ESG INDEX 2019 BY GRP

Technical Methodology

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The ESG Index (Environmental, Social and Governance Index) or ESGI is a composite measure offering a classification of exogenous risks by country with regards to the environment, human rights and health & safety. This index was built in the framework of a more general risk mitigation plan, compliant with international recommendations and current binding legal requirements, such as the French law "Devoir de Vigilance".

This technical methodology is meant to provide all necessary information for understanding the variables used and their respective impact in rankings.

1- Indicators and Data Overview

The ESGI is based on 45 variables that are exclusively borrowed from internationally recognized entities. The ESGI is divided into 3 independent sub-indexes as presented below.

The Environment sub-index covers 180 countries and displays two indicators:

- o (1) Ratification Status
- o (2) Environmental Performance Index

The Human Rights sub-index covers 189 countries and comprises 4 indicators:

- o (1) Ratification Status of Conventions
- o (2) Social Rights
- o (3) Civil and Political Rights
- o (4) Collective Rights.

The last sub-index focuses on Health & Safety and provides a result for 184 countries. It is divided into 3 indicators:

- o (1) Health
- o (2) Safety
- o (3) Inequality by Residential Area

177 countries and territories are scored in all three sub-indexes and are therefore included in the global scoring of the ESG Index

Table 1 Levels of aggregation

ESG Index

Index	ESG Index		
Weight	0.3	0.5	0.2
Sub-index	Env.	Human Rights	Health & Safety
Weight	0.3 / 0.7	0.25 / 0.35 / 0.25 / 0.15	0.4 / 0.4 / 0.2

Indicator level (top): Human Rights → Social Rights, Civil and Political Rights, Collective Rights; Health & Safety → Health Indicators, Safety Indicators

Sub-index	Indicator (weight)	Sub-indicator (weight)	Variable weight	Variable Ref.
Env.	Ratification Status of the Kyoto Protocol and Paris Agreement (0.3)		0.3	V1
Env.			0.7	V2
Env.	Environment Performance Index (0.7)		/	V3
Human Rights — Social Rights	Ratified treaties, reporting compliance and standing invitations (0.25)		0.55	V4
			0.15	V5
			0.15	V6
			0.15	V7
Human Rights — Social Rights (0.35)	Labor Rights (0.5)		0.1	V8
			0.15	V9
			0.1	V10
			0.2	V11
			0.2	V12
			0.1	V13
			0.15	V14
	Education (0.15)		0.7	V15
			0.3	V16
	Housing (0.15)		0.5	V17
			0.5	V18
	Gender Equality (0.2)		/	V19
	Public Affairs Investment (0.1)		/	V20
	Press Freedom (0.1)		/	V21
Human Rights — Civil and Political Rights (0.25)	Factionalized Elites (0.3)		/	V22
	Group Grievance (0.3)		/	V23
	Prohibition of Discrimination & Minority Rights (0.4)		0.8	V24
	Perceptions		0.2	V25
	Personal Freedom (0.2)		/	V26
	Political Rights and Civil Liberties Index (0.3)		/	V27
Human Rights — Collective Rights (0.15)	Gobal Peace Index (0.7)		/	V28
	Right to Self Determination (0.3)		0.3	V29
			0.7	V30
Health & Safety — Health Indicators (0.4)	Medical Care (0.35)		0.5	V31
			0.5	V32
	Life Expectancy (0.25)		0.4	V33
			0.6	V34
	Access to Food and Drinking Water (0.4)		0.65	V35
			0.35	V36
Health & Safety — Safety Indicators (0.4)	Safety at Work (0.5)		0.5	V37
			0.5	V38
	Social Security (0.5)	Social health Protection Coverage (0.4)	/	V39
		Unemployment Benefits (0.3)	/	V40
		Protection of Vulnerable Persons (0.3)	0.5	V41
			0.5	V42
Health & Safety (0.2)	Inequality by Residential Area		0.4	V43
			0.3	V44
			0.3	V45

The following table lists the data variables used to calculate the ESGI, together with their respective variable code.

Table 2 Data Overview

Sub-index	Ref.	Variable
Env.	V1	Ratification Status of the Kyoto Protocol
	V2	Ratification Status of the Paris Agreement
	V3	Envronmental Performance Index
Human Rights	V4	Ratification Status of 18 Human Rights Treaties
	V5	Overdue Reports (total)
	V6	5+ Years Overdue Reports
	V7	Standing Invitations
	V8	Income Inequality
	V9	Working Poverty Rate
	V10	Vulnerable Employment
	V11	Child Labour
	V12	Prohibition of Slavery
	V13	Human Trafficking Minimum Standards
	V14	Collective Rights at Work
	V15	Access to Education
	V16	Pupil-teacher ratio
	V17	Access to Electricity
	V18	Sanitation Services
	V19	Gender Inequality Index
	V20	Share of Seats in Parliament held by Women
	V21	Press Freedom
	V22	Factionalized Elites
	V23	Group Grievance
	V24	Migrants Acceptance Index
	V25	Freedom to Make Life Choices
	V26	Personal Freedom
	V27	Political Rights and Civil Liberties
	V28	Global Peace
	V29	Number of Conflicts for Autonomy and / or Secession
	V30	Intensity of Conflicts for Autonomy and / or Secession
Health & Safety	V31	Mortality Rate of Children
	V32	Maternity Mortality Ratio
	V33	Healthy Life Expectancy
	V34	Inequality Adjusted Life Expectancy
	V35	Undernourishment
	V36	Drinking Water Services
	V37	Non-fatal Occupational Injuries
	V38	Fatal Occupational Injuries
	V39	Social Health Protection Coverage
	V40	Unemployment Benefits
	V41	Population Above Statutory Pensionable Age Receiving Age Pension
	V42	Mandatory Paid Maternity Leave
	V43	Inequlity by Residential Area of Maternal Mortality Ratio
	V44	Inequlity by Residential Area of Health Care Coverage Deficit
	V45	Inequlity by Residential Area of Staff Access Deficit

A number of criteria were considered during the selection process:

- All data variables are linked to the measures of environment, human rights and health & safety, either directly or indirectly.

- In order to ensure cross-country comparability, no country specific information is considered. Such data would generate valuations relying on different bases / concepts, which is unsuitable for rankings

- Data sources with limited coverage are set aside, except in the case of a high explanation power. The two variables displaying the highest number of missing values are V37 *Non-fatal Occupational Injuries* (34.2% of country coverage) and V38 *Fatal Occupational Injuries* (35.3% of country coverage)[1]. With the objective to measure health & safety risks, injuries at work are of primary importance. In this context and considering the absence of other similar measures, both variables were kept in the analysis.

- Although some variables have wider coverage than others, none of them are limited to a specific cluster of countries. This decision is meant to guarantee that each variable offers a data set with scattered points across the full spectrum of possibilities

- During the selection process, preference is given to quantitative type of data. Qualitative information is also considered if and only if the transitivity axiom is ultimately satisfied

2- Missing Data

Several methods exist to deal with missing values, which can be grouped into two types of treatments: deletion - such as listwise deletion (complete-case analysis) and simple case deletion - or imputation.

Considering that most of our missing data is either of type MAR (Missing at Random) or MNAR (Missing not at Random), deletion is hardly appropriate and would lead to biased estimates.

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[1] The coverage rate considered is that obtained after the imputation processes based on real values, that is the linear extrapolation from the five available years and / or the LOCF, if applicable.

The processing of missing data is thus handled on a case-by-case basis depending on the structure of the datasets:

2.1- Imputation

First, in the case of time series datasets with visible trends, we proceed with a linear extrapolation from the five last available years. This method allows to estimating parameters based on real past values.

The second approach used is the method of the Last Observation Carried Forward (LOCF), which is a common statistical approach for time series data that consists in imputing the last available observation. Similar to the first method, only the last five available years are considered.

The two above-mentioned methods are selected to be based on known values that are specific to the countries, and consequently true at a point in time. In most cases, such methods can't be applied because no current nor past value is available. In these cases, we consider a third imputation method: Predictive Mean Matching (PMM) with multiple imputation.

Single imputation provides only one parameter estimate for each missing value and omits possible alternatives. It therefore tends to underestimate the standard errors and consequently overestimate the validity of the estimated scoring. As opposed to single imputation, multiple imputation provides *n* different possibilities for each missing value. These *n* possibilities allow for two desirable outputs:
-   First, each imputed value results from the pooling of the *n* parameter estimates, thus providing a better approximation of the true value
-   Second and more importantly, multiple imputation allows for measures of uncertainty, by sampling *n* times from the posterior predictive distribution.

As previously mentioned, the selected method of multiple imputations is that of Predictive Mean Matching (PMM). This approach allows us to preserve the distributions in the data and ensures that imputed values are plausible as it fills in values from real observations (Vink et al., 2014[2]). PMM provides a random value from a donor, based on the closeness of the regression-predicted values of the donor $\hat{\beta}$, with that of the recipient β^*. This implies that

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[2] Vink, G., Frank, L. E., Pannekoek, J., and van Buuren, S. (2014). Predictive mean matching imputation of semicontinuous variables. Statistica Neerlandica. 68(1). 61-90

linear regressions are not used to generate imputed values but rather to determine the donor (Schenker, N. & Taylor, J.M.G., 1996[3]).

The process by which PMM is performed is as follows (Vink et al., 2014[4]):

1. First, an Ordinary Least Squares (OLS) linear regression of γ given the selected predictors χ is performed to obtain the parameter estimates $\hat{\beta}$, $\hat{\sigma}^2$ and $\hat{\varepsilon}$, respectively the regression coefficient, the variance and the random error

2. In a second step, random draws of σ^{2*} and β^* are performed based on the posterior predictive distributions to provide new sets of coefficients. These draws allow for the calculation of $\hat{\gamma}_{missing}$

3. Predicted values are then generated by calculating $\hat{\gamma}$ for both cases with values (potential donors) and missing values (recipients), using the parameter estimates $\hat{\beta}$ and β^* respectively

4. The closeness of predicted values between donors and recipients is evaluated, so as to identify the three cases which minimizes $|\hat{\gamma}_{observed} - \hat{\gamma}_{missing}|$

5. Missing values are substituted from a random donor among those that satisfy the minimization criteria of the previous step.

6. Considering this index uses PMM for multiple imputation, the process starting from the random draws of σ^{2*} and β^* to the final imputation is repeated n times, in order to provide n complete datasets with n possible values for each missing case

2.2- Case Deletion

For some variables, no PMM imputation was performed and only true values were considered in the analysis. This is due to the structure of the data and the absence of correlation with other variables. In the case of a missing value, the algorithm proportionally redistributes the according weight to variables measuring the same indicator.

The variables with missing values are the following:

1. Income Inequality
2. Migrant Acceptance Index

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[3] Schenker, N., & Taylor, J. M. G. (1996). Partially parametric techniques for multiple imputation. Computational Statistics & Data Analysis, 22(4), 425–446

[4] Vink, G., Frank, L. E., Pannekoek, J., and van Buuren, S. (2014). Predictive mean matching imputation of semicontinuous variables. Statistica Neerlandica. 68(1). 61-90

3. Freedom to Make Life Choices
4. Non-fatal Occupational injuries
5. Fatal Occupational injuries
6. Mandatory Paid Maternity Leave
7. Inequality by Residential Area of Health Care Deficit

Despite the process described above, some missing values remained. A redistribution of weights is thus also performed between indicators. The concerned indicators are the following:
1. Perception (Prohibition of Discrimination & Minority Rights)
2. Public Affairs Investment
3. Safety at Work

3- Standardization

Aside from binary variables, all datasets were tested for skewness, then transformed and recoded if necessary. The mean and standard deviation is calculated and all variables are then standardized, to allow for a proper aggregation in the global scoring. Several normalization methods exist. The one used here is that of z-scores, which converts datasets to a common scale with a mean of zero and a standard deviation of one, as follows:

$$I_{i,c} = \frac{X_{i,c} - X_{i,\bar{c}}}{\sigma_{\bar{c}}}$$

with:
ι = variable
c = country
$\bar{c}$ = reference country
σ = standard deviation

4- Aggregation

The aggregation process converts all data points to a scale of 0-100, where 0 represents the lowest risk, and 100 corresponds to the highest risk. Country scores are then calculated for each sub-index (Environment, Human Rights and Health & Safety) using an arithmetic mean and following the weights previously presented (table 1).

In order to provide a unique risk score encompassing all three measures, scores by sub-index are eventually aggregated using a weighted geometric mean.

5- Measure of Uncertainty

Based on the *n* datasets obtained from the multiple imputation process, a standard error and a 90 percent confidence interval are calculated for each dataset to reflect the variance around the different scores.