

# ESG Index: A Multicriteria Analysis Model

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# Objectives

- Using the ESG criteria selected based on the literature and the availability of the database, we tried to create an ESG score with the help of a new prototype multi-criteria model.
- The objectives of this presentation are:
  - first the presentation of this new multi-criteria model
  - secondly to examine whether the criteria chosen as well as the overall approach to the issue are appropriate for drawing reasonable conclusions



# Multi-Criteria Decision Aid

- New model is created
- The model is based on the multi-criteria UTA model

# Model for the analysis of ESG index

- Additive form combining evaluation criteria and nominal factors

ESG criteria

Nominal factors

$$ESG = (E + S + G) + (CTRY + SCTR + YR)$$

- $E, S, G$  partial scores on the three ESG pillars, each expressed in the form of an additive value function of the criteria in each pillar

$$E = \sum_k w_k^E v_k^E(x_k^E) \quad S = \sum_k w_k^S v_k^S(x_k^S) \quad G = \sum_k w_k^G v_k^G(x_k^G)$$

- piecewise linear marginal value functions of the criteria
- Country (CNTR), sector (SCTR), and year (YR) effects are used to consider the context in which firms operate

# Optimization-based model estimation

- From a sample of  $n$  firms with given ESG scores  $ESG_1, \dots, ESG_n$

$$\min \sum_{i=1}^n (s_i^+ + s_i^-)^2 + \|\mathbf{w}^E\|_2^2 + \|\mathbf{w}^S\|_2^2 + \|\mathbf{w}^G\|_2^2 + \sum_{i=1}^n (CTRY_i^2 + SCTR_i^2 + YR_i^2)$$

$$\text{s. t. } E_i = \sum_k w_k^E v_k^E(x_{ik}^E)$$

$$S_i = \sum_k w_k^S v_k^S(x_{ik}^S)$$

$$G_i = \sum_k w_k^G v_k^G(x_{ik}^G)$$

$$E_i + S_i + G_i + CTRY_i + SCTR_i + YR_i + s_i^+ - s_i^- = ESG_i$$

$$\mathbf{w}^E, \mathbf{w}^S, \mathbf{w}^G, s^\pm \geq 0, CTRY, SCTR, YR \in \mathbb{R}$$

# Optimization-based model estimation

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$$G_i = \sum_k w_k^G v_k^G(x_{ik}^G)$$

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Squared error

# Optimization-based model estimation

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$$E_i + S_i + G_i + CTRY_i + SCTR_i + YR_i + s_i^+ - s_i^- = ESG_i$$

$$\mathbf{w}^E, \mathbf{w}^S, \mathbf{w}^G, s^\pm \geq 0, CTRY, SCTR, YR \in \mathbb{R}$$

Regularization to  
improve robustness

# Optimization-based model estimation

- From a sample of  $n$  firms with given ESG scores  $ESG_1, \dots, ESG_n$

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$$G_i = \sum_k w_k^G v_k^G(x_{ik}^G)$$

Specification of the  
pillars' scores

$$E_i + S_i + G_i + CTRY_i + SCTR_i + YR_i + s_i^+ - s_i^- = ESG_i$$
$$\mathbf{w}^E, \mathbf{w}^S, \mathbf{w}^G, s^\pm \geq 0, CTRY, SCTR, YR \in \mathbb{R}$$



# Optimization-based model estimation

- From a sample of  $n$  firms with given ESG scores  $ESG_1, \dots, ESG_n$

$$\min \sum_{i=1}^n (s_i^+ + s_i^-)^2 + \|\mathbf{w}^E\|_2^2 + \|\mathbf{w}^S\|_2^2 + \|\mathbf{w}^G\|_2^2 + \sum_{i=1}^n (CTRY_i^2 + SCTR_i^2 + YR_i^2)$$

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$$E_i + S_i + G_i + CTRY_i + SCTR_i + YR_i + s_i^+ - s_i^- = ESG_i$$

$$\mathbf{w}^E, \mathbf{w}^S, \mathbf{w}^G, s^\pm \geq 0, CTRY, SCTR, YR \in \mathbb{R}$$

Constraints for the  
specification of the errors

# The three pillars of ESG

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The term ESG encompasses the wide set of environmental, social and corporate governance considerations.

**ENVIRONMENT:** , living and non-living natural systems, including land, air, water and ecosystems

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**SOCIAL:** rights of individuals and the well-being of the communities

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**GOVERNANCE:** decision-making processes, management practices and corporate governance structure

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# Environmental criteria (1/2)

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<b>no</b>	<b>Category</b>	<b>Index name</b>	<b>Definition</b>
<b>1</b>	Emissions	CO2 Equivalent Emissions Total To Revenues	Total Carbon dioxide (CO2) and CO2 equivalents emission divided by net sales in US dollars in million
<b>2</b>	Emissions	ISO 14000 or EMS	Does the company claim to have an ISO 14000 or EMS certification?
<b>3</b>	Emissions	Biodiversity Impact Reduction	Does the company report on its impact on biodiversity or on activities to reduce its impact on the native ecosystems and species, as well as the biodiversity of protected and sensitive areas?
<b>4</b>	Resource use	Total Energy Use To Revenues USD in million	Total direct and indirect energy consumption in gigajoules divided by net sales or revenue in US dollars in million.

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# Environmental criteria (2/2)

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<b>5</b>	Resource use	Land use	Does the company report on initiatives to reduce the environmental impact on land owned, leased or managed for production activities or extractive use?
<b>6</b>	Resource use	Policy Environmental Supply Chain	Does the company have a policy to include its supply chain in the company's efforts to lessen its overall environmental impact?
<b>7</b>	Resource use	Toxic Chemicals Reduction	Does the company report on initiatives to reduce, reuse, substitute or phase out toxic chemicals or substances?
<b>8</b>	Resource use	Policy Sustainable Packaging	Does the company have a policy to improve its use of sustainable packaging?

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# Social criteria (1/2)

<b>no</b>	<b>Category</b>	<b>Index name</b>	<b>Definition</b>
<b>1</b>	Workforce	Policy Employee Health & Safety	Does the company have a policy to improve employee health & safety?
<b>2</b>	Workforce	Policy Supply Chain Health & Safety	Does the company have a policy to improve employee health & safety in its supply chain?
<b>3</b>	Workforce	Supply Chain Health & Safety Improvements	Does the company show through the use of surveys or measurements that it is improving the level of employee health & safety in its supply chain?
<b>4</b>	Workforce	Training and Development Policy	Does the company have a policy to support the skills training or career development of its employees?
<b>5</b>	Workforce	Policy Diversity and Opportunity	Does the company have a policy to drive diversity and equal opportunity?

# Social criteria (2/2)

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<b>6</b>	HR	Policy Human Rights	Does the company have a policy to ensure the respect of human rights in general?
<b>7</b>	Product responsibility	Policy Data Privacy	Does the company have a policy to protect customer and general public privacy and integrity?
<b>8</b>	Product responsibility	Policy Responsible Marketing	Does the company have a policy on responsible marketing ensuring protection of children?
<b>9</b>	Product responsibility	Healthy Food or Products	Does the company reportedly develop or market products and services that foster specific health and safety benefits for the consumers (healthy, organic or nutritional food, safe cars, etc.)?
<b>10</b>	Product responsibility	ISO 9000	Does the company claim to have an ISO 9000 certification or any industry specific certification (QS-9000-automotive, TL 9000-telecommunications, AS9100-aerospace, ISO/TS 16949-automotive, etc.)?
<b>11</b>	Product responsibility	Product Responsibility Monitoring	Does the company monitor the impact of its products or services on consumers or the community more generally?

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# Governance criteria

no	Category	Index name	Definition
1	Management	Policy Board Independence	Does the company have a policy regarding the independence of its board?
2	Management	Audit Board Committee	Does the company have an audit board committee?
3	Management	Policy Board Experience	Does the company have a policy regarding the adequate experience on its board?
4	Shareholders	Policy Shareholder Engagement	Does the company have a policy to facilitate shareholder engagement, resolutions or proposals?
5	Shareholders	Director Election Majority Requirement	Are the company's board members generally elected with a majority vote?
6	CSR strategy	CSR Sustainability External Audit	Does the company have an external auditor of its CSR/H&S/Sustainability report?

# APPLICATION: DATA

- The multi-criteria methodology was used to examine ESG criteria that are considered appropriate to generate an ESG index for each industry.
  - Data base: Thomson Reuters
  - YEARS 2007 – 2019
  - 16 Industries
  - 39 Countries



# SAMPLE

Country	Count	Country	Count	Country	Count	INDUSTRY	Sample size
Argentina	41	Mexico	127	Denmark	204	A - Agriculture, forestry and fishing	177
Australia	711	Netherlands	258	Finland	260	B - Mining and quarrying	1379
Austria	127	New Zealand	55	France	872	C - Manufacturing	6871
Belgium	156	Norway	216	Germany	642	D - Electricity, gas, steam and air conditioning supply	1035
Brazil	196	Philippines	101	Greece	87	E - Water supply; sewerage; waste management; remediation activities	150
Canada	783	Poland	129	Hong Kong	576	F - Construction	393
Chile	69	Portugal	72	India	405	G - Wholesale and retail trade	809
China	287	Russia	253	South Africa	559	H - Transporting and storage	901
Colombia	71	Singapore	172	South Korea	543	I - Accommodation and food service activities	193
Indonesia	139	Taiwan	493	Spain	405	J - Information and communication	1254
Italy	360	Thailand	221	Sweden	389	K - Financial and insurance activities	2338
Japan	1507	Turkey	178	Switzerland	450	L - Real estate activities	954
Malaysia	195	UK	1380	US	3328	M - Professional, scientific and technical activities	161
						N - Administrative and support service activities	219
						Q - Human health and social work activities	91
						R - Arts, entertainment and recreation	92

# RESULTS: WEIGHTS FOR PILLAR E

INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Q	R	AVG
<b>CO2 Equivalent Emissions Total / Revenues</b>	0.059	0.026	0.046	0.084	0.032	0.112	0.058	0.000	0.011	0.167	0.010	0.093	0.078	0.069	0.008	0.085	0.059
<b>Total Energy Use To Revenues USD in million</b>	0.000	0.024	0.009	0.044	0.045	0.061	0.000	0.093	0.000	0.000	0.038	0.073	0.089	0.085	0.103	0.024	0.043
<b>ISO 14000 or EMS</b>	0.076	0.033	0.063	0.076	0.128	0.000	0.009	0.031	0.043	0.022	0.060	0.018	0.071	0.082	0.077	0.055	0.053
<b>Biodiversity Impact Reduction</b>	0.014	0.050	0.041	0.075	0.046	0.038	0.025	0.047	0.059	0.027	0.005	0.060	0.081	0.004	0.000	0.016	0.037
<b>Land use</b>	0.047	0.034	0.025	0.034	0.000	0.055	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.056	0.016
<b>Policy Environmental Supply Chain</b>	0.059	0.048	0.056	0.062	0.049	0.107	0.064	0.032	0.088	0.049	0.076	0.076	0.071	0.085	0.083	0.017	0.064
<b>Toxic Chemicals Reduction</b>	0.113	0.000	0.025	0.046	0.030	0.042	0.016	0.044	0.066	0.011	0.029	0.000	0.017	0.021	0.070	0.067	0.037
<b>Policy Sustainable Packaging</b>	0.028	0.000	0.027	0.002	0.000	0.021	0.061	0.000	0.003	0.032	0.000	0.039	0.000	0.000	0.074	0.011	0.019
<b>SUM</b>	0.396	0.214	0.291	0.423	0.330	0.437	0.232	0.247	0.270	0.317	0.220	0.358	0.407	0.347	0.415	0.330	0.327

# RESULTS: WEIGHTS FOR PILLAR S

INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Q	R	AVG
Policy Employee Health & Safety	0.069	0.023	0.025	0.070	0.069	0.081	0.025	0.048	0.018	0.033	0.042	0.030	0.093	0.007	0.051	0.078	0.048
Policy Supply Chain Health & Safety	0.047	0.022	0.034	0.006	0.000	0.027	0.032	0.048	0.050	0.027	0.050	0.032	0.052	0.000	0.004	0.080	0.032
Supply Chain Health & Safety Improvements	0.000	0.054	0.000	0.000	0.000	0.124	0.024	0.007	0.001	0.000	0.000	0.000	0.000	0.081	0.000	0.000	0.018
Training and Development Policy	0.062	0.087	0.072	0.038	0.012	0.062	0.104	0.070	0.097	0.108	0.059	0.058	0.031	0.032	0.000	0.126	0.064
Policy Diversity and Opportunity	0.034	0.040	0.043	0.055	0.005	0.012	0.040	0.043	0.070	0.043	0.048	0.020	0.000	0.049	0.000	0.035	0.034
Policy Human Rights	0.054	0.082	0.065	0.047	0.112	0.032	0.045	0.054	0.031	0.082	0.054	0.055	0.073	0.060	0.036	0.001	0.055
Policy Data Privacy	0.031	0.030	0.030	0.004	0.015	0.028	0.055	0.055	0.050	0.023	0.077	0.053	0.006	0.000	0.086	0.030	0.036
Policy Responsible Marketing	0.000	0.065	0.031	0.019	0.000	0.000	0.018	0.000	0.000	0.046	0.000	0.038	0.000	0.071	0.000	0.020	0.019
Healthy Food or Products	0.000	0.000	0.020	0.030	0.000	0.035	0.046	0.022	0.029	0.000	0.000	0.027	0.000	0.000	0.054	0.000	0.016
ISO 9000	0.071	0.035	0.019	0.033	0.030	0.010	0.000	0.036	0.069	0.021	0.046	0.015	0.044	0.072	0.034	0.000	0.033
Product Responsibility Monitoring	0.040	0.041	0.050	0.027	0.074	0.000	0.047	0.072	0.032	0.045	0.021	0.005	0.073	0.038	0.076	0.047	0.043
<b>SUM</b>	<b>0.407</b>	<b>0.479</b>	0.390	0.329	0.317	<b>0.410</b>	<b>0.436</b>	<b>0.456</b>	<b>0.446</b>	<b>0.428</b>	0.397	0.334	0.372	<b>0.411</b>	0.341	0.417	0.398

# RESULTS: WEIGHTS FOR PILLAR G

	INDEX	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Q	R	AVG
	<b>Audit Committee NonExecutive Members</b>	0.026	0.090	0.043	0.025	0.023	0.009	0.141	0.099	0.080	0.035	0.004	0.052	0.000	0.034	0.026	0.015	0.044
	<b>Audit Committee Independence</b>	0.000	0.047	0.068	0.032	0.159	0.056	0.047	0.031	0.040	0.064	0.101	0.089	0.071	0.099	0.091	0.100	0.068
	<b>Policy Board Independence</b>	0.029	0.028	0.030	0.050	0.000	0.000	0.013	0.009	0.032	0.033	0.027	0.005	0.020	0.000	0.000	0.120	0.025
	<b>Audit Board Committee</b>	0.000	0.000	0.040	0.000	0.037	0.002	0.018	0.000	0.000	0.000	0.109	0.000	0.000	0.000	0.000	0.000	0.013
G	<b>Policy Board Experience</b>	0.001	0.014	0.026	0.026	0.020	0.005	0.000	0.048	0.007	0.000	0.031	0.027	0.032	0.000	0.076	0.000	0.019
	<b>Policy Shareholder Engagement</b>	0.004	0.033	0.025	0.029	0.025	0.000	0.019	0.025	0.033	0.038	0.021	0.037	0.039	0.022	0.000	0.000	0.022
	<b>Director Election Majority Requirement</b>	0.071	0.043	0.034	0.020	0.088	0.029	0.012	0.029	0.068	0.049	0.034	0.019	0.058	0.057	0.016	0.000	0.039
	<b>CSR Sustainability External Audit</b>	0.066	0.052	0.052	0.066	0.001	0.054	0.082	0.056	0.024	0.035	0.056	0.080	0.000	0.030	0.036	0.017	0.044
	<b>SUM</b>	0.197	0.307	0.319	0.247	0.353	0.153	0.331	0.297	0.284	0.255	0.384	0.308	0.221	0.242	0.245	0.253	0.275

# AVF REGRESSION **VS** Bootstrap Analysis

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Q	R	AVERAGE
E	0.395	0.223	0.294	0.423	0.327	0.417	0.239	0.244	0.276	0.314	0.214	0.369	0.420	0.347	0.408	0.349	0.329
S	0.399	0.472	0.390	0.327	0.320	0.406	0.439	0.457	0.439	0.428	0.403	0.325	0.366	0.396	0.338	0.394	0.394
G	0.207	0.305	0.316	0.250	0.352	0.177	0.322	0.299	0.285	0.258	0.383	0.306	0.214	0.257	0.253	0.257	0.278
E	0.396	0.214	0.291	0.423	0.330	0.437	0.232	0.247	0.270	0.317	0.220	0.358	0.407	0.347	0.415	0.330	0.327
S	0.407	0.479	0.390	0.329	0.317	0.410	0.436	0.456	0.446	0.428	0.397	0.334	0.372	0.411	0.341	0.417	0.398
G	0.197	0.307	0.319	0.247	0.353	0.153	0.331	0.297	0.284	0.255	0.384	0.308	0.221	0.242	0.245	0.253	0.275

# RESULTS: $R^2$ (Coefficient of determination)

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A	B	C	D	E	F	G	H	I	J	K	L	M	N	Q	R
0.948	0.844	0.819	0.875	0.907	0.873	0.879	0.843	0.927	0.807	0.819	0.832	0.916	0.914	0.936	0.958

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# Conclusions & Future directions

- This is the first time that a multi-criteria methodology has been used to explain the importance of criteria and decisions in ESG investment
- The results were considered very satisfactory in relation to the previous research and the efficiency indicators of the model ( $R^2$  )
- Social criteria seem more important, this makes sense as CSR is the first in history to concern businesses.
- The pillar environment is also emerging as an important sign that climate change is now influencing business decisions.
- In the coming years, the pillar of governance will play an important role in the top management.

# Conclusions & Future directions

- We will get an index per pillar
- We will compare our model with other classic models of data analysis
- We will distinguish the countries in developed economies and transition economies
- We will compare the ESG index with the financial performance



#NEWBOOK

Διαθέσιμο από τις εκδόσεις Κλειδάριθμος

ΕΚΔΟΣΕΙΣ ΚΛΕΙΔΑΡΙΘΜΟΣ

Καθηγητής **Κωνσταντίνος Ζοπουνίδης**, *Ακαδημαϊκός*  
Υποψήφια Δρ **Μαριάννα Εσκαντάρ**

## Κοινωνικά Υπεύθυνη Επένδυση: Μέθοδοι και Κριτήρια ESG



- **THANK YOU FOR YOUR ATTENTION**