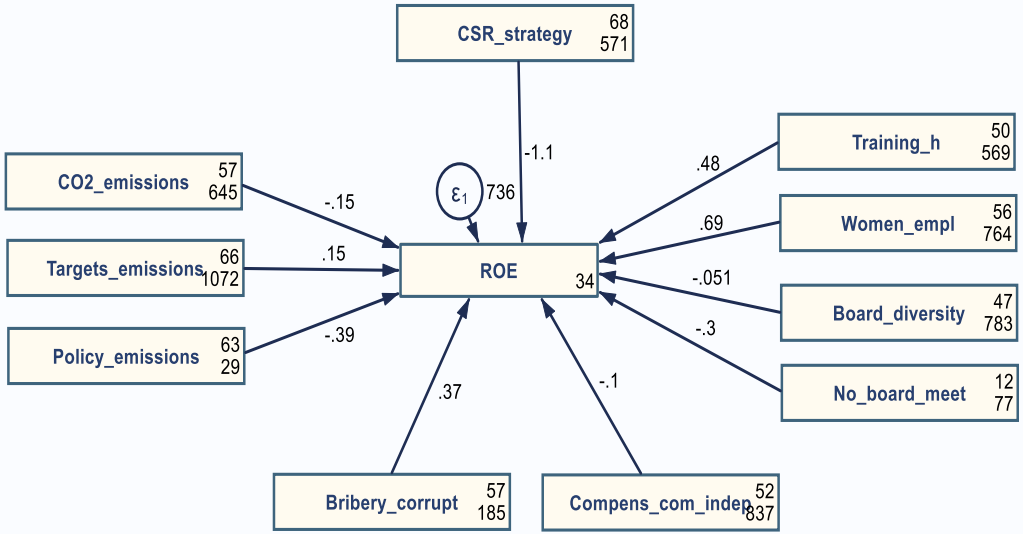
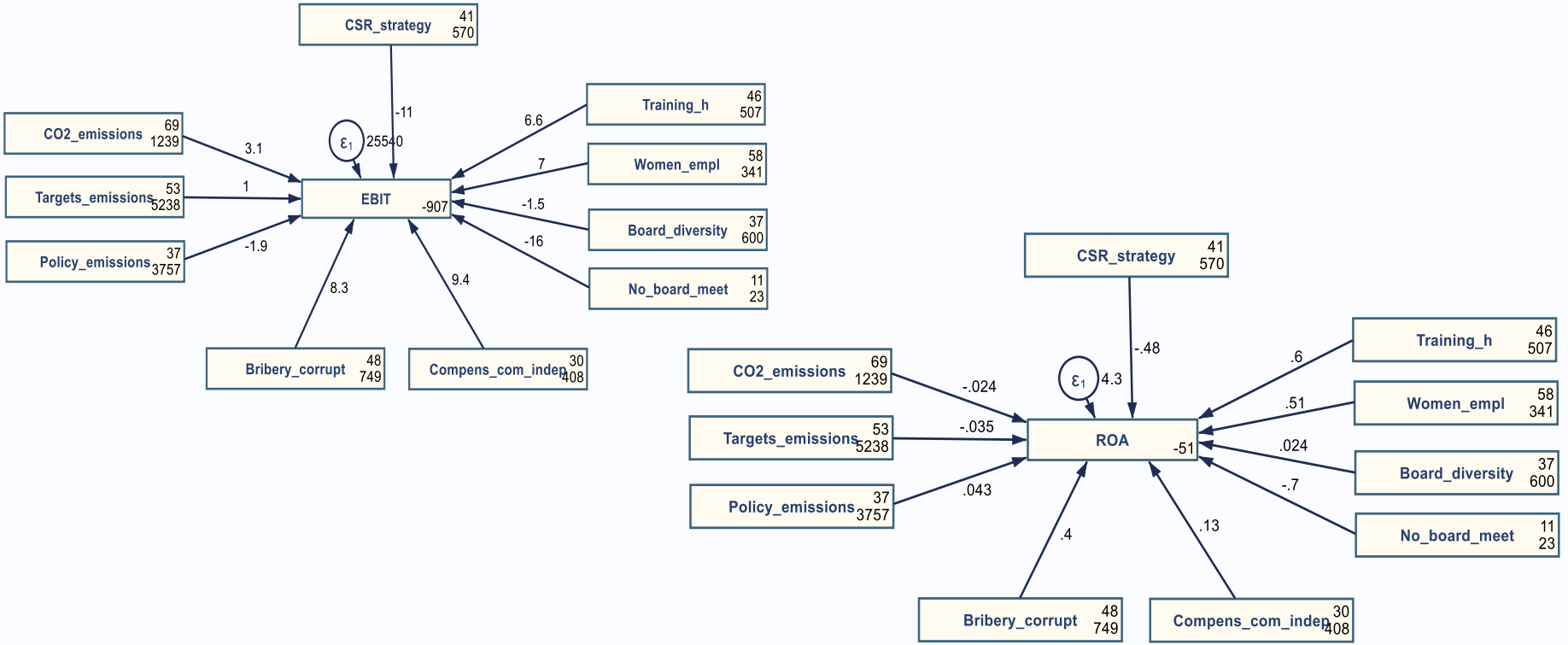


	(1) EBIT	(2) ROA	(3) ROE
main			
co2_emissions	4.327 (13.84)	-0.0246 (0.0555)	-0.146 (0.208)
targets_emissions	11.17 (13.09)	0.0640 (0.0498)	0.151 (0.187)
policy_emissions	-70.19 (60.98)	0.210 (0.244)	-0.392 (0.914)
bribery_corrupt	36.75 (32.91)	0.0566 (0.105)	0.372 (0.394)
training_h	22.42 (14.27)	0.106 (0.0568)	0.479* (0.213)
women_empl	13.11 (11.99)	**0.123**** **(0.0472)**	**0.686***** **(0.177)**
board_diversity	-14.82 (11.51)	0.0287 (0.0456)	-0.0510 (0.171)
no_board_meet	45.66 (40.77)	-0.0738 (0.163)	-0.304 (0.613)
compens_com_indep	-9.096 (12.11)	-0.0360 (0.0462)	-0.104 (0.173)
csr_strategy	-10.73 (16.22)	**-0.290***** **(0.0627)**	**-1.124***** **(0.235)**
_cons	2214.3 (4468.5)	-6.156 (16.70)	34.41 (62.61)
/			
var(e.ebit)	2956356.0*** (687338.8)		
var(e.roa)		52.39*** (11.57)	
var(e.roe)			736.4*** (162.6)
N	37	41	41

4. Results SEM – energy companies – renewable energy fields



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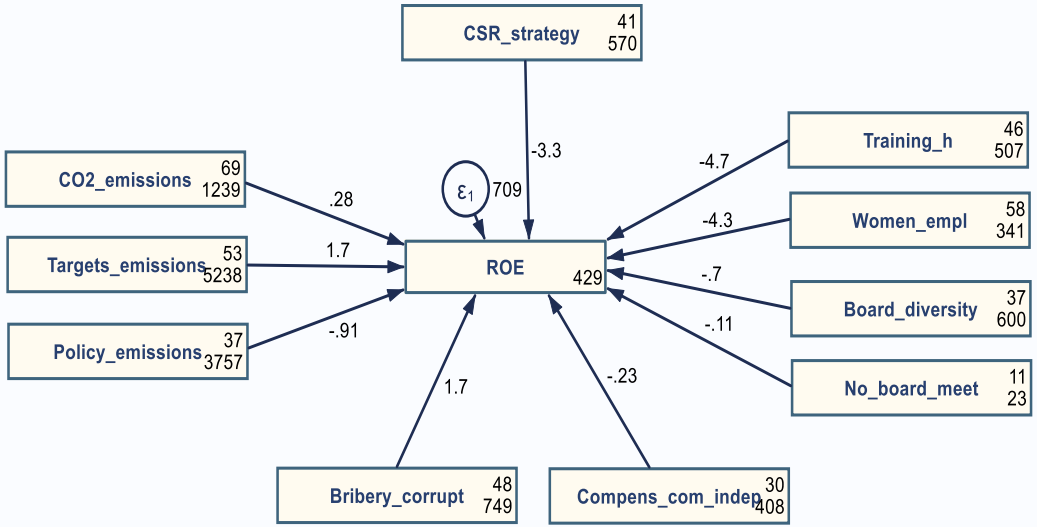
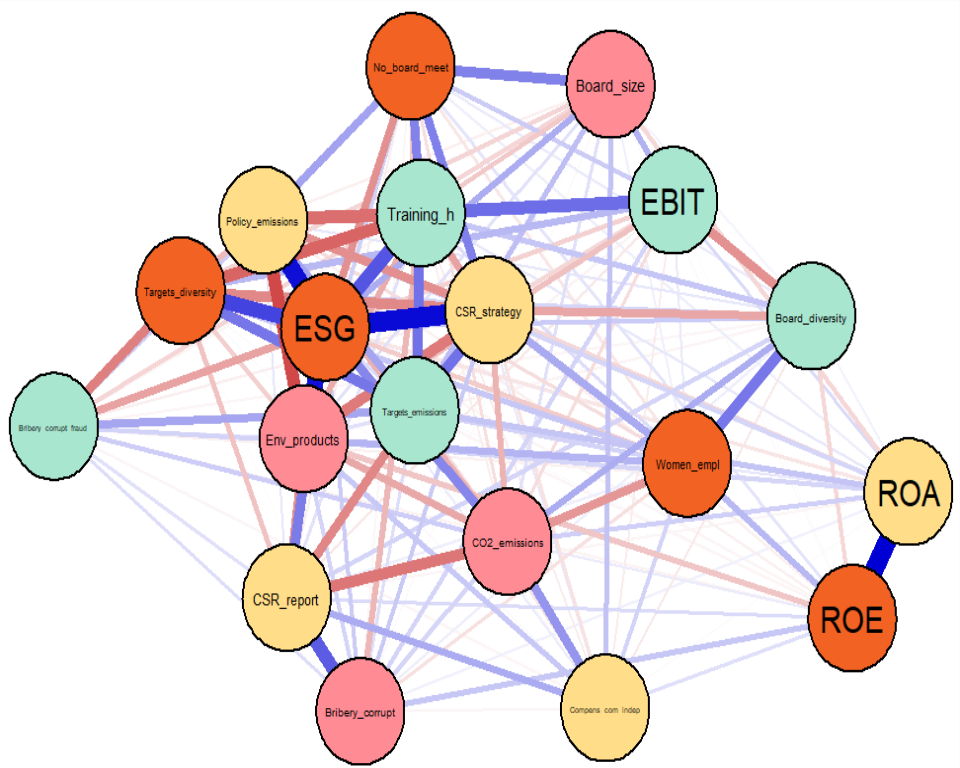
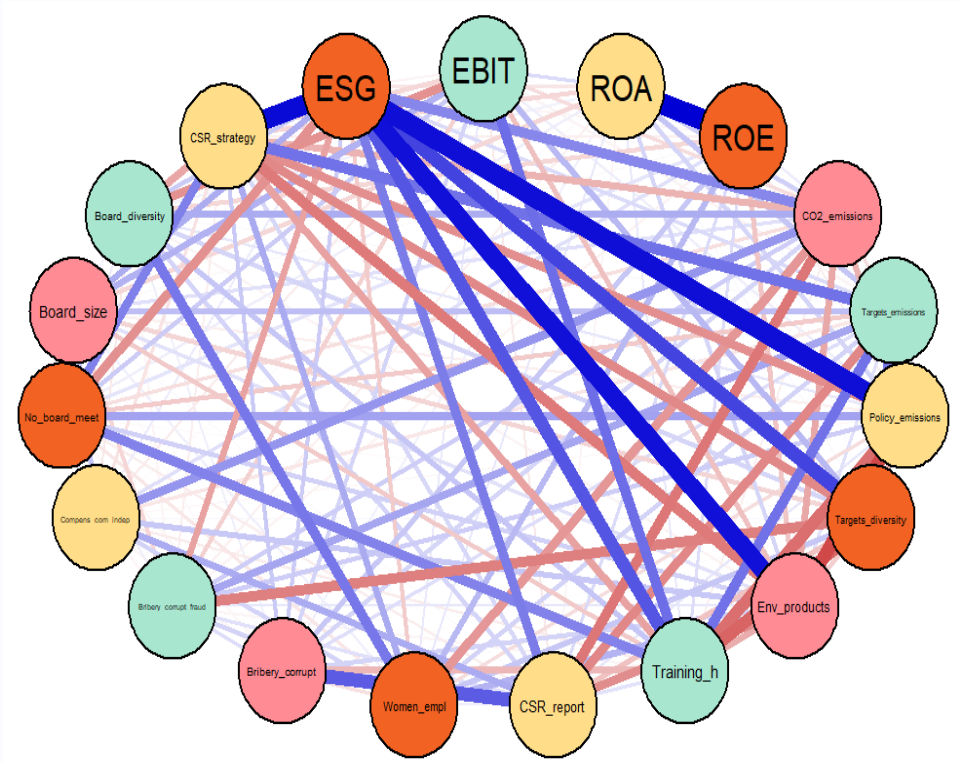


	(1) EBIT	(2) ROA	(3) ROE
main			
CO2_emissions	3.062	-0.0240	0.283
	(3.276)	(0.0423)	(0.546)
Targets_emissions	1.034	-0.0353	1.658**
	(3.409)	(0.0440)	(0.568)
Policy_emissions	-1.862	0.0426	-0.906
	(3.950)	(0.0510)	(0.658)
Bribery_corrupt	8.263	**0.397***	1.747
	(6.691)	**(0.0864)**	(1.115)
Training_h	6.648	**0.597***	**-4.704****
	(10.04)	**(0.130)**	**(1.673)**
Women_empl	7.013	**0.507***	**-4.341****
	(9.122)	**(0.118)**	**(1.520)**
Board_diversity	-1.490	0.0240	-0.697
	(2.756)	(0.0356)	(0.459)
No_board_meet	-16.16	**-0.704***	-0.106
	(10.77)	**(0.139)**	(1.793)
Compens_com_indep	**9.434****	**0.131****	-0.225
	(3.412)	**(0.0440)**	(0.568)
CSR_strategy	-10.95	**-0.484***	**-3.345***
	(8.755)	**(0.113)**	**(1.458)**
_cons	-907.1	**-50.62***	428.9**
	(940.0)	**(12.13)**	(156.6)
/			
var(e.EBIT)	25539.7***		
	(5783.6)		
var(e.ROA)		4.254***	
		(0.963)	
var(e.ROE)			708.6***
			(160.5)
N	39	39	39

4. Results of GGMs and MGMs





Key takeaways

Considering the many economic, social, environmental, and technical challenges that companies need to face in the present context, firms become important players globally, their behavior being in a process of metamorphosis considering, on the one hand, the pressures of shareholders to maximize financial performance, and, on the other hand, the actions of other stakeholders who sanction less environmentally and socially responsible behavior of these entities. Therefore, companies' business strategies have been reshaped in recent decades by incorporating ESG aspects, promoting CSR actions, and, more recently, by raising awareness of the importance of non-financial reporting and performance.

We evidenced the implications of ESG actions, including human resources attributes, on the financial performance of companies from the energy field. Our focus was on energy companies, conventional vs. renewable ones, in view of the ongoing energy transition process, given their support in sustainable development, and the different externalities they generate in economic, social, and environmental terms. Overall, we can say that we are witnessing a process of corporate divestment in traditional energy sources and the growing interest in renewable energy with less or no impact on the environment, but with sound inferences on firm financial performance.

Thank you very much!

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