



Research article

Do diversity & inclusion of human capital affect ecoefficiency? Evidence for the energy sector

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Appendix A. Distribution of sample and sample selection

Table i. Distribution of sample observations by country.

Country	Percentage	Frequency
Argentina	0,48	5
Australia	3,86	41
Austria	0,48	5
Belgium	0,48	5
Brazil	1,93	21
Canada	12,32	131
Chile	0,24	3
China	8,70	92
Colombia	0,48	5
Cyprus	0,24	3
Denmark	0,24	3
Finland	0,24	3
France	1,93	21
Germany	0,72	8
Greece	0,48	5
Hong Kong	1,21	13
Hungary	0,24	3
India	4,11	44
Indonesia	1,93	21
Israel	0,24	3
Italy	0,97	10
Japan	1,93	21
Jersey	0,24	3
Kazakhstan	0,48	5
Korea; Republic (S. Korea)	0,97	10
Luxembourg	0,48	5
Malaysia	3,14	33
Mexico	0,24	3
Monaco	0,24	3
Mongolia	0,24	3
Netherlands	0,72	8
New Zealand	0,48	5
Nigeria	0,24	3
Norway	3,14	33
Philippines	0,24	3
Poland	0,72	8
Portugal	0,24	3
Romania	0,24	3
Russia	2,17	23
Saudi Arabia	0,24	3
Singapore	0,72	8
South Africa	0,48	5
Spain	0,72	8
Sweden	0,97	10
Switzerland	0,24	3
Taiwan	0,24	3
Thailand	2,42	26
Turkey	1,21	13
United Arab Emirates	0,97	10
United Kingdom	5,07	54
United States of America	28,99	308
Total	100	1062

Table ii. Sample selection.

	Observations	Firms
Observations and number of firms of listed companies in the energy sector in the LSEG database from 2016 to 2022	2898	414
Less observations/firms with missing data	1836	41
Final sample	1062	373

Appendix B. DEA model: Descriptive statistics and correlation coefficients**Table iii.** Descriptive statistics for the inputs and outputs used in the DEA model.

	Variable	Mean	Std. Dev.	Min.	Max.
Inputs	Employees	13,796.25	41,756.91	7	330,100
	PP&E	1.06e+10	2.94e+10	5,417,844	2.10e+11
	Operating Cost	1.14e+10	3.12e+10	6,015,514	2.25e+11
Outputs	Operating Revenues	1.27e+10	3.54e+10	667,492.4	2.56e+11
	Market Capitalization	1.07e+10	2.50e+10	2.11e+07	1.64e+11
	Env. Score	47.06597	24.71376	0.001	96.92313

Table iv. Spearman rank correlation coefficients for the inputs and outputs used in the DEA model.

	Inputs			Outputs		
	Employees	PP&E	Operating Cost	Operating Revenues	Market Capitaliz.	Env. Score
Employees	1.0000					
PP&E	0.5467	1.0000				
Operating Cost	0.7914	0.7455	1.0000			
Operating Revenues	0.7913	0.7643	0.9767	1.0000		
Market Capitalization	0.6569	0.7484	0.7677	0.8104	1.0000	
Env. Score	0.5622	0.4033	0.5422	0.5586	0.5007	1.0000

Note: The coefficients are significant at the 1% level.

Appendix C. Definitions of the variables and expected sign

Table v. Variable explanations.

Dependent variables	Symbol	Definition	Expected sign	Main references
Ecoefficiency	ECO	Technical efficiency calculated using data envelopment analysis.		
Independent variables				
D&I Global	D&I Global	Overall score of a company based on reported workforce information that define diverse and inclusive workplaces.	(+)	Suciu et al. (2020); Bax (2023)
Diversity	D&I Div	Measures a company's commitment and effectiveness toward maintaining a gender diverse workforce and board member cultural diversity.	(+)	
Inclusion	D&I Incl	Measures a company's commitment and effectiveness toward effective life-work balance, a family-friendly environment, and disability inclusion.	(+)	
People development	D&I PD	Measures a company's commitment and effectiveness toward providing training and development (education) for its workforce.	(+)	
Controversies	D&I Contr	Accounts for the negative impact workforce controversies have on the company. Higher values mean fewer controversies in a company.	(+)	
Control Variables: Corporate governance structure				
Board size	B_Size	Size of the board of directors	(+)	McGuinness et al. (2017)
CEO duality	CEO_Duality	If the CEO simultaneously chairs the board or if the chairman of the board is simultaneously the CEO. 1 true, 0 false	(-)	Webb (2004)
Independent board members	boardIndpBMemb	The percentage of non-executive members on the board	(+)	Issa et al. (2022); Shahbaz et al. (2020)
Sustainability compensation	Sus_Comp	Senior executive's compensation linked to sustainability targets	(+)	D'apolito (2019)
Quality management systems	QMS	Does the company claim to apply quality management systems, such as ISO 9000, Six Sigma, Lean Manufacturing, Lean Sigma, TQM, or any other similar quality principles?	(+)	Kumar et al. (2018)
CSR strategy	CSR_Stra	Company's practices to communicate that it integrates the economic (financial), social, and environmental dimensions into its day-to-day decision-making processes	(+)	Shaukat et al. (2016)
CSR committee score	CSR_Com	Assesses whether the company has a CSR committee	(+)	Hussain et al. (2018); Ben-Amar et al. (2017); Taglialatela et al. (2023)
SDG environmental	Env_SDGs	The number of environmental SDGs a firm supports over total number of environmental SDGs considered	(+)	
Other control variables				
ROA	ROA	Income after taxes for the fiscal period divided by the average total assets	(+)	Guo et al. (2020)
CAPEX	Capex	Capital expenditures represents the sum of purchase of fixed assets and intangibles	(+)	Moussa and Elmarzouky (2023)
Market risk	Beta	How much the price of a stock changes in relation to the movement of the market	(-)	Ramírez-Orellana et al. (2023)
Leverage	Lev	The ratio of total debt divided by total assets	(+)	Haque (2017)
Firm size	Size	The logarithm of total assets	(+)	Ruggiero & Cupertino (2018)
Firm age	Age	The logarithm of the number of years since incorporation	(+)	De Villiers et al. (2011)

Note: The positive sign in the "expected sign" column indicates that the independent/control variables are expected to have a positive relationship with the dependent variables according to previous literature. The negative sign indicates the opposite.

Appendix D. Endogeneity analysis.

Table vi. Lag OLS.

	ECO	ECO	ECO	ECO	ECO
D&I Global	0.003*** (0.001)				
D&I Div		0.001** (0.001)			
D&I PD			0.002*** (0.000)		
D&I Incl				-0.000 (0.000)	
D&I Contr					0.001 (0.001)
Control	Yes	Yes	Yes	Yes	Yes
Constant	-0.057 (0.119)	0.011 (0.118)	-0.015 (0.117)	-0.002 (0.119)	-0.066 (0.209)
Year FE	Yes	Yes	Yes	Yes	Yes
N	735	735	735	735	735
R ²	0.3471	0.3413	0.3549	0.3369	0.3370

Note: Data enclosed in () are the standard error. Dummy variables for time have been used. Asterisks indicate significance at the 10 percent (*), 5 percent (**), and 1 percent (***) levels.

Table vii. Two-stage least squares regression.

	ECO	ECO	ECO	ECO	ECO
D&I Global	0.005*** (0.001)				
D&I Div		0.003*** (0.001)			
D&I PD			0.003*** (0.001)		
D&I Incl				-0.000 (0.000)	
D&I Contr					0.000 (0.002)
Control	Yes	Yes	Yes	Yes	Yes
Constant	-0.051 (0.107)	0.073 (0.106)	-0.024 (0.106)	0.037 (0.110)	0.047 (0.289)
Year FE	Yes	Yes	Yes	Yes	Yes
N	612	612	612	612	612
Centered R2	0.4456	0.4359	0.4471	0.4317	0.4324
Anderson canon. corr. LM statistic	199.068	189.467	199.031	197.437	160.810
Chi-sq(8) P-value	0.0000	0.0000	0.0000	0.0000	0.0000
Sargan statistic	12.501	13.994	10.450	17.089	16.986
Chi-sq(7) P-value	0.2529	0.1733	0.4019	0.0724	0.0747

Note: Data enclosed in () are the standard error. Dummy variables for time have been used. Asterisks indicate significance at the 10 percent (*), 5 percent (**), and 1 percent (***) levels.



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