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Sustainability Evaluation Model: a composite index to measure country sustainability

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Abstract

Achieving a sustainable development, defined by Brundtland in 1987 as «…the development that meets the needs of the present without compromising the ability of future generation to meet their own needs», is one of the major concerns of modern societies.
In the last years, a comprehensive assessment of sustainability has become crucial to measure progress, identify areas to be addressed and evaluate the outcome of implemented policies.
For this reason the Sustainability Evaluation Model, a composite index including 36 indicators, has been built to measure the level of sustainability of a nation referring to the four main dimensions: economic, social, environmental and institutional. The final structure derives from a detailed analysis of the already existing models concerning all the sustainability aspects, built based on the framework of the FEEM Sustainability Index of Fondazione ENI Enrico Mattei.
The Mediterranean area, a context characterized by different socio-political scenarios, has been selected to calibrate the proposed index.
First a normalization procedure has been applied in order to standardize heterogeneous measurements units. Furthermore various weighting and aggregation methods have been used to assess the importance of each indicator, in particular great relevance has been given to weights obtained by experts' judgments through an ad-hoc questionnaire. In order to treat the experts' answers, the Analytic Hierarchy Process (AHP) methodology has been used.
The results of the Sustainability Evaluation Model have allowed to trace the sustainability profiles of the countries of the application context, including scores and relative ranks based on the different weighting and aggregation methods. Finally, robustness and correlation analysis has been performed to assess the validity of the model.
The final goal is to provide not a simple picture of the analyzed context, but a robust framework which could be applied to different areas, able to highlight strengths and weaknesses concerning the sustainability.

Keywords: Sustainable Development; Sustainability Index; Composite Indicators; Analytic Hierarchy Process (AHP) Method.

Sommario

Conseguire uno sviluppo sostenibile, definito da Brundtland nel 1987 come «…lo sviluppo che soddisfa i bisogni del presente senza compromettere la possibilità delle generazioni future di soddisfare i propri», è una delle questioni principali delle società moderne.
Negli ultimi anni, la valutazione della sostenibilità ha acquisito un'importanza notevole per misurare il progresso, identificare le aree in cui intervenire e valutare l'efficacia delle politiche sviluppate.
Per questa ragione è stato creato il Sustainability Evaluation Model, un indice composito che comprende 36 indicatori, capace di misurare il livello di sostenibilità di una nazione sulla base delle quattro dimensioni principali: economica, sociale, ambientale e istituzionale. La struttura finale è il risultato di un'analisi dettagliata dei modelli già presenti in letteratura che trattano aspetti di sostenibilità, costruita sulla base dello scheletro del FEEM Sustainability Index, della Fondazione ENI Enrico Mattei.
Per calibrare l'indice proposto, è stata scelta l'area del Mediterraneo, un contesto caratterizzato da scenari socio-politici variegati.
Per prima cosa i dati sono stati normalizzati al fine di omogeneizzare unità di misura differenti. Successivamente sono stati usati diversi metodi di pesatura e aggregazione per valutare l'importanza di ogni indicatore, in particolare è stato dato rilievo ai pesi ottenuti da giudizi di esperti attraverso un questionario specifico. Per elaborare le risposte degli esperti, è stata utilizzata la metodologia dell'Analytic Hierarchy Process (AHP).
I risultati del Sustainability Evaluation Model hanno permesso di tracciare i profili di sostenibilità dei paesi del contesto di applicazione, riportando i punteggi e le relative classifiche basate sui diversi metodi di pesatura e aggregazione. Infine, sono state eseguite analisi di robustezza e correlazione per valutare la validità del modello.
L'obiettivo finale non è quello di fornire una semplice fotografia del contesto analizzato, ma una struttura solida, applicabile ad aree differenti e capace di mettere in luce i punti di forza e debolezza per quanto riguarda il tema della sostenibilità.

Parole Chiave: Sviluppo Sostenibile; Indice di Sostenibilità; Indicatori Compositi; Metodo Analytic Hierarchy Process (AHP).

1. Introduction

In this thesis, an index able to measure the level of sustainability of a nation through a model based on the four main pillars - economic, social, environmental and institutional – is presented.
A comprehensive framework has thus been built, consisting of a limited number of selected indicators based on a standardized and transparent methodology, able to represent in the best possible way the above-mentioned dimensions. The structure of the FEEM Sustainability Index, recently published by Fondazione ENI Enrico Mattei, has been the initial reference for the proposed index.

Achieving a sustainable development is one of the major concerns of modern societies, which have long been interested in understanding and governing the multi-faceted issue of development, those making a comprehensive assessment of sustainability crucial to measure progress, identify areas to be addressed and evaluate the outcome of implemented policies. [1]

Sustainable development is a fluid concept and various definitions have emerged over the past two decades. The most used was given by Brundtland in 1987 as *"Sustainable development is development that meets the needs of the present without compromising the ability of future generation to meet their own needs*". [2]

Despite an on-going debate on the actual meaning, a few common principles tend to be emphasized. The first is a commitment to equity and fairness, in that priority should be given to the improving the conditions of the world's poorest and decisions should account for the rights of future generations. The second is a long-term view that emphasizes the precautionary principle, i.e., "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (Rio Declaration on Environment and Development, Principle 15). Third, sustainable development embodies integration, and understanding and acting on the complex interconnections that exist between the environment, economy, society and institutions. This is not a balancing act or a playing of one issue off against the other, but recognizing the interdependent nature of these four pillars.

Sustainable development is also a prominent component of the Millennium Development Goals, which have been widely endorsed by national governments and the world's foremost development organizations since they were adopted at the Millennium Summit in 2000. [3] Considering that the Millennium Development Goals have been planned with the target date of 2015, United Nations are nowadays working on a global development agenda beyond 2015, with sustainable development at its core. [4]

The idea of indicators to describe the sustainable development concept appeared in the World Conference on the Environment — Rio 92, in one of its final documents, Agenda 21 that registers in chapter 40: *"Commonly used indicators such as the gross national product (GNP) and measurements of individual resource or pollution flows do not provide adequate indications of sustainability. Methods for assessing interactions between different parameters (environmental, demographic, social and developmental) are not sufficiently developed or applied. Indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems"* (United Nations, 1992). The proposal was to define sustainable standards of development that considered ambient, economic, social, ethical and cultural aspects; for this, it became necessary to define indicators that could measure and evaluate all the important aspects of the question. [5]

Thanks to a specific research described in Chapter 2, it has been possible to observe that in literature many indexes dealt with the different aspects of sustainability, but only few handled this concept in an exhaustive way. Moreover some models were composed by too many and unnecessary indicators while others were too simplified.

In order to assess which was the best among the already existing indexes concerning the sustainable development concept, in Chapter 4 a comparison using the Analytic Hierarchy Process (AHP) method, which is explained in Chapter 3, has been performed. The best model of this analysis is not a real one, but a theoretical one built grouping the best indexes for the economic, social and environmental dimensions.

Therefore, the best resulting index, named Best Dimensions Model, has been the starting point for the construction of a proper composite index, which considered all the aspects of the sustainability. The framework of the proposed index, called Sustainability Evaluation Model, is shown in Chapter 5.

The methodology for the construction of the Sustainability Evaluation Model, which follows to the guidelines established by the Organization for Economic Co-operation and Development (OECD) [6] and the Joint Research Centre of the European Commission[7], is presented in Chapter 6. In particular the imputation of missing data, the normalization procedure, the weighting and aggregation methods have been performed.

Chapter 7 describes the Mediterranean region, chosen as context of application due to its characteristic to represent the meeting point of different realities regarding the sustainability concept.

Finally, the results of the Sustainability Evaluation Models and the relative analysis are shown in Chapter 8. In detail a geographic-theme analysis, single countries' profiles and a specific focus on Egypt and Italy are reported. Moreover, Chapter 9 presents a sensitivity analysis performed through the robustness and the correlation analysis, and the comparisons with other significant indexes.

The final goal of this thesis is the construction of a robust framework, able to describe in a proper and complete way the sustainable development concept. Regardless of the scores, obtained through arbitrary choices as the weighting or the aggregation methodologies, the Sustainability Evaluation Model represents a reliable structure for the evaluation of the sustainability level of a nation. In fact the proposed index has not to be interpreted as a simple picture of the analyzed context, but as a useful framework, which could be applied to different scenarios and potentially implemented when updated data and new developed indicators will be available. Furthermore, due to the ability to highlight the weakness and strengths of a country, the achieved results could also become a useful tool to promote proper policies and to check the coherence for the institutions.

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2. State of the Art

The aim of this chapter is to describe the most significant models existing in literature that deal with the sustainable development concept.
As specified in the Brundtland report (World Commission on Environment and Development, 1987), the concept of sustainable development comprises three aspects: economic, social and environment. Recently, a fourth dimension has been added: the institutional one. [1]

Therefore a research about indexes concerning these four sustainability dimensions has been carried out.
For this purpose, the main composite indexes has been selected from lists drafted by the United Nations Development Programme (UNDP)[2], the United Nations Commission on Sustainable Development (CSD)[3] and the Working Group on Environmental Information and Outlooks (WGEIO) of the Organization for Economic Co-operation and Development (OECD)[4]. Moreover also two scientific papers have been considered, in particular those ones written by Rajesh Kumar Singh, H.R. Murty, S.K. Gupta, A.K. Dikshit[5] and by Thomas M. Parris and Robert W. Kates[6].

Among the high number of indexes listed in the above-mentioned sources, 53 have been selected according to their representativeness, the affordability of the developers and their pertinence respect to the final goal of this thesis.
The first evident remark has been the heterogeneity of the models regarding the description of the sustainable development concept. In fact the majority of the models did not represent the sustainability in all its dimensions, but only in some particular aspects.
For this reason the following classification of the analyzed indexes has been made:

- Sustainability Indexes, which take into account all the four dimensions.
- Economic Indexes
- Environmental Indexes
- Social Indexes
- Socio-Economic-Institutional Indexes. In this category, indexes present indicators regarding two or three of these dimensions.
- Institutional Indexes
- Energy Indexes. This class does not represent a dimension among the traditional sustainability pillars, but it has been added for the importance of the theme respect to the sustainable development concept.
- Other Indexes. This category includes two types of models: some do not consider the four sustainability dimensions but include interesting sustainable development indicators, while others are meaningful, but applied to a local scale.

From a detailed analysis on the considered indexes, some general observations have emerged:

- (+) Frequent important topics for each dimension have been recognized in different models.
- (+) Interesting indicators, apparently minors, have been identified thanks to the diversification of the treated themes.

- (-) Presence of a high number of incomplete indexes from the whole sustainable development point of view: some considered only one dimension, some included too specific indicators, while in others, fundamental indicators according to the United Nations Commission on Sustainable Development (CSD) Theme Indicator Framework[7], were missing.
- (-) Some indexes are applied to a local scale and so not useful for the purpose of this thesis.
- (-) Variety of the authors which implies different perspectives about the sustainable development concept.
- (-) Diversity in the methodology used for the construction of the indexes.
- (-) Due to the inhomogeneity regarding the period of the models implementation and to the development of the sustainability meaning over the years, the analyzed indexes represent different needs.

In accordance with these remarks, the lack of a unique, complete, globally recognized and actual index, has emerged. Therefore it has occurred the necessity to construct a model which satisfied these aspects.

Below the analyzed indexes are listed, while in the APPENDIX B a more detailed description for each of them is reported, highlighting:

- the authors
- the composition year
- an abstract including a general description of the framework
- the weighting and aggregation methodologies used
- advantages and disadvantages obtained through a SWOT* analysis.

* SWOT analysis is a structured planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project. It operates specifying the objective of the project and identifying the internal and external factors that are favorable and unfavorable to achieving that objective. Strengths: characteristics of the project that give it an advantage over others; Weaknesses: characteristics that place the project at a disadvantage relative to others; Opportunities: elements that the project could exploit to its advantage; Threats: elements in the environment that could cause trouble for the project.

Sustainability Indexes

Table 2.1. Sustainability indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
FEEM Sustainability Index	Fondazione Eni Enrico Mattei	23	Weighted average
BCFN Index – Well Being Index	Barilla Center for Food & Nutrition	41	Weighted average
Index of Sustainable Society	Sustainable Society Foundation	24	Equally weighted average
Happy Planet Index (HPI)	Centre of Well-being at New Economics Foundation (NEF)	3	Equally weighted product
Composite Performance Index for Sustainability	Rajesh Singh, H.R. Murty, S.K. Gupta, A.K. Dikshit	60	Weighted average
Compass Index of Sustainability	Alan Atkisson and R. Lee Hatcher	4	Equally weighted average
Global Innovation Index (GII)	Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO)	84	Weighted average
Index of Human Insecurity (IHI)	Global Environmental Change and Human Security (GECHS) Project	16	Equally weighted average
Social Progress Index (SPI)	Social Progress Imperative	52	Equally weighted average
Weighted Index of Social Progress (WISP)	Richard J. Estes,University of Pennsylvania	40	Weighted average

Economic Indexes

Table 2.2. Economic indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
Internal Market Index (IMI)	European Commission	20	Weighted average
Index of Sustainable Economic Welfare (ISEW)	Herman Daly and John B. Cobb	7	Equally weighted sum
Genuine Savings Index	Pearce and Atkinson, in1993; Bohringer and Jochem, in 2007	6	Equally weighted sum
Economic Vulnerability Index (EVI)	Committee for Development Policy	8	Weighted average
Genuine Progress Indicator (GPI)	Marilyn Waring studies in the UN System of National Accounts and no profit association Redefining Progress	24	Equally weighted sum

Environmental Indexes

Table 2.3. Environmental indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
Environmental Sustainability Index (ESI)	Yale University and Columbia University	76	Equally weighted average
Environmental performance index (EPI)	Yale University and Columbia University, World Economic Forum and Joint Research Centre of the European Commission	22	Weighted average
Ecological Footprint (EF)	William Rees and Mathis Wackernagel	6	Equally weighted sum
Living Planet Index (LPI)	The World Wide Fund for Nature (WWF), Institute of Zoology (IoZ), the research division of the Zoological Society of London	3	Equally weighted average
Environmental Vulnerability Index (EVI)	South Pacific Applied Geoscience Commission (SOPAC) and United Nations Environment Program	50	Weighted average

Social Indexes

Table 2.4. Social indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
Human Development Index (HDI)	Mahbub ul Haq, Amartya Sen, United Nations Development Programme (UNDP)	4	Equally weighted geometric average
Inequality–Adjusted Human Development Index	Foster, Lopez-Calva and Szekely United Nations Development Programme (UNDP)	3	Equally weighted geometric average
Gender Inequality Index (GII)	United Nations Development Programme (UNDP)	5	Equally weighted geometric average
Multidimensional Poverty Index (MPI)	Oxford Poverty & Human Development Initiative and the United Nations Development Programme (UNDP)	10	Weighted average
Gini Index	Gini Corrado	2	Equally weighted ratio
Well-being Index	Gallup – Healthways	6	Equally weighted average
Overall Health System Attainment	World Health Organization (WHO)	5	Weighted average
Human Poverty Index (HPI 1-2)	United Nations (UN)	4	Equally weighted average
Index of Human Progress	Fraser Institute (Canada)	5	Equally weighted average

Socio-Economic-Institutional Indexes

Table 2.5. Socio-Economic-Institutional indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
Global Competitiveness Index (GCI)	World Economic Forum	91	Equally weighted average
CSGR Globalization Index	University of Warwick	16	Weighted average
Innovation Union Scoreboard (IUS) and Summary Innovation Index (SII)	European Commission, under the Lisbon Strategy	25	Weighted average
Country Policy and Institutional Assessment (CPIA)	World Bank	16	Equally weighted average

Institutional Indexes

Table 2.6. Institutional indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
Bertelsmann Transformation Index (BTI)	Bertelsmann Stiftung Foundation	49	Equally weighted average
Index of Social Vulnerability to Climate Change	Tyndall Centre for Climate Change Research and School of Environmental Sciences University of East Anglia	5	Weighted average
The Political Risk Services Index	Political Risk Services (PRS) group	23	Weighted sum
Political Rights and Civil Liberties Ratings	Freedom House	25	Equally weighted sum
Institutional Environment and Sovereign Credit Ratings	Butler Alexander W. and Fauver Larry	17	Equally weighted average
Democracy Index	Economist Intelligence Unit	60	Equally weighted sum
Press Freedom Index	Freedom House	109	Weighted sum
Bribe Payers Index (BPI)	Transparency International	7	Equally weighted sum
Corruption Perception Index (CPI)	Transparency International	60	Equally weighted sum
Global Terrorism Index	Institute for Economics and Peace (IEP)	4	Weighted average

Energy Indexes

Table 2.7. Energy indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
Energy Development Index (EDI)	International Energy Agency (IEA)	4	Equally weighted average
Energy Sustainability Index (ESI)	World Energy Council (WEC)	22	Weighted average

Other Indexes

Table 2.8. Others indexes list

Name	Developed by	Number of sub-indicators	Weighting and Aggregation
Millennium Development Goals	United Nations	8	-
Technology Achievement Index (TAI)	United Nations Development Programme (UNDP)	8	Equally weighted average
National Innovation Capacity Index	Porter Michael E., Stern Scott, Institute for Strategy and Competitiveness	8	Weighted average
City Development Index (CDI)	Urban Indicators Programme of the United Nations Human Settlements Programme (UN-Habitat)	5	Weighted average
Networked Readiness Index (NRI)	INSEAD – business school for the world, World Bank and World Economic Forum	48	Equally weighted average
Market Potential Index (MPI)	Michigan State University	8	Weighted average
Quality of Life Index	The Economist Intelligence Unit	9	Weighted average
Millennium Challenge Account Country Rankings	US Government Millennium Challenge Corporation (MCC)	17	Equally weighted average

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3. Multi-Criteria Decision Analysis (MCDA): Analytic Hierarchy Process (AHP) Method

During the elaboration of this thesis, the Analytic Hierarchy Process (AHP) method has been applied for the comparison of the indexes analyzed in Chapter 2 and for obtaining the experts' weights used to compute the final scores. In this chapter the basic concepts of the AHP methodology are described.

3.1 Introduction

Multi-criteria decision analysis (MCDA) methods have become increasingly popular in decision-making for sustainability because of the multi-dimensionality of its goal and the complexity of the economic-social-environmental systems. [1]
MCDA is an operational evaluation and decision support approach that is suitable for addressing complex problems featuring high uncertainty, conflicting objectives, different forms of data and information, multi interests and perspectives, and the accounting for complex and evolving biophysical and socio-economic systems.

Compared to single criteria approach, the distinctive advantage of MCDA methods is to employ multi-criteria or attributes to obtain an integrated decision-maker (DM) result. Generally, the MCDA problem for sustainable development DM involves *m* alternatives evaluated on *n* criteria. The grouped decision matrix can be expressed as follows:

$$
\begin{array}{rl}
 & \begin{array}{cccccc} \text{criteria} & C_1 & C_2 & \cdots & C_n \\ (\text{weights} & w_1 & w_2 & \cdots & w_n) \end{array} \\
\begin{array}{r}\text{alternatives}\\ \\ A_1 \\ A_2 \\ \vdots \\ A_m \end{array} & X = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{pmatrix}_{m\times n}
\end{array}
$$

Figure 3.1. MCDA decision matrix

where x_{ij} is the performance of *j-th* criteria of *i-th* alternative, w_j is the weight of criteria *j*, *n* is the number of criteria and *m* is the number of alternatives.

Among all the possible MDCA methods, it is observed that AHP is the most popular and comprehensive one so that the elementary weighted sum method is still basic in multi-criteria decisions-making problems. Moreover AHP methodology in the rank-order weighting method is more and more prevalent because of its understandability in theory and the simplicity in application. [1]

3.2 Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process facilitates the decomposition of a problem into a hierarchical structure and assures that both qualitative and quantitative aspects of a problem are incorporated into the evaluation process, during which opinions are systematically extracted by means of pairwise comparisons.
According to Forman (1983):

AHP is a compensatory decision methodology because alternatives that are efficient with respect to one or more objectives can compensate by their performance with respect to other objectives. AHP allows for the application of data, experience, insight, and intuition in a logical and thorough way within a hierarchy as a whole. In particular, AHP as a weighting method enables decision-makers to derive weights as opposed to arbitrarily assigning them. [2]

To make a decision in an organized way to generate priorities it is needed to decompose the decision into the following steps.

1. Defining the problem and determining the kind of knowledge sought.
2. Structuring the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) to the lowest level (which usually is a set of the alternatives).
3. Constructing a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.
4. Use of priorities obtained from the comparisons to weigh the priorities in the level immediately below. This has to be made for every element. Then for each element in the level below, in order to obtain its overall or global priority, it is necessary to add its weighed value. The weighing and adding process has to be continued until the final priorities of the alternatives in the most bottom level are obtained. [3]

Weights represent the trade-off across indicators. They measure willingness to forego a given variable in exchange for another. Hence, they are not importance coefficients. It could cause misunderstandings if AHP weights were to be interpreted as importance coefficients.

The core of AHP is an ordinal pairwise comparison of attributes. For a given objective, the comparisons are made between pairs of individual indicators, asking which of the two is the more important, and by how much. The preference is expressed on a semantic scale of 1 to 9. A preference of 1 indicates equality between two individual indicators, while a preference of 9 indicates that the individual indicator is 9 times more important than the other one. The results are represented in a comparison matrix, where $A_{ii} = 1$ and $A_{ij} = 1 / A_{ji}$. [2]

Table 3.1 exhibits the Saaty scale for the pairwise comparisons. Table 3.2 exhibits an example in which the scale is used to compare the relative consumption of drinks in the USA. One compares a drink indicated on the left with another indicated at the top and answers the question: How many times more, or how strongly more is that drink consumed in the US than the one at the top? One then enters the number from the scale that is appropriate for the judgment. [3]

Table 3.1. The fundamental scale of absolute numbers (Saaty scale)

Intensity of Importance	*Definition*	*Explanation*
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

Table 3.2. Relative consumption of drinks

Which drink is consumed more in the USA?							
An example of examination using judgements							
Drink consumption in US	*Coffee*	*Wine*	*Tea*	*Beer*	*Sodas*	*Milk*	*Water*
Coffee	1	9	5	2	1	1	1/2
Wine	1/9	1	1/3	1/9	1/9	1/9	1/9
Tea	1/5	2	1	1/3	1/4	1/3	1/9
Beer	1/2	9	3	1	1/2	1	1/3
Soda	1	9	4	2	1	2	1/2
Milk	1	9	3	1	1/2	1	1/3
Water	2	9	9	3	2	3	1

Note: The derived scale based on the judgements in the matrix is:
0.177 0.019 0.042 0.116 0.190 0.129 0.327
With a consistency ratio of 0.022.
the actual consumption (from statistical sources) is:
0.180 0.010 0.040 0.120 0.180 0.140 0.330

People's beliefs, however, are not always consistent. For example, if one person claims that A is much more important than B, B slightly more important than C, and C slightly more important than A, his/her judgment is inconsistent and the results are less trustworthy. Inconsistency, however, is part of human nature. It might therefore be adequate to measure the degree of inconsistency in order to make results acceptable to the public. For a matrix of size Q × Q, only Q–1 comparisons are required to establish weights for Q indicators.

The actual number of comparisons performed in AHP is Q×(Q–1)/2. This is computationally costly, but results in a set of weights that is less sensitive to errors of judgment. In addition, redundancy allows for a measure of judgment errors, an inconsistency ratio. Small inconsistency ratios – the suggested rule-of-thumb is less than 0.1, although 0.2 is often cited – do not drastically affect the weights. [2]

In order to implement the AHP methodology for the purposes explained at the beginning of this chapter, the Super Decisions software has been used.

3.3 Super Decisions Software

The Super Decisions software is used for decision-making with dependence and feedback.
It implements the Analytic Hierarchy Process, AHP, and the Analytic Network Process, ANP.
Both use the same fundamental prioritization process based on deriving priorities by making judgments on pairs of elements, or obtaining priorities by normalizing direct measurements.

In the AHP the decision elements are arranged in a hierarchic decision structure from the goal to the criteria to the alternatives of choice, while in the ANP the decision elements are grouped in clusters, one of which contains the alternatives, which the others contain the criteria, or stakeholders or other decision elements. In the ANP there is not a specific goal element, rather the priorities are determined in a relative framework of influences and the prioritization of the alternatives is implicitly understood to be with respect to whatever the network is about: the decision concern. The clusters are arranged into a network with links among the elements, or sometimes into multiple tiers of elements such as when a problem is decomposed into Benefits, Opportunities, Costs and Risks. Most decision-making methods including the AHP assume independence: between the criteria and the alternatives, or among the criteria or among the alternatives. The ANP is not limited by such assumptions. It allows for all possible and potential dependencies. [4]

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[2] OECD, Handbook on Constructing Composite Indicators - METHODOLOGY AND USER GUIDE. 2008.

[3] Thomas L. Saaty, Decision making with the analytic hierarchy process. *Int. J. Services Sciences, Vol. 1, No. 1, 2008.* 2008.

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4. Comparisons among the Already Existing Indexes

According to the conclusions deducted in Chapter 2, where the need to develop a unique, complete, globally recognized and actual index has emerged, a comparison in order to assess the best among the analyzed index has been performed through the Analytic Hierarchy Process (AHP) method.

4.1 Introduction

The starting point has been the comprehension of which among the already existing indexes, examined in Chapter 2, was the best one, based on their sphere of reference: Economy, Society and Environment.
For this procedure the institutional sector has not been taken into account due to the actuality of this new dimension, not yet completely defined, and the relative difficulty to find common criteria to perform comparisons through the AHP methodology.
After the analysis of the indexes, the models resulted the best in each dimension have been aggregated in only one index, called Best Dimensions Model, which has been consequently compared with the other sustainability indexes. This has allowed to include in the final comparison also the models concerning only one of the three dimensions.

The comparison procedure has been useful to understand strengths and weakness in each dimension of the indexes existing in literature.

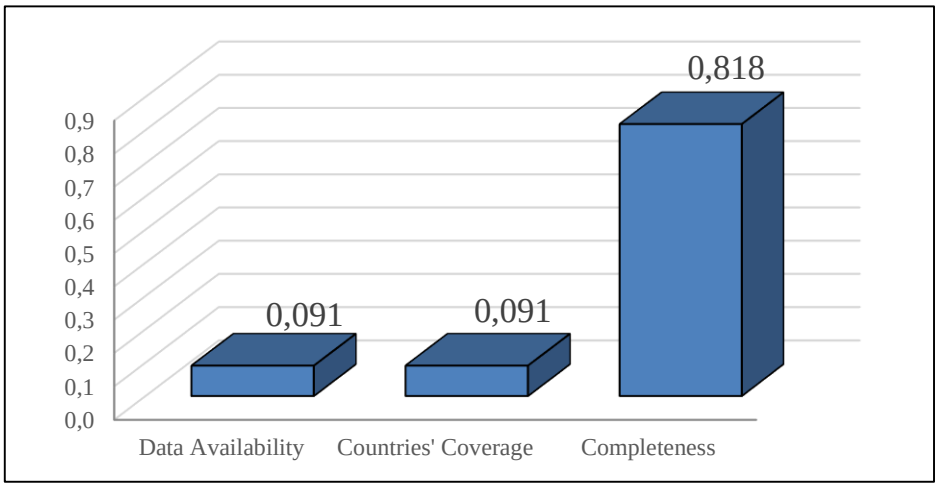
In order to simplify the computation among the alternatives, only the most meaningful models analyzed have been selected for the pairwise comparison implemented through the Super Decisions software. The choice has been based on the application and diffusion levels of the indexes.

To assess the best models, three criteria, considered fundamental for the evaluation of each index, have been established: Data Availability, Countries' Coverage and Completeness.

- Data Availability refers to the number of indicators. An index has been negatively evaluated when it presented a huge number of indicators.
- Countries' Coverage represents the number of countries in which the model is applied. The indexes have received the highest score when they were applied worldwide.
- Completeness has been evaluated based on the categories proposed in the Theme Indicator Framework of the United Nations Commission on Sustainable Development (CSD) [1].
  Of course, each dimension had to be assessed through specific sub-criteria referred to the belonging sector. In particular, regarding the social and environmental dimensions, the Themes of the framework have been considered, while concerning the economic dimension, because of the generic nature of the Themes, the more detailed Sub-themes have been taken into account. The sub-criteria are here listed:
  - Economic Completeness: Energy Factors, Imports/Exports, Income, Public Debt, Unemployment.
  - Social Completeness: Accessibility to Primary Needs, Education, Gender, Health, Psycho-Physical Well Being.
  - Environmental Completeness: Air, Biodiversity, Land, Waste, Water.

Different weights have been assigned to the criteria in order to highlight their different level of importance. Since the ability to describe the reality through proper indicators represents the main pillar for the construction of a composite index, the highest weight has been given to the completeness

criterion. In fact the other two criteria could be easily improved: the country coverage criterion once the data will be provided, while the data availability criterion through the removal of the not necessary indicators. In Graph 4.1 the criteria weights are shown.



Graph 4.1. Plot of the criteria weights

Otherwise equal weights have been assigned to the completeness sub-criteria, because a different hierarchy among the issues regarding the economic, social and environmental dimensions cannot be arbitrarily established a priori. Therefore, since the sub-criteria were five for each dimension, the weight of 0.2 has been given to each of them.

In order to perform the pairwise comparisons, all the three criteria have been verified for each index, reporting the total number of indicators, the number of countries where it was applied and the number of indicators regarding the completeness sub-criteria.

Once the models information concerning criteria and sub-criteria has been obtained, the indexes have been classified according to orders of importance relative to each criterion and sub-criterion. Therefore, a value corresponding to the Saaty scale methodology, which is explained in Chapter 3, has been assigned to each index, according to its position in the rankings. This has allowed to perform pairwise comparisons through the Super Decisions software, in order to obtain the best models.

Table 4.1. Adopted scale of importance

Intensity of importance	Definition
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong or demonstrated importance
9	Extreme importance
2, 4, 6, 8	Intermediate values
Reciprocals of above	If factor i has one of the above numbers assigned to it when compared to factor j, then j has the reciprocal value when compared with i

Adapted from Saaty (1977)

4.2 Economic Dimenion Analysis

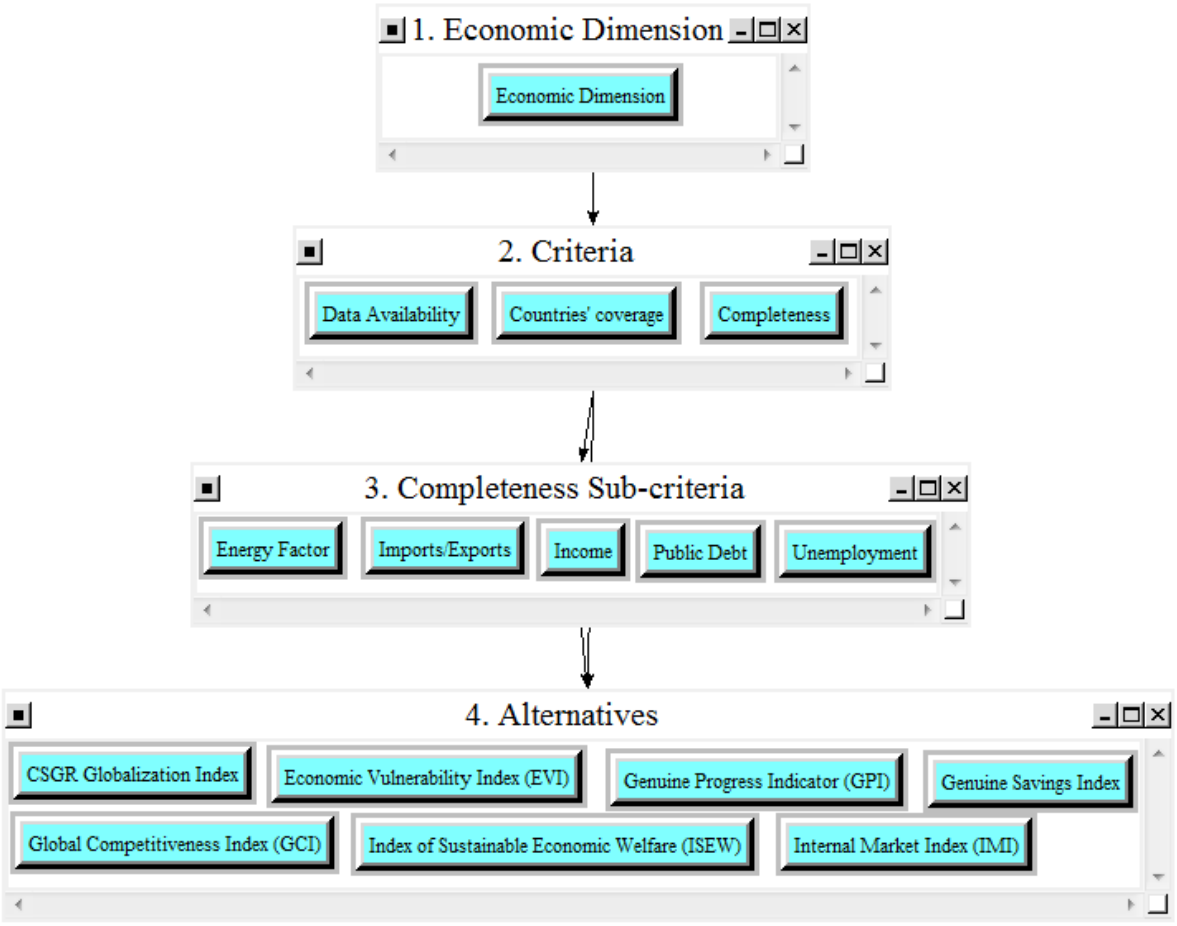


Figure 4.1. Economic dimension structure through the Super Decisions software

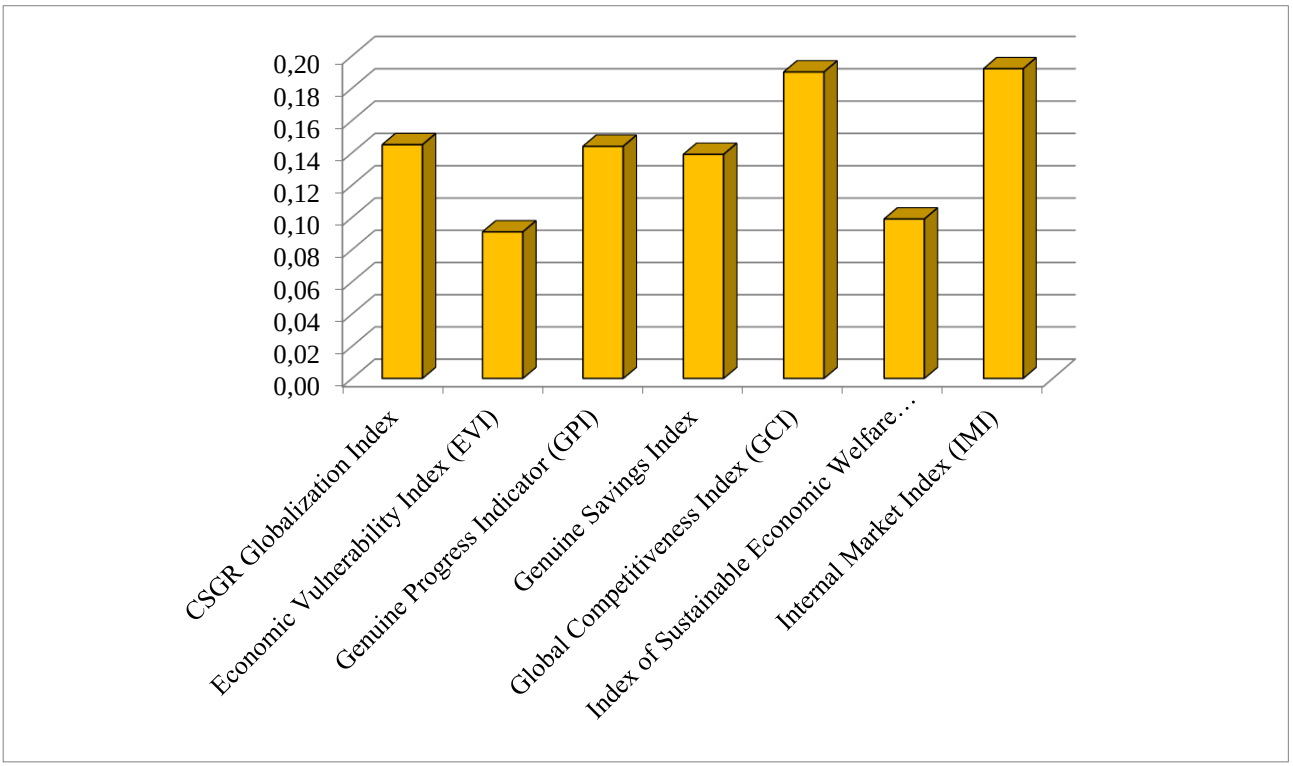
4.2.1 Economic Dimension Results

Table 4.2. Criteria evaluation of the economic models. Data availability: number of indicators; countries' coverage: number of countries in which the model is applied; completeness: presence of the specific indicator

ECONOMIC DIMENSION								
		Index of Sustainable Economic Welfare (ISEW)	Genuine Savings Index	Internal Market Index (IMI)	Economic Vulnerabilty Index (EVI)	Global Competitiveness Index (GCI)	Genuine Progress Indicator (GPI)	CSGR Index
DATA AVAILABILITY		7	6	20	8	36	24	4
COUNTRIES' COVERAGE		10	150	29	129	131	150+	119
COMPLETENESS	ENERGY FACTOR	0	1	2	0	0	1	0
	IMPORTS/EXPORTS	0	0	2	1	3	2	3
	INCOME	0	1	1	0	1	1	1
	PUBLIC DEBT	1	0	0	0	2	0	0
	UNEMPLOYMENT	0	0	1	0	0	0	0

Table 4.3. Economic dimension results

ECONOMIC DIMENSION	
NAME	RESULTS
CSGR Globalization Index	0,145
Economic Vulnerability Index (EVI)	0,091
Genuine Progress Indicator (GPI)	0,144
Genuine Savings Index	0,139
Global Competitiveness Index (GCI)	0,190
Index of Sustainable Economic Welfare (ISEW)	0,099
Internal Market Index (IMI)	0,192



Graph 4.2. Plot of the economic dimension results

4.2.2 Analysis of the Best Economic Model

In the economic dimension analysis the Internal Market Index is the best model according to the criteria. In fact, even if it is applied only to some developed countries, it is composed by few indicators (20) that satisfy the majority of the economic completeness sub-criteria.

In detail, it includes indicators concerning: Energy Factor, Income, Imports/Exports and Unemployment. On the other hand it shows some weaknesses: absence of indicators regarding Public Debt and presence of some too specific and not so meaningful indicators like "Postal Tariffs" and "Telecom Basket Cost".

Variable	Data used
Intra-EU FDI inward flows as % of GDP	1996-2000
Total state aid as % of GDP	1995-1999
Value of published public procurement as % of GDP	1996-2000
Greenhouse gas emissions	1995-1999
Energy intensity of GDP	1995-1999
Stock of ISO 14000 certificates	1996-2000
Per capita income (PPP)	1996-2000
Energy basket cost (electricity + gas)	1996-2000
Retail lending interest rates over savings interest rates ratio	1996-2000
Long term unemployment rate	1995-1999
EU citizens working in other EU Member States	1996-2000
Price dispersion in household consumption	1995-1999
Intra-EU trade as % of GDP	1996-2000
Value of pension fund assets as % of GDP	1995-1999
Stock market capitalisation as % of GDP	1996-2000
Number of patent applications per capita	1996-2000
Venture capital funds raised for start-ups and seed as share of the total	1996-2000
ICT expenditure as % of GDP	1996-2000
Postal tariffs (20g standard letter)	1996-2000
Telecom basket cost (OECD national residential basket)	1996-2000

Figure 4.2. Internal Market Index (IMI) framework

4.3 Social Dimension Analysis

Since many social models were related to single issues, also the social sectors of those indexes which dealt with socio-economic-institutional aspects, have been included in the analysis.

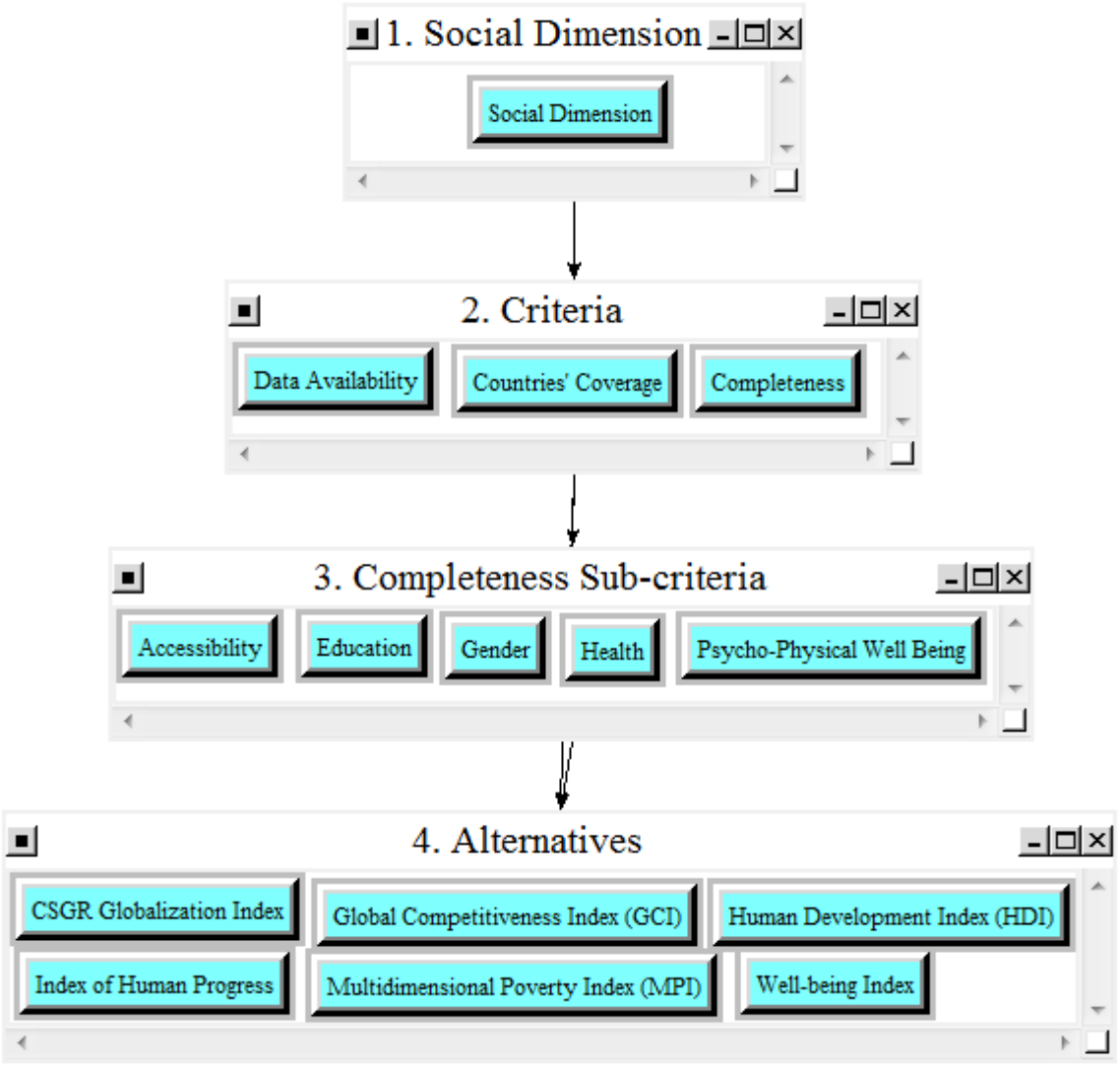


Figure 4.3. Social dimension structure through the Super Decisions software

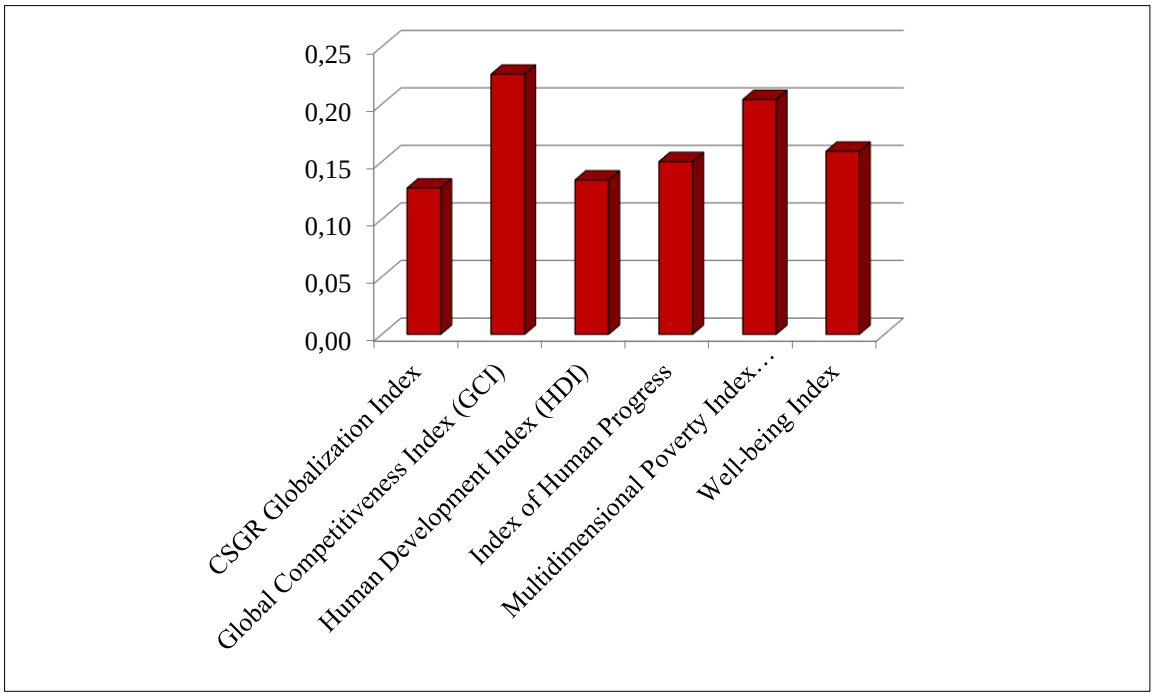
4.3.1 Social Dimension Results

Table 4.4. Criteria evaluation of the social models. Data availability: number of indicators; countries' coverage: number of countries in which the model is applied; completeness: presence of the specific indicator

SOCIAL DIMENSION							
		Human Development Index (HDI)	Well-being Index	Multidimensional Poverty Index (MPI)	Index of Human Progress	Global Competitiveness Index (GCI)	CSGR Index
DATA AVAILABILITY		4	6	10	10	16	16
COUNTRIES' COVERAGE		187	1	104	128	131	119
COMPLETENESS	ACCESSIBILITY	0	1	6	0	0	0
	EDUCATION	2	0	2	2	6	0
	GENDER	0	0	0	0	0	0
	HEALTH	1	2	2	4	8	0
	PSYCHO-PHYSICAL WELLBEING	0	2	0	0	0	2

Table 4.5. Social dimension results

SOCIAL DIMENSION	
NAME	RESULTS
CSGR Globalization Index	0,127
Global Competitiveness Index (GCI)	0,226
Human Development Index (HDI)	0,134
Index of Human Progress	0,150
Multidimensional Poverty Index (MPI)	0,204
Well-being Index	0,159



Graph 4.3. Plot of the social dimension results

4.3.2 Analysis of the Best Social Model

In the social dimension analysis the Global Competitiveness Index (CGI) is the best model, according to the criteria. In fact it is applied worldwide and it is composed by few indicators, that make the model simple.

Since this index considers the economic, social and institutional dimensions, only the 16 social indicators have been taken into account.

It includes indicators concerning only Education and Health but they are treated in detail, using respectively six and eight indicators.

On the other hand it shows some weaknesses: absence of indicators regarding Accessibility to Primary Needs, Gender issue and Psycho-Physical Well Being. These aspects of social sustainability are seldom included in the analyzed indexes, but they are not secondary and they cannot be neglected, as reported by the Theme Indicators Framework of the United Nations Commission on Sustainable Development (CSD) [1].

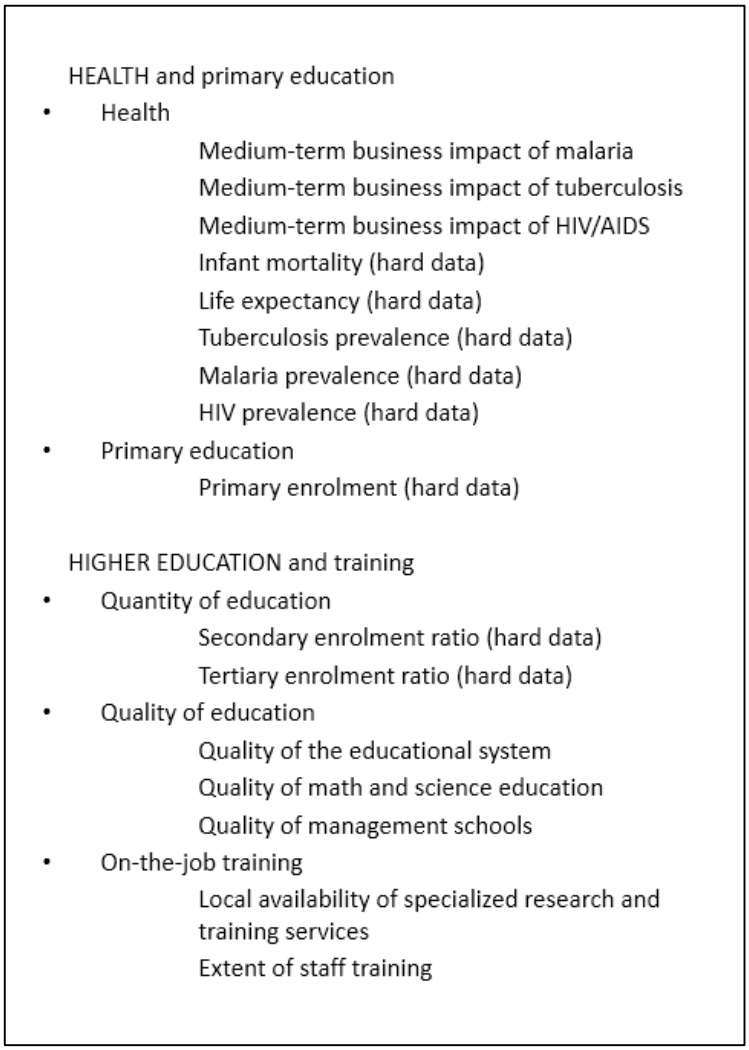


Figure 4.4. Global Competitiveness Index (GCI) framework

4.4 Environmental Dimension Analysis

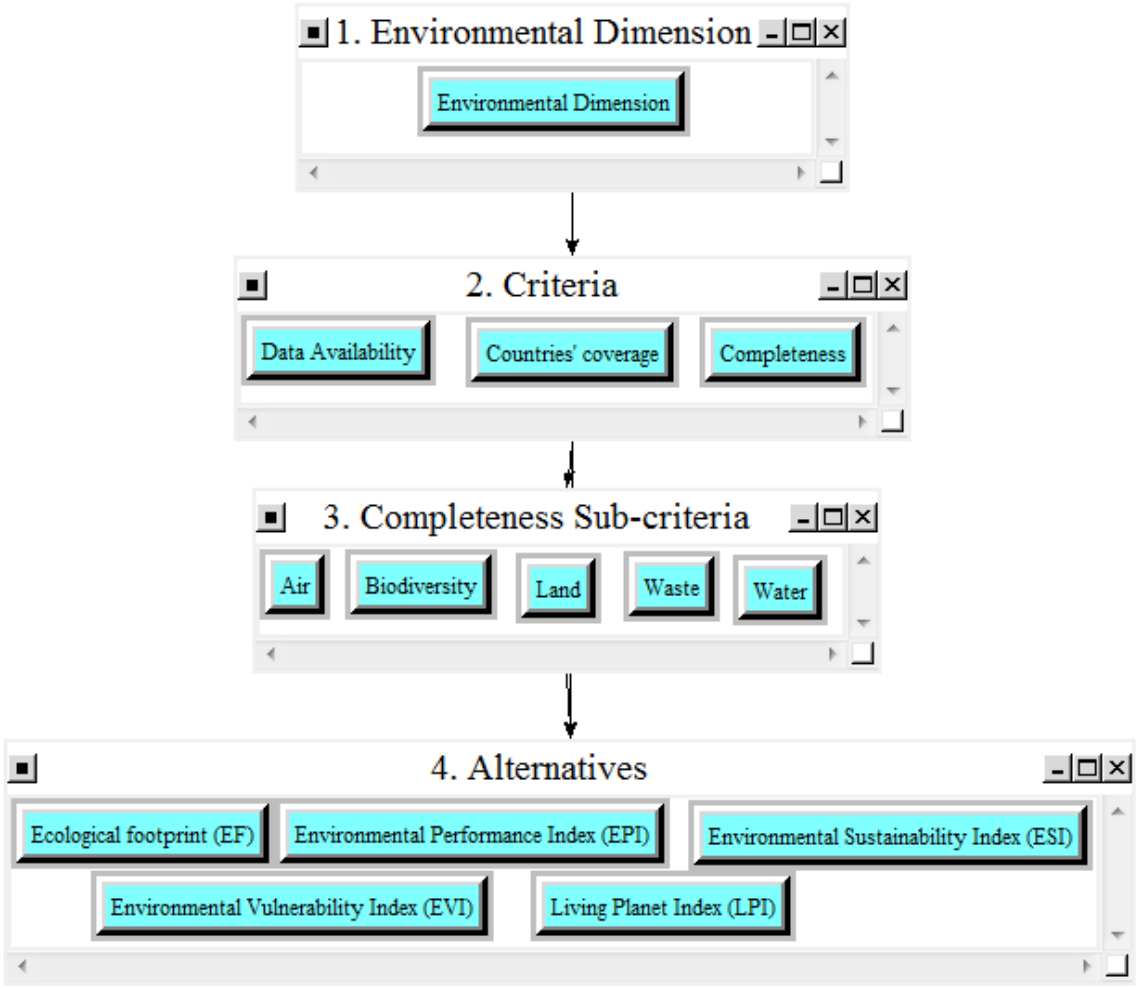


Figure 4.5. Environmental dimension structure through the Super Decisions software

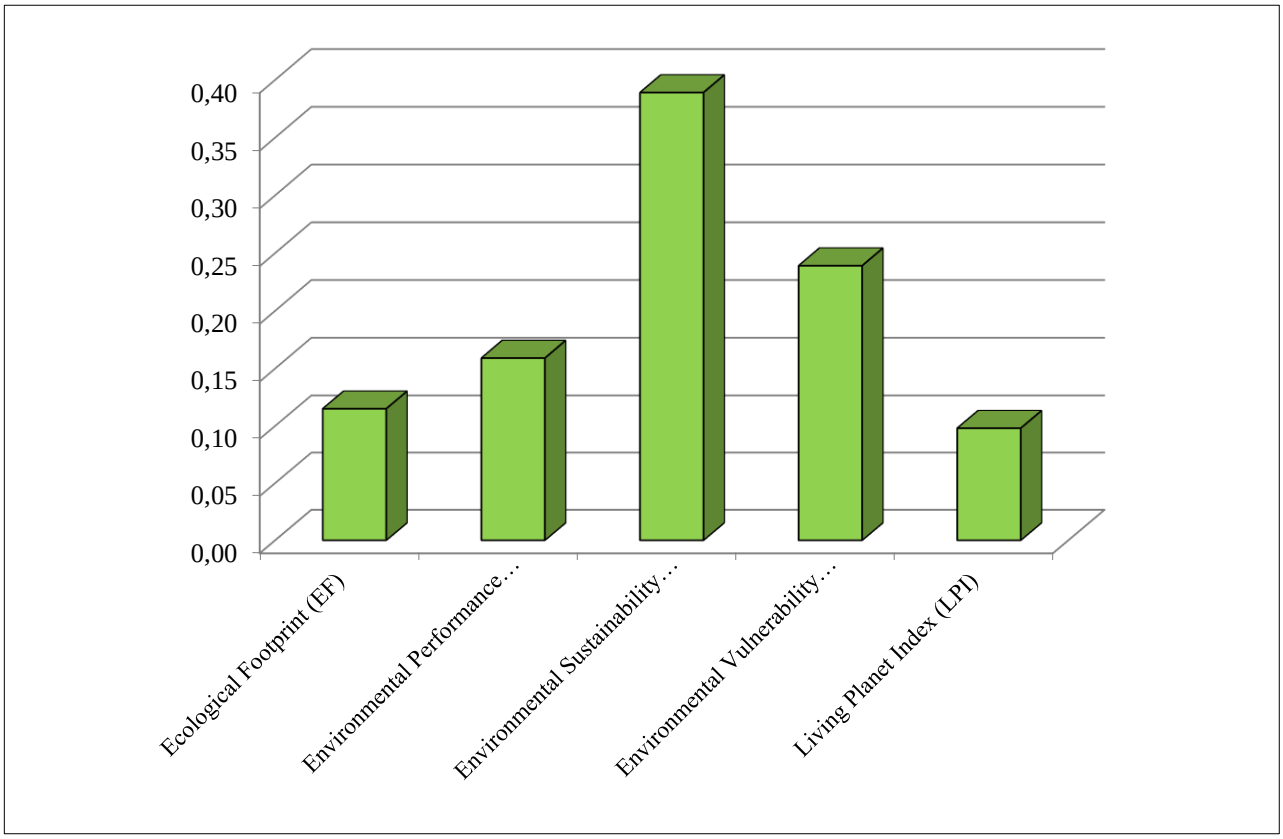
4.4.1 Environmental Dimension Results

Table 4.6. Criteria evaluation of the environmental models. Data availability: number of indicators; countries' coverage: number of countries in which the model is applied; completeness: presence of the specific indicator

ENVIRONMENTAL DIMENSION						
		Environmental Sustainability Index (ESI)	Environmental Performance Index (EPI)	Ecological Footprint (EF)	Living Planet Index (LPI)	Environmental Vulnerability Index (EVI)
DATA AVAILABILITY		76	22	6	1	50
COUNTRIES' COVERAGE		147	132	153	200	200
COMPLETENESS	AIR	13	5	1	0	2
	BIODIVERSITY	5	3	0	1	4
	LAND	3	3	0	0	4
	WASTE	3	0	2	0	1
	WATER	10	4	0	0	5

Table 4.7.Environmental dimension results

ENVIRONMENTAL DIMENSION	
NAME	RESULTS
Ecological Footprint (EF)	0,115
Environmental Performance Index (EPI)	0,159
Environmental Sustainability Index (ESI)	0,389
Environmental Vulnerability Index (EVI)	0,239
Living Planet Index (LPI)	0,098



Graph 4.4. Plot of the environmental dimension results

4.4.2 Analysis of the Best Environmental Model

In the environmental dimension analysis the Environmental Sustainability Index (ESI) is the best model, according to the criteria. In fact, even if it is composed by too many indicators (76), it is applied worldwide and it satisfy the whole environmental completeness sub-criteria.

In particular it focuses on the Air Quality issue, using 13 indicators, and on the Water issue, using 10 indicators. Moreover it deals with the Environmental Health, including indicators like Death Rate from Intestinal Infectious Diseases, with the Environmental Governance, including indicators like Corruption Measures and with the Science and Technology, including indicators like Number of Researchers per million Inhabitants.

On the other hand it shows some weaknesses: presence of some too specific indicators like "Threatened Amphibian Species as Percentage of Known Amphibian Species in Each Country" and "Salinized Area due to Irrigation as Percentage of Total Arable Land".

Comp-onent	Indicator Number	Indicator	Variable Number	Variable Code	Variable
Environmental Systems	1	Air Quality	1	NO2	Urban population weighted NO_2 concentration
			2	SO2	Urban population weighted SO_2 concentration
			3	TSP	Urban population weighted TSP concentration
			4	INDOOR	Indoor air pollution from solid fuel use
	2	Biodiversity	5	ECORISK	Percentage of country's territory in threatened ecoregions
			6	PRTBRD	Threatened bird species as percentage of known breeding bird species in each country
			7	PRTMAM	Threatened mammal species as percentage of known mammal species in each country
			8	PRTAMPH	Threatened amphibian species as percentage of known amphibian species in each country
			9	NBI	National Biodiversity Index
	3	Land	10	ANTH10	Percentage of total land area (including inland waters) having very low anthropogenic impact
			11	ANTH40	Percentage of total land area (including inland waters) having very high anthropogenic impact
	4	Water Quality	12	WQ_DO	Dissolved oxygen concentration
			13	WQ_EC	Electrical conductivity
			14	WQ_PH	Phosphorus concentration
			15	WQ_SS	Suspended solids
	5	Water Quantity	16	WATAVL	Freshwater availability per capita
			17	GRDAVL	Internal groundwater availability per capita
Reducing Environmental Stresses	6	Reducing Air Pollution	18	COALKM	Coal consumption per populated land area
			19	NOXKM	Anthropogenic NO_x emissions per populated land area
			20	SO2KM	Anthropogenic SO_2 emissions per populated land area
			21	VOCKM	Anthropogenic VOC emissions per populated land area
			22	CARSKM	Vehicles in use per populated land area
	7	Reducing Ecosystem Stress	23	FOREST	Annual average forest cover change rate from 1990 to 2000
			24	ACEXC	Acidification exceedance from anthropogenic sulfur deposition
	8	Reducing Population Pressure	25	GR2050	Percentage change in projected population 2004-2050
			26	TFR	Total Fertility Rate
	9	Reducing Waste & Consumption Pressures	27	EFPC	Ecological Footprint per capita
			28	RECYCLE	Waste recycling rates
			29	HAZWST	Generation of hazardous waste
	10	Reducing Water Stress	30	BODWAT	Industrial organic water pollutant (BOD) emissions per available freshwater
			31	FERTHA	Fertilizer consumption per hectare of arable land
			32	PESTHA	Pesticide consumption per hectare of arable land
			33	WATSTR	Percentage of country under severe water stress
	11	Natural Resource Management	34	OVRFSH	Productivity overfishing
			35	FORCERT	Percentage of total forest area that is certified for sustainable management
			36	WEFSUB	World Economic Forum Survey on subsidies
			37	IRRSAL	Salinized area due to irrigation as percentage of total arable land
			38	AGSUB	Agricultural subsidies

Comp-onent	Indicator Number	Indicator	Variable Number	Variable Code	Variable
Reducing Human Vulnerability	12	Environmental Health	39	DISINT	Death rate from intestinal infectious diseases
			40	DISRES	Child death rate from respiratory diseases
			41	U5MORT	Children under five mortality rate per 1,000 live births
	13	Basic Human Sustenance	42	UND_NO	Percentage of undernourished in total population
			43	WATSUP	Percentage of population with access to improved drinking water source
	14	Reducing Environment-Related Natural Disaster Vulnerability	44	DISCAS	Average number of deaths per million inhabitants from floods, tropical cyclones, and droughts
			45	DISEXP	Environmental Hazard Exposure Index
Social and Institutional Capacity	15	Environmental Governance	46	GASPR	Ratio of gasoline price to world average
			47	GRAFT	Corruption measure
			48	GOVEFF	Government effectiveness
			49	PRAREA	Percentage of total land area under protected status
			50	WEFGOV	World Economic Forum Survey on environmental governance
			51	LAW	Rule of law
			52	AGENDA21	Local Agenda 21 initiatives per million people
			53	CIVLIB	Civil and Political Liberties
			54	CSDMIS	Percentage of variables missing from the CGSDI "Rio to Joburg Dashboard"
			55	IUCN	IUCN member organizations per million population
			56	KNWLDG	Knowledge creation in environmental science, technology, and policy
			57	POLITY	Democracy measure
	16	Eco-Efficiency	58	ENEFF	Energy efficiency
			59	RENPC	Hydropower and renewable energy production as a percentage of total energy consumption
	17	Private Sector Responsiveness	60	DJSGI	Dow Jones Sustainability Group Index (DJSGI)
			61	ECOVAL	Average Innovest EcoValue rating of firms headquartered in a country
			62	ISO14	Number of ISO 14001 certified companies per billion dollars GDP (PPP)
			63	WEFPRI	World Economic Forum Survey on private sector environmental innovation
			64	RESCARE	Participation in the Responsible Care Program of the Chemical Manufacturer's Association
	18	Science and Technology	65	INNOV	Innovation Index
			66	DAI	Digital Access Index
			67	PECR	Female primary education completion rate
			68	ENROL	Gross tertiary enrollment rate
			69	RESEARCH	Number of researchers per million inhabitants
Global Stewardship	19	Participation in International Collaborative Efforts	70	EIONUM	Number of memberships in environmental intergovernmental organizations
			71	FUNDING	Contribution to international and bilateral funding of environmental projects and development aid
			72	PARTICIP	Participation in international environmental agreements
	20	Greenhouse Gas Emissions	73	CO2GDP	Carbon emissions per million US dollars GDP
			74	CO2PC	Carbon emissions per capita
	21	Reducing Transboundary Environmental Pressures	75	SO2EXP	SO_2 Exports
			76	POLEXP	Import of polluting goods and raw materials as percentage of total imports of goods and services

Figure 4.6. Environmental Sustainability Index (ESI) framework

4.5 Sustainability Models Analysis

As mentioned in Paragraph 4.1, the best models of each sustainability dimension have been aggregated in one complete index called Best Dimensions Model, composed by the Internal Market Index (IMI) for the economic sector, the Global Competitiveness Index (GCI) for the social one and the Environmental Sustainability Index (ESI) for the environmental one.

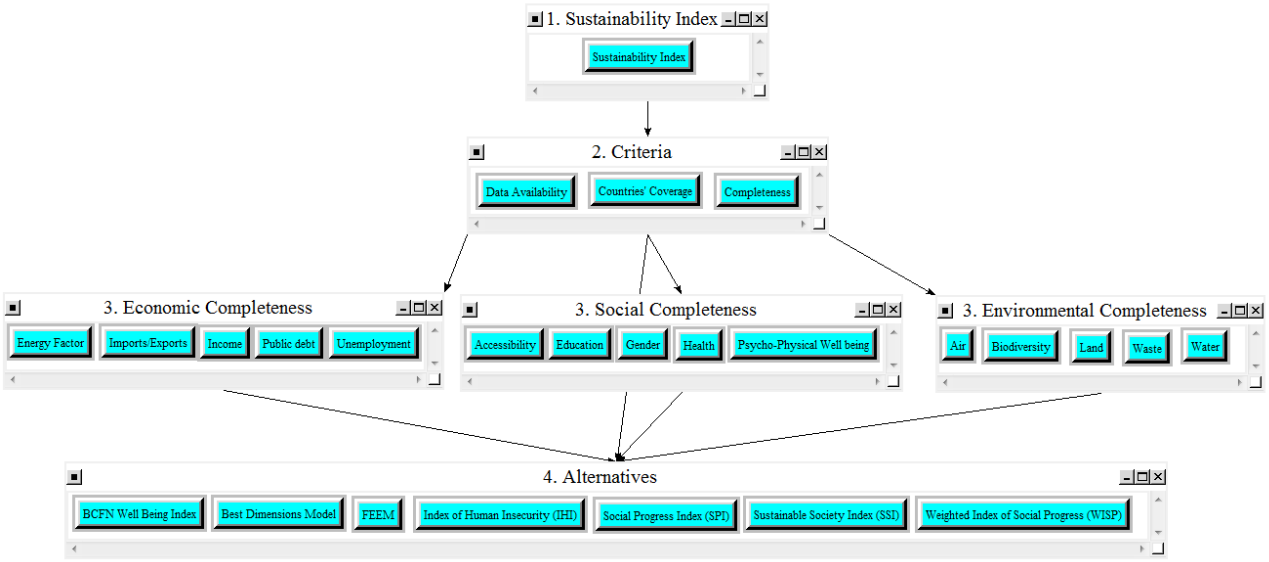


Figure 4.7. Sustainability models structure through the Super Decisions software

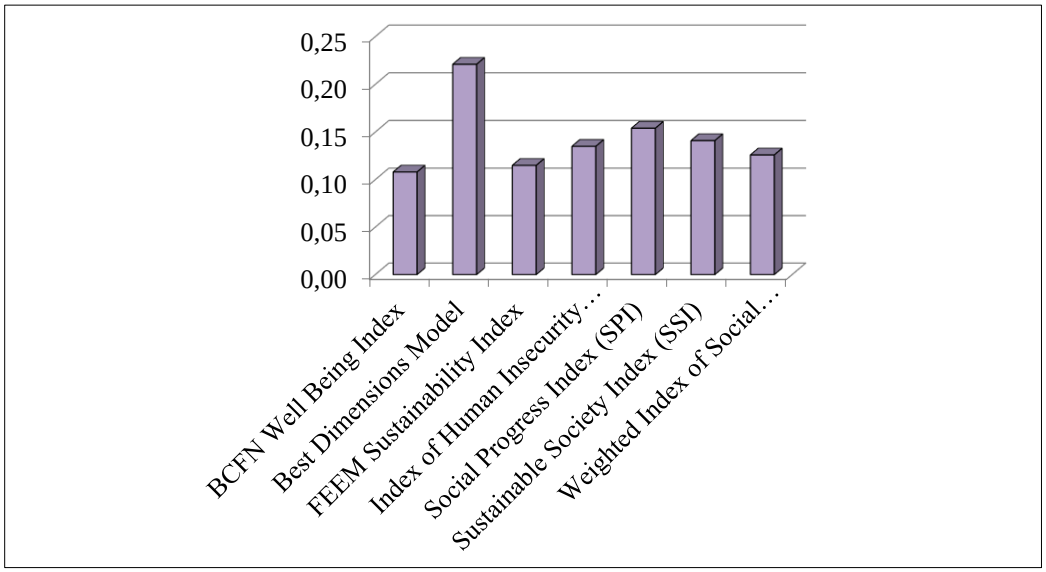
4.5.1 Sustainability Models Results

Table 4.8. Criteria evaluation of the sustainability models. Data availability: number of indicators; countries' coverage: number of countries in which the model is applied; completeness: presence of the specific indicator

SUSTAINABILITY MODELS								
		FEEM Sustainability Index	Index of Sustainable Society	Index of Human Insecurity (IHI)	Social Progress Index (SPI)	Weighted Index of Social Progress (WISP)	BCFN Well Being Index	Best Dimensions Model
DATA AVAILABILITY		23	24	12	38	26	41	113
COUNTRIES' COVERAGE		40	151	150+	50	36	10	29
COMPLETENESS	ENERGY FACTOR	4	2	1	1	0	0	2
	IMPORTS/EXPORTS	1	0	1	0	0	0	2
	INCOME	1	2	2	0	2	1	1
	PUBLIC DEBT	1	1	0	0	1	0	0
	UNEMPLOYMENT	0	1	0	0	1	3	1
	AIR	2	3	0	3	1	2	13
	BIODIVERSITY	2	1	0	0	0	0	5
	LAND	0	1	2	0	1	1	3
	WASTE	1	0	0	1	0	1	3
	WATER	1	3	1	2	0	1	10
	ACCESSIBILITY	1	1	0	5	1	0	0
	EDUCATION	1	1	1	7	5	3	6
	GENDER	0	1	1	1	3	0	0
	HEALTH	1	1	2	11	6	12	8
	PSYCHO-PHYSICAL WELLBEING	0	0	0	8	0	6	0

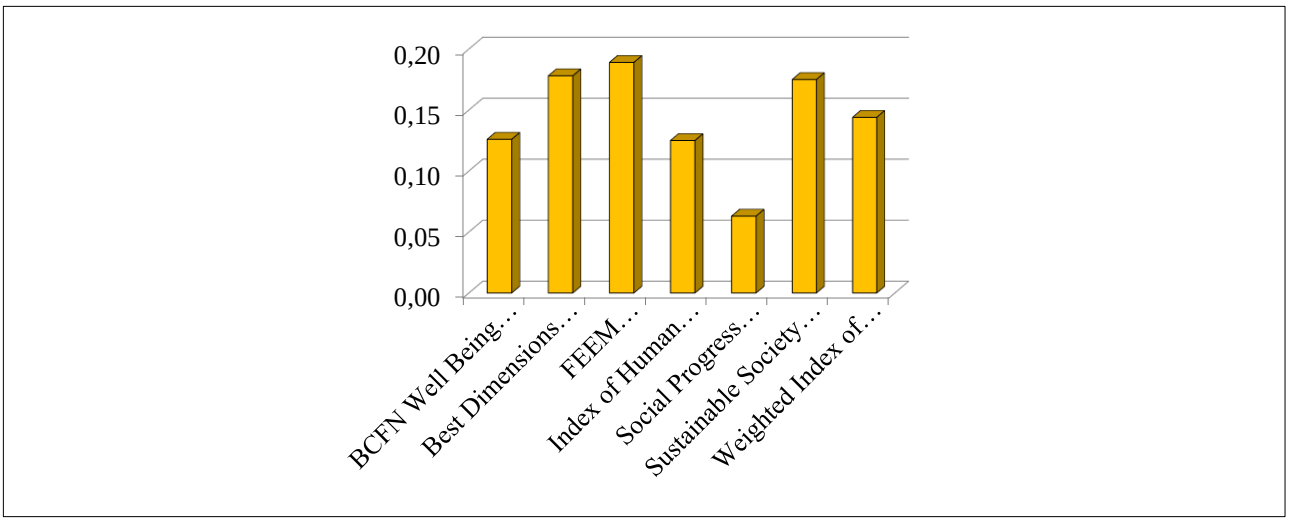
Table 4.9. Sustainability models results

SUSTAINABILITY MODELS	
NAME	RESULTS
BCFN Well Being Index	0,108
Best Dimensions Model	0,221
FEEM Sustainability Index	0,115
Index of Human Insecurity (IHI)	0,135
Social Progress Index (SPI)	0,154
Sustainable Society Index (SSI)	0,141
Weighted Index of Social Progress (WISP)	0,126

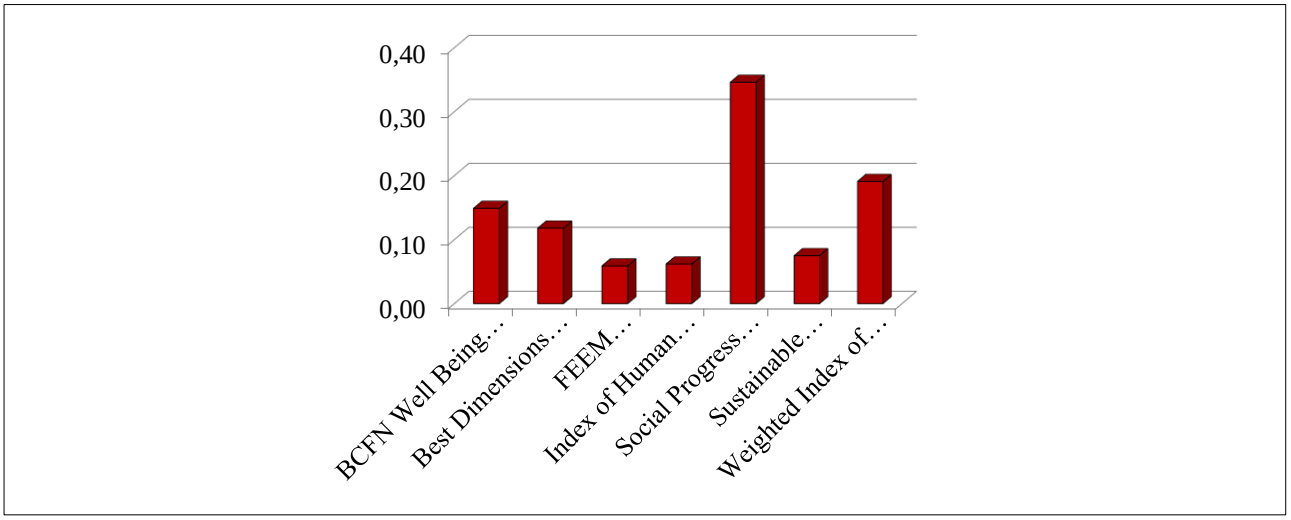


Graph 4.5. Plot of the sustainability models results

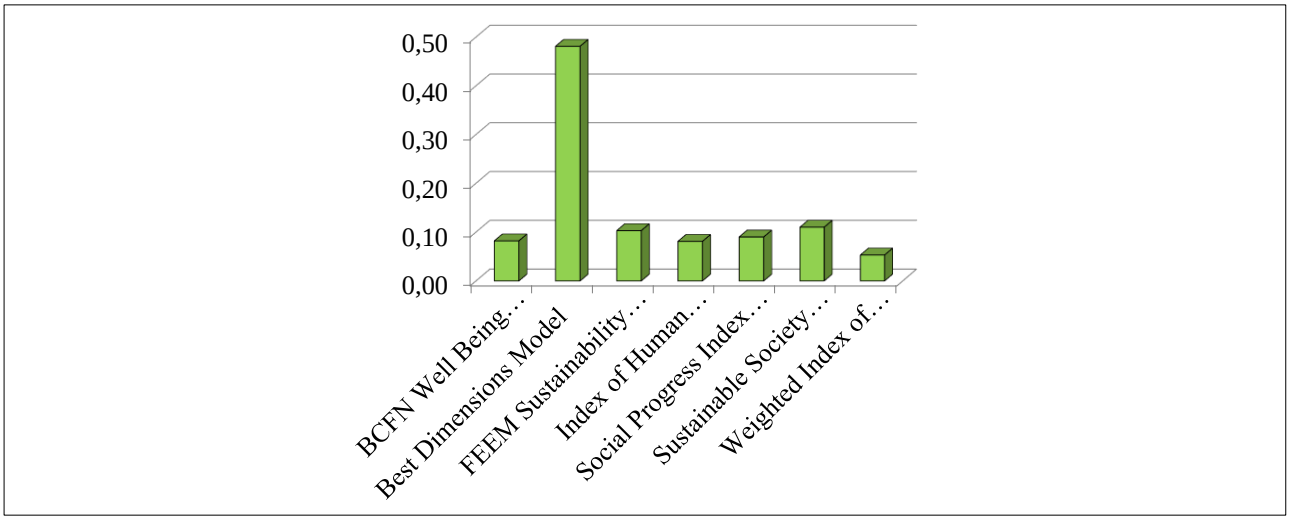
Below are the graphs showing the results of the sustainability models comparison, split by dimension, evaluated considering only the completeness criterion.



Graph 4.6. Plot of the sustainability models results by economic dimension



Graph 4.7. Plot of the sustainability models results by social dimension



Graph 4.8. Plot of the sustainability models results by environmental dimension

4.5.2 Analysis of the Sustainability Models Comparison

Looking at Graphs 4.6, 4.7 and 4.8, it is possible to understand which among the sustainability models were the best in the single dimensions.
The FEEM Sustainability Index, the Social Progress Index and the Best Dimensions Model are the most complete models respectively for the economic, social and environmental dimension.

Considering all the dimensions (Graph 4.5), the Best Dimensions Model is the best one among the analyzed sustainability models. Its total number of indicator (113) is the sum of all the indicators of each component model, while the countries' coverage is established by the component model applied in the minimum number of countries (29, corresponding to the Global Competitiveness Index coverage).

Even if it presents a huge number of indicators and it is applied only to few countries, the general completeness in the three sustainability dimensions makes it the best index over the others.

In particular it stands out in the environmental sector, thanks to the overall completeness of the Environmental Sustainability Index, and in the educational and health aspects concerning the social dimension.

The weaknesses of the Best Dimensions Models Model are represented by the already analyzed lacks of its component models, in detail the absence of indicators regarding Public Debt, Accessibility to Primary Needs, Gender issue and Psycho-Physical Well Being.

As final consideration, it is important to underline the difficult applicability of this index in the reality, due to the enormous number of indicators and to the different methodology used in each component model.

4.6 Remarks

This benchmarking has allowed to understand the frameworks and the issues considered in the models already existing in literature.
Some models are too specific or composed by too many and unnecessary indicators, while only few indexes deal with the sustainability development concept in a complete way. It has been noticed that even the best index resulted by this analysis, the Best Dimensions Model, presents some fields that could be revised and implemented to describe all the aspects of the sustainability. Therefore it has been reached the conclusion that a complete index which considered the economic, social, and environmental dimensions and which took also into account the institutional sector, was necessary,

Among all the analyzed indexes, indicators which satisfied the completeness sub-criteria have been recognized.

Moreover, identifying the areas of the Best Dimensions Model which needed improvements has been possible and this has represented the starting point for the construction of the Sustainability Evaluation Model.

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[1] United Nations Commission on Sustainable Development - Department of Economic and Social Affairs, Indicators of sustainable development: Framework and methodologies. April 2001.

5. Sustainability Evaluation Model

In this chapter the Sustainability Evaluation Model is shown. In particular are described:

- the framework of the index
- a brief analysis regarding the choice of the indicators
- the validation respect to the Best Dimensions Model

5.1 Framework

Starting from the analysis performed in the previous chapter, in which the Best Dimensions Model (composed by the Internal Market Index (IMI), the Global Competitiveness Index (GCI) and the Environmental Sustainability Index (ESI)) was the best index, the Sustainability Evaluation Model has been built.

In this phase strengths and weaknesses of the Best Dimensions Model have been taken into account, trying to face the lacks and the missing fields.

As shown in Graph 4.8, the Best Dimensions Model is the most complete index concerning the environmental dimension, in fact all the relative completeness sub-criteria were already satisfied.

While, Graphs 4.6 and 4.7 clearly show that it has not been the best one in the economic and social dimensions, since it presented some weaknesses in the completeness sub-criteria.

Hence the necessity to add indicators relative to the completeness sub-criteria not considered by the Best Dimensions Model, has emerged. In particular, the involved areas were:

Economic dimension:

- Public Debt

Social dimension:

- Accessibility
- Gender
- Psycho-Physical Well Being

Therefore, for these fields, proper indicators, identified among the analyzed indexes in Chapter 2 and among the Sub-themes of the United Nations Commission on Sustainable Development (CSD) Theme Indicators Framework [1], have been selected.
Moreover, the same sources have been used in order to enrich the Sustainability Evaluation Model, considering issues which were not included in the evaluation criteria. Thus indicators frequently present in literature have been added:

Economic dimension:

- Research & Development Expenditure
- Public Spending on Education
- Public Health Expenditure

Social dimension:

- Urban Population Density
- Homicide Rate

Concerning the environmental dimension, any new indicators have been added because the completeness criteria already satisfied the main sustainability parameters, which are proposed by the United Nations Commission on Sustainable Development (CSD) Theme Indicators Framework [1]. Therefore the Environmental Sustainability Index has just been simplified to reduce the number of indicators and avoid redundancy.
Additionally the institutional dimension, not treated in the comparisons procedure, has been taken into account according to the recent frameworks describing the sustainable development concept [2].

On the basis of the review regarding the indexes carried out in Chapter 2, the indicators that have been considered representative of the sustainability for the institutional dimension are:

- Corruption Perception
- Press Freedom
- Level of Democracy

Below the Sustainability Evaluation Model framework is presented.
The grey cells represent the criteria and the relative indicators in common with the Best Dimensions Model.

Table 5.2. Sustainability Evaluation Model framework

DIMENSION	NODE	CRITERIA	SUB-CRITERIA	INDICATORS
Economic	GNI per capita	1. GNI Balance		GNI (PPP) per Capita
	Long Term Drivers	2. Research & Development		R&D Expenditure (% of GDP)
		3. Public Education		Public Spending on Education (% of GDP)
		4. Public Health		Public Health Expenditure (% of GDP)
		5. Labor		Unemployment, Total (% of Total Labor Force)
		6. Energy Intensity		Total Primary Energy Supply / GDP
	Vulnerability	7. Electricity Share from Renewables		Electricity Production from Renewables / Total Electricity Production
		8. Relative Trade Balance		Net Exports / (Exports + Imports of Goods and Services)
		9. Energy Imported		Energy Imports, Net (% of Energy Use)
		10. Public Debt (% of GDP)		Public Debt (% of GDP)
Social	Population	11. Urban Population Density		Urban Population / Urban Areas
		12. Gender Balance		Gender Inequality Index
		13. GINI Index		GINI Richness Distribution
	Wellbeing	Education	14. School Enrolment	School Enrolment, Secondary (% Respect to the Official Secondary School Age)
			15. Education Policy	Mean Years of Schooling
		Health	16. Life Expectancy	Life Expectancy at Birth
			17. Infectious Disease	% of HIV Cases
			18. Obesity & Malnutrition	Obesity Prevalence, (% 20+ Years Old); Malnutrition Prevalence, (% < 5 Years Old)
		Premature Deaths	19. Suicide	Suicide Rate per 100'000 People
			20. Criminality	Homicide Rate per 100'000 People
	Accessibility	21. Physicians		Physicians per 1'000 People
		22. Energy Access		Access to Electricity (% of Population)
		23. Water Source		Improved Water Source (% of Population with Access)
		24. Food Security		Food Security Index
		25. Rail Lines Transport		Rail Route-km per 1'000 People
Environmental	Air	Local	26. PM_{10} Emissions	PM_{10} Emissions
		Global	27. CO_2 Intensity	Total CO_2 Emissions / Total Final Consumption
			28. GHG Emissions	GHG Emissions
	Water	29. Water Footprint		Human Impact on Water
	Land	30. Forest		Change in Forest Area
		31. Ecological Footprint		Ecological Footprint Index
	Biodiversity	32. Animals and Plants Biodiversity		GEF Benefits Index for Biodiversity
	Waste	33. Waste Production		Amount of Total Waste / Population
Institutional	Transparency	34. Corruption Perception Index		
	Press Freedom	35. Press Freedom Index		
	Democracy	36. Democray Index		

5.2 References

Indicators and composite indexes are adopted by countries and corporates because of their ability to summarize, focus and condense the enormous complexity of the reality to a manageable amount of meaningful information. [3]
Indicators translate physical and social science knowledge into manageable units of information that can facilitate the decision-making process. They can help to measure and calibrate progress towards sustainable development goals and provide an early warning, sounding the alarm in time to prevent economic, social and environmental damage. [4]
Proper indicators should meet the SMART criteria: Specific, Measurable, Attainable, Relevant, Time-bound. Furthermore indicators can be classified by typology, according to the Driving Force, State and Response scheme. [1]

To handle with a broad concept, as the sustainable development, the use of a composite index has been necessary. By definition, a composite index is the mathematical combination of individual indicators that represent different dimensions of a concept whose description is the objective of the analysis. [5]

The aim of this section is to describe the indicators chosen for the Sustainability Evaluation Model, specifying:

- a brief definition
- the reasons of the selection
- the analyzed indexes which use the considered indicator
- the international organizations which mention the considered indicator
- the data source.

They have been classified according to their dimension and their position on the basis of nodes and criteria in the framework.

In APPENDIX C, international and globally recognized organizations, used both to identify proper indicators for the Sustainability Evaluation Model and consequently as data source, are listed.

In APPENDIX D, indicators not included in the final framework, which have been initially considered and subsequently discarded during the elaboration process, are reported.

5.2.1 Economic Dimension

In this dimension three main categories have been taken into account: GNI per Capita, Long Term Drivers and Vulnerability.
In order to emphasize the importance of GNI per Capita, which is the basic index to measure the economy of a country, the single indicator has been used to represent the whole sector.
The category regarding Long Term Drivers stresses the concept that particular preconditions and growth drivers are necessary for the economic development.
Finally the Vulnerability category shows the exposure level of a country in terms of self-sufficiency concerning energy, imports/exports balance and public debt issues.

1.1 GNI per Capita

1.1.1 GNI per Capita, PPP [Constant 2005 International $]

Definition	Gross National Income (GNI) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. GNI PPP is converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States. Data are in constant 2005 international dollars. [6]
Description	The evaluation of income per capita is a basic indicator to define the level of richness of the population, used to give an initial classification of the countries. The Purchasing Power Parity conversion allows the comparison of national currencies on the basis of their purchasing powers of the currencies in their respective domestic markets free from differences in price levels across countries. The Gross National Income has been chosen instead of the Gross Domestic Product because the GNI takes also into account the foreign investments and incomes performed by enterprises and citizens owned by the country and the possible donations received from another country charity organization.
Analyzed Indexes	• Human Development Index (from 2010) • Market Potential Index • Weighted Index of Social Progress
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • World Bank
Data Source	World Bank [6]

1.2.2 Research & Development Expenditures (% of GDP)

Definition	Expenditures for research and development are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development. [7]
Description	This indicator has been chosen to represent the growth policy of a country because it defines the investments in order to increase the possibilities of development for the future generations. The Gross Domestic Product is used as normalization factor in order to allow comparisons among countries with different economic levels.
Analyzed Indexes	• FEEM Sustainability Index • Global Innovation Index • National Innovation Capacity • Summary Innovation Index
International Organizations	• Organization for Economic Co-operation and Development (OECD) • United Nations Educational, Scientific, and Cultural Organization (UNESCO) • World Bank
Data Source	World Bank [7] Data are available as percentage of GDP.

1.2.3 Public Spending on Education (% of GDP)

Definition	Public expenditure on education is the total public expenditure (current and capital) on education expressed as a percentage of the Gross Domestic Product (GDP) in a given year. Public expenditure on education includes government spending on educational institutions, education administration, and transfers/subsidies for private entities (students/households and other private entities). [8]
Description	This indicator represents the policy regarding the formation and schooling of the young people, fundamental for the progress of a country. Expenditure on education is not properly a growth driver but it is a precondition for an adequate economic and social development. Since the public education is accessible to the entire population, it has been chosen over the total spending on education (which also includes the private rate).
Analyzed Indexes	As Total Expenditure: public + private: • FEEM Sustainability Index • Genuine Savings Index • Global Innovation Index • Networked Readiness Index As Public Expenditure for the Primary Education: • Millennium Challenge Account Country Rankings
International Organizations	• Central Intelligence Agency (CIA) • United Nations Development Programme (UNDP) • United Nations Educational, Scientific, and Cultural Organization (UNESCO) • World Bank
Data Source	World Bank [8] Data are available as percentage of GDP.

1.2.4 Public Health Expenditure (% of GDP)

Definition	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. [9]
Description	This indicator represents the investments on the health sector, including infrastructures, personnel and services, fundamental to guarantee a proper level of health care to the population. Expenditure on health is not properly a growth driver but it is a precondition for an adequate economic and social development. The public expenditure has been chosen because the health care should be accessible to the entire population, ensuring the fundamental right to health, highlighted by the United Nations Millennium Development Goals.
Analyzed Indexes	As Total Expenditure: public + private: • FEEM Sustainability Index • Millennium Challenge Account Country Rankings, • Networked Readiness Index
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • United Nations Development Programme (UNDP) • World Bank • World Health Organization (WHO)
Data Source	World Bank [9] Data are available as percentage of GDP.

1.2.5 Unemployment Rate (% of Total Labor Force)

Definition	Unemployment refers to the share of the labor force that is without work but available for and seeking employment. [10] Definitions of labor force and unemployment differ by country.
Description	It is a fundamental issue for the economic growth because it strictly influences the personal richness and consequently the wellbeing of the population. If people are unemployed, they cannot spend money limiting the development of the entire market. In particular this indicator has been chosen to represent the actual situation concerning the job sector, affected by the global economic crisis started in 2008.
Analyzed Indexes	• Index of Sustainable Society • Internal Market Index (IMI) • Political Risk Service • Quality of Life Index • Weighted Index of Social Progress (WISP)
International Organizations	• Central Intelligence Agency (CIA) • International Labor Organization (ILO) • Organization for Economic Co-operation and Development (OECD) • United Nations through the Millennium Development Goals • World Bank
Data Source	World Bank [10]

1.2.6 Energy Intensity (Total Primary Energy Supply / GDP) [toe/ thousands 2005 USD]

Definition	Energy intensity is a measure of the energy efficiency of a nation economy. It is calculated as units of primary energy supply per unit of GDP. High energy intensities indicate a high price or cost of energy.
Description	Primary energy refers to energy sources as found in their natural state. It is the total global use of various sources of energy currently deployed, including coal, oil, gas, nuclear, hydropower, geothermal/solar/wind, other combined renewables and waste. This indicator has been chosen because it determines the cost of primary energy, which is a fundamental aspect for the economy of a country.
Analyzed Indexes	• Energy Sustainability Index (ESI) • Environmental Sustainability Index (ESI) • FEEM Sustainability Index • Internal Market Index (IMI)
International Organizations	• European Environment Agency (EEA) • International Energy Agency (IEA) • Organization for Economic Co-operation and Development (OECD) • World Bank
Data Source	International Energy Agency (IEA) [11]

1.3 Vulnerability

1.3.7 Electricity Share from Renewables (Electricity Production from Renewables / Total Electricity Production)

Definition	It is the share of electricity produced by renewables sources respect to the total electricity production. Renewables sources include biofuels, waste, hydroelectricity, geothermal, solar Photo Voltaic, solar thermal, wind and tide. On the other hand, total electricity production is also composed by the wide share of oil, gas, nuclear, coal and peat. Total electricity generation covers gross electricity generation in all types of power plants. At plant level it is defined as the electricity measured at the outlet of the main transformers. [12]
Description	Renewable energy resources exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency is resulting in significant energy security, climate change mitigation, and economic benefits. In international public opinion surveys there is strong support for promoting renewable sources. [13] This indicator has been chosen because renewable sources cannot be depleted and are independent from global market fluctuations, ensuring a secure reservoir of energy and a low exposure.
Analyzed Indexes	• Environmental Performance Index (EPI)
International Organizations	• Central Intelligence Agency (CIA) • European Environment Agency (EEA) • International Energy Agency (IEA)
Data Source	International Energy Agency (IEA) [14]

1.3.8 Relative Trade Balance (Net Exports / [Exports + Imports])

Definition	Net exports is the difference between the monetary value of exports and imports of goods and services in an economy over a certain period. Relative Trade Balance is computed dividing the Net Exports by the sum of Exports and Imports. It provides not the absolute value but the relative trade referred to the total amount of goods and services.
Description	A positive balance is known as a trade surplus if it consists of exporting more than is imported; a negative balance is referred to as a trade deficit. This indicator is a snapshot of the capacity of a country to be as independent as possible concerning the trade of goods and services with other countries. Negative values (imports greater than exports) refer to a possible exposure to external factors out of the control of the country.
Analyzed Indexes	• CSGR Globalization Index, the Country Policy and Institutional Assessment (CPIA) • FEEM Sustainability Index • Global Competitiveness Index (GCI) • Index of Human Insecurity (IHI) • Internal Market Index (IMI) • Market Potential Index (MPI) • Millennium Challenge Account Country Rankings and the Index of Social Vulnerability to Climate Change
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • World Bank
Data Source	World Bank [15]

1.3.9 Energy Imported, Net (% of Energy Use)

Definition	Net energy imports are estimated as energy use less production, both measured in oil equivalents. A negative value indicates that the country is a net exporter. Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport. [16]
Description	This indicator determines the energy dependence from other countries. A nation based on significant energy imports, increases its vulnerability level because it cannot satisfy its energy self-sufficiency. The amount of energy imported is strictly related to the presence of energy sources on the territory.
Analyzed Indexes	• FEEM Sustainability Index
International Organizations	• International Energy Agency (IEA) • World Bank
Data Source	World Bank [16]

1.3.10 Public Debt (% of GDP)

Definition	Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans. It is the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government. Because debt is a stock rather than a flow, it is measured as of a given date, usually the last day of the fiscal year. [17]
Description	This indicator has been chosen to show the level of exposure of a country in the long term. The ratio between Public Debt and GDP is a significant index of the economic and financial situation of a state.
Analyzed Indexes	• Country Policy and Institutional Assessment (CPIA) • FEEM Sustainability Index • Global Competitiveness Index (GCI) • Index of Sustainable Society • Weighted Index of Social Progress (WISP)
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • United Nations (UN) • World Bank
Data Source	Central Intelligence Agency (CIA) Data are available as percentage of GDP. [18]

5.2.2 Social Dimension

In this dimension three main categories have been taken into account: Population, Wellbeing and Accessibility.
The first one describes the population in terms of city livability related to the urban density, equality level between genders and richness distribution.
For the second category only the main wellbeing aspects have been described: education level, health and deaths due to suicides and homicides.
Finally the last category describes the population accessibility to the basic needs: water, food, health, electricity and transport.

2.1 Population

2.1.11 Urban Population Density (Urban Population / Urban Areas) [inhabitants/km^2]

Definition	It is computed as the number of people living in urban areas over the urban areas extension.
Description	This index has been used because the already existing similar indicators were not suitable for the final goal. Urban Density is an index of the quality of life in the cities represented as essential space needed. High values correspond to bad livability conditions. Since this indicator was not present in any international database, it has been computed taking into account the urban densities of the first four biggest cities of each considered country. In order to obtain results relative to the context of the specific country, any threshold regarding the choice of the cities in terms of population dimension has been fixed.
Analyzed Indexes	• /
International Organizations	As Urban Population Rate and Global Population Density • United Nations Development Programme (UNDP) • World Bank
Data Source	City Population (German website linked to national data sources). [19]

2.1.12 Gender Inequality Index [0-1]

Definition	It reflects gender-based disadvantages showing the loss in potential human development due to inequality between female and male achievements in three dimensions: reproductive health, empowerment, and labor market participation.
Description	The Gender Inequality Index (GII) is a new index for measurement of gender disparity that has been introduced in the 2010 Human Development Report. Unlike the usual gender indicators like "P*roportion of seats held by women in national parliament*" or "*Wage disparities between men and women*", Gender Inequality Index is more complete and considers different aspects. The promotion of gender equality and the empowerment of women is a basic issue for the social sustainability of a country, as declared by the United Nations Millennium Development Goals.
Analyzed Indexes	• /
International Organizations	• United Nations Development Programme (UNDP)
Data Source	United Nations Development Programme (UNDP) [20]

2.1.13 Gini (Richness Distribution) Index [0-100]

Definition	This indicator measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A Gini coefficient of zero expresses perfect equality, where all values are the same (for example, where everyone has the same income). A Gini coefficient of 100 expresses maximal inequality among values (for example where only one person has all the income). However, a value greater than 100 may occur if some persons have negative income or wealth. For larger groups, values close to or above 100 are very unlikely in practice. [21]
Description	A homogeneous richness distribution is necessary to guarantee the social sustainability of a country and to avoid the poverty of wide population groups.
Analyzed Indexes	• Genuine Progress Indicator (GPI) • Weighted Index of Social Progress (WISP)
International Organizations	• Central Intelligence Agency (CIA) • United Nations Development Programme (UNDP) • World Bank
Data Source	Central Intelligence Agency (CIA) [22]

2.2 Well Being

2.2.1 Education

2.2.1.14 Secondary School Enrolment (% Respect to the Official Secondary School Age)

Definition	This indicator represents the total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age. It can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition. [23]
Description	Since the primary school enrolment is guaranteed in almost all the worldwide countries, and the tertiary school enrolment is referred to an advanced level of education (as the university one), the indicator that takes into account the years needed to obtain a diploma has been chosen.
Analyzed Indexes	• Global Competitiveness Index (GCI) • Millennium Challenge Account Country Rankings • Social Progress Index (SPI)
International Organizations	• United Nations (UN) • World Bank
Data Source	World Bank [23]

2.2.1.15 Mean Years of Schooling

Definition	This indicator represents the average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level. [24]
Description	It is a fundamental index to represent the education level of a nation, necessary to achieve personal knowledge and consciousness. It is one of the four indicators which form the Human Development Index, published by United Nations Development Programme (UNDP).
Analyzed Indexes	• Human Development Index (HDI) • Technology Achievement Index (TAI) • Weighted Index of Social Progress (WISP)
International Organizations	• United Nations Development Programme (UNDP)
Data Source	United Nations Development Programme (UNDP) [24]

2.2.2 Health

2.2.2.16 Life Expectancy at Birth

Definition	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. [25]
Description	It is one of the most used worldwide indicators to summarize the well being, health care and life style level of the population.
Analyzed Indexes	• BCFN Index – Well Being Index • City Development Index (CDI) • Global Competitiveness Index (GCI) • Happy Planet Index (HPI) • Human Development Index (HDI) • Index of Human Insecurity (IHI) • Index of Human Progress • Overall Health System Attainment • Quality of Life Index • Social Progress Index (SPI) • Weighted Index of Social Progress (WISP) • Well Being Index
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • United Nations Development Programme (UNDP) • World Bank • World Health Organization (WHO)
Data Source	World Bank [25]

2.2.2.17 HIV Prevalence (% of Cases)

Definition	Prevalence of HIV refers to the percentage of adult people aged 15 and up who are infected by HIV.
Description	HIV is one of the major causes of premature death, especially in the developing countries. Combat HIV/AIDS is one of the eight United Nations Millennium Development Goals.
Analyzed Indexes	• Global Competitiveness Index (GCI) • Social Progress Index (SPI)
International Organizations	• Central Intelligence Agency (CIA) • Joint United Nations Programme on HIV/AIDS (UNAIDS) • Organization for Economic Co-operation and Development (OECD) • United Nations Development Programme (UNDP) • United Nations International Children's Emergency Fund (UNICEF) • World Bank • World Health Organization (WHO)
Data Source	Joint United Nations Programme on HIV/AIDS (UNAIDS) [26]

2.2.2.18 Obesity & Malnutrition

Obesity and Malnutrition have been aggregated in order to represent in a single and more direct indicator the health issues related to the nourishment level.

Obesity Prevalence, Body Mass Index > 30 (% 20+ Years Old)

Definition	Obesity is defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters [kg/m^2]. The World Health Organization (WHO) definition is that a BMI greater than or equal to 30 is obesity.
Description	BMI provides the most useful population-level measure of obesity as it is the same for both sexes and for all ages of adults. However, it should be considered a rough guide because it may not correspond to the same degree of fatness in different individuals. [27] The population older than 20 years old has been chosen because it is the group at highest risk of premature deaths and that one which mostly burden on the society.
Analyzed Indexes	• BCFN Index – Well Being Index
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • World Bank • World Health Organization (WHO)
Data Source	World Health Organization (WHO) [28]

Malnutrition Prevalence, (% < 5 Years Old)

Definition	Prevalence of child malnutrition is the percentage of children under age five whose weight for age is more than two standard deviations below the median for the international reference population ages 0-59 months. [29]
Description	Children affected by malnutrition have an increased risk of mortality associated to a high number of nutrition-related deaths. The population younger than five years old has been chosen because it is not self-sustaining and it is the most vulnerable by the hunger. Eradicate extreme poverty and hunger and reduce child mortality are two of the eight United Nations Millennium Development Goals.
Analyzed Indexes	• Environmental Sustainability Index (ESI) • Human Poverty Index (HPI) • Multidimensional Poverty Index (MPI) • Social Progress Index (SPI) • Weighted Index of Social Progress (WISP)
International Organizations	• Central Intelligence Agency (CIA) • United Nations Development Programme (UNDP) • World Bank • World Health Organization (WHO)
Data Source	World Health Organization (WHO) [30]

2.2.3 Premature Deaths

2.2.3.19 Suicide Rate (per 100’000 People)

Definition	This indicator represents the number of people every 100’000 who commit suicide.
Description	Suicide is among the top 20 leading causes of death globally for all ages. Every year, nearly one million people die from suicide. Mental illness, primarily depression and alcohol use disorders, abuse, violence, loss, cultural and social background, represent major risk factors for suicide. [31] It is also strictly linked to environmental conditions like the daily sunlight hours or the average annual temperature. This indicator has been chosen to represent the population perception of well being in a specific context, and in particular to show that a high economic standard is not necessarily related to a high human welfare.
Analyzed Indexes	• /
International Organizations	• Organization for Economic Co-operation and Development (OECD) • World Health Organization (WHO)
Data Source	World Health Organization (WHO) [32]

2.2.3.20 Homicide Rate (per 100’000 People)

Definition	This indicator represents the number of people every 100’000 who commit murders.
Description	Intentional homicides are estimates of unlawful homicides purposely inflicted as a result of domestic disputes, interpersonal violence, violent conflicts over land resources, inter-gang violence over turf or control, and predatory violence and killing by armed groups. Intentional homicide does not include all intentional killing; the difference is usually in the organization of the killing. Individuals or small groups usually commit homicide, whereas killing in armed conflict is usually committed by fairly cohesive groups of up to several hundred members and is thus usually excluded. [33] This indicator has been chosen to represent the criminality presence and consequently the level of security guaranteed to the population.
Analyzed Indexes	• Social Progress Index (SPI)
International Organizations	• United Nations Development Programme (UNDP) • World Bank
Data Source	World Bank [33]

2.3 Accessibility

2.3.21 Physicians (per 1’000 People)

Definition	This indicator gives the number of medical doctors, including generalist and specialist medical practitioners, per 1’000 people. Medical doctors are defined as doctors that study, diagnose, treat, and prevent illness, disease, injury, and other physical and mental impairments in humans through the application of modern medicine. They also plan, supervise, and evaluate care and treatment plans by other health care providers.
Description	This indicator has been used to show the possibility to receive medical cares by specialized personnel. The World Health Organization (WHO) estimates that fewer than 2.3 health workers (physicians, nurses, and midwives only) per 1’000 would be insufficient to achieve coverage of primary healthcare needs. [34] Usually countries with the lowest relative need have a high number of health workers, while those with the greatest burden of disease have to deal with a much smaller health workforce.
Analyzed Indexes	• Weighted Index of Social Progress (WISP)
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • World Bank • World Health Organization (WHO)
Data Source	World Bank [35]

2.3.22 Access to Electricity (% of Population)

Definition	This indicator represents the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources. [36]
Description	Energy alone is not sufficient for creating the conditions for economic growth, but it is certainly necessary. It is impossible to operate a factory, run a shop, grow crops or deliver goods to consumers without using some form of energy. Access to electricity is particularly crucial to human development as electricity is, in practice, indispensable for certain basic activities, such as lighting, refrigeration and the running of household appliances, and cannot easily be replaced by other forms of energy. Individuals' access to electricity is one of the most clear and un-distorted indication of a country energy poverty status. [37]
Analyzed Indexes	• Energy Development Index (EDI) • Energy Sustainability Index (ESI) • FEEM Sustainability Index • Multidimensional Poverty Index (MPI) • Social Progress Index (SPI) • Well Being Index
International Organizations	• International Energy Agency (IEA) • United Nations (UN) • World Bank
Data Source	World Bank [36]

2.3.23 Improved Water Source (% of Population with Access)

Definition	Access to an improved water source refers to the percentage of the population using an improved drinking water source.
Description	The improved drinking water source includes piped water on premises (piped household water connection located inside the user's dwelling, plot or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection). [33] Water is a primary need not always properly guaranteed, especially in the developing countries with adverse climatic conditions.
Analyzed Indexes	• Environmental Performance Index (EPI) • Index of Human Insecurity (IHI) • Index of Sustainable Society • Multidimensional Poverty Index (MPI) • Social Progress Index (SPI) • Well Being Index
International Organizations	• United Nations Millennium Development Goals • United Nations International Children's Emergency Fund (UNICEF) • World Bank
Data Source	World Bank [38]

2.3.24 Food Security Index [0-100]

Definition	Food security is defined as the state in which people at all times have physical, social, and economic access to sufficient and nutritious food that meets their dietary needs for a healthy and active life.
Description	The index is a dynamic quantitative and qualitative scoring model, constructed from 27 unique indicators, that measures these drivers of food security across both developing and developed countries. The overall goal of the study is to assess which countries are most and least vulnerable to food insecurity through the categories of Affordability, Availability, and Quality and Safety. This index is the first to examine food security comprehensively across the three internationally established dimensions. Moreover, the study looks beyond hunger to the underlying factors affecting food insecurity. [39] This indicator has been chosen because the food access is one of the basic needs for humans.
Analyzed Indexes	• Index of Sustainable Society • Social Progress Index (SPI) • Well-being Index
International Organizations	• Food and Agriculture Organization (FAO) • World Bank
Data Source	Economist Intelligence Unit [40]

2.3.25 Rail Lines Transport [Route-km per 1’000 People]

Definition	Rail lines are the length of railway route available for train service, irrespective of the number of parallel tracks. [41]
Description	This indicator has been built to represent the public possibility of moving within the country (to reach schools, workplaces, etc.), even for those who do not own a private vehicle. Rail Lines Length has been normalized with the population and not with the country surface because, in this way, distortions related to possible presences of uninhabited areas (in particular in case of desert areas) are avoided.
Analyzed Indexes	• /
International Organizations	• Central Intelligence Agency (CIA) • Organization for Economic Co-operation and Development (OECD) • World Bank
Data Source	World Bank [41] [42]

5.2.3 Environmental Dimension

In this dimension the main environmental spheres have been taken into account: air, water, land, biodiversity and waste. Particular attention has been given to the air sector, because it actually represents the most debated issue at global level.

3.1 Air

3.1.1 Local

3.1.1.26 PM_{10} Emissions [$\mu g/m^3$]

Definition	Particulate matter concentrations refer to fine suspended particulates less than 10 microns in diameter (PM_{10}) that are capable of penetrating deep into the respiratory tract and causing significant health damage. Data for countries are urban-population weighted PM_{10} levels in residential areas of cities with more than 100'000 residents. The estimates represent the average annual exposure level of the average urban resident to outdoor particulate matter. The state of a country technology and pollution controls is an important determinant of particulate matter concentrations. [43]
Description	In the air quality directive (2008/EC/50), the European Union has set two limit values for particulate matter (PM_{10}) for the protection of human health: the PM_{10} daily mean value may not exceed 50 [$\mu g/m^3$] more than 35 times in a year and the PM_{10} annual mean value may not exceed 40 [$\mu g/m^3$]. [44] Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes and coal combustion (primary method for heating homes and supplying energy in developing countries) are recognized like the main sources of PM_{10}. This indicator has been chosen to represent the local air pollution and the related risk to contract diseases of the respiratory system, which is one of the main cause of death in metropolitan areas.
Analyzed Indexes	• BCFN Index – Well Being Index.
International Organizations	• European Environment Agency (EEA) • World Bank • World Health Organization (WHO)
Data Source	World Bank [43]

3.1.2 Global

3.1.2.27 CO_2 Intesity (Total CO_2 Emissions / Total Final Consumption) [t CO_2/toe]

Definition	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. [45] CO_2 Intensity refers to the ratio between the Total CO_2 Emissions and the Total Final Consumption. The latter covers the energy supplied to the final consumer for all energy uses. It is calculated as the sum of final energy consumption of all sectors. [46]
Description	Data on CO_2 Intensity help estimating the environmental impacts of energy use. The type and extent of energy-related pressures on the environment depends both on the sources of energy (and how they are used) and on the total amount of energy consumed. [47]
Analyzed Indexes	• FEEM Sustainability Index As CO_2 Emissions: • BCFN Index – Well Being Index • Ecological footprint (EF) • Energy Sustainability Index (ESI) • Environmental Performance Index (EPI) • Environmental Sustainability Index (ESI) • Environmental Vulnerability Index (EVI) • Genuine Progress Indicator (GPI) • Genuine Savings Index • Social Progress Index (SPI)
International Organizations	• Central Intelligence Agency (CIA) • European Environment Agency (EEA) • International Energy Agency (IEA) • Organization for Economic Co-operation and Development (OECD) • United Nations Development Programme (UNDP) • United Nations Millennium Development Goals • World Bank
Data Source	World Bank (CO_2 Emissions) [45], International Energy Agency (IEA) (Total Final Consumption) [48]

3.1.2.28 GreenHouse Gases Emissions (Tons of CO_2 Equivalent per Capita per Year)

Definition	The GHG data contain estimates for direct greenhouse gases, such as: CO_2 - Carbon dioxide, CH_4 – Methane, N_2O - Nitrous oxide, PFCs – Perfluorocarbons, HFCs – Hydrofluorocarbons, SF_6 - Sulphur hexafluoride, as well as for the indirect greenhouse gases such as SO_2, NOx, CO and Non-Methane VOC. [49] It includes activities of Land Use Change and Forestry (LUCF).
Description	The contribution of each gas to the greenhouse effect is affected by the characteristics of that gas, its abundance, and any indirect effects it may cause. In this sense the Global Warming Potential (GWP) represents how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A high GWP correlates with a large infrared absorption and a long atmospheric lifetime. This indicator has been chosen to define how much a country contributes to the greenhouse effect and therefore to the global warming.
Analyzed Indexes	• Environmental Sustainability Index (ESI) • FEEM Sustainability Index • Index of Sustainable Society • Internal Market Index (IMI)
International Organizations	• European Environment Agency (EEA) • Organization for Economic Co-operation and Development (OECD) • United Nations Development Programme (UNDP) • World Bank • World Resource Institute (WRI)
Data Source	World Resource Institute (WRI) [50]

3.2.29 Human Impact on Water (Grey Water Footprint / Total Water Footprint)

Definition	The water footprint of an individual, community or business is defined as the total volume of freshwater used to produce the goods and services consumed by the individual or community or produced by the business, that looks at both direct and indirect water use. The total water footprint is determined as the sum of three components: blue, green and grey water. - Blue water footprint: volume of surface and groundwater (water in freshwater lakes, rivers and aquifers) consumed as a result of the production of a good or service. - Green water footprint: volume of rainwater consumed during the production process (precipitation on land that does not run off or recharge the groundwater but is stored in the soil or temporarily stays on top of the soil or vegetation). - Grey water footprint: volume of freshwater that is required to assimilate the load of pollutants based on natural background concentrations and existing ambient water quality standards. [51]
Description	This indicator has been chosen in order to represent the level of freshwater potentially polluted related to the amount of available water in a country. In fact regardless of the water presence in a determined territory, it is important to maintain an adequate water quality standard to avoid harmful consequences to human health and ecosystems.
Analyzed Indexes	• BCFN Index – Well Being Index
International Organizations	• /
Data Source	Water Footprint Network [52]

3.3 Land

3.3.30 Change in Forest Area, 1990/2010 (%)

Definition	Forest area is land under natural or planted stands of trees of at least five meters in situ, whether productive or not, and excludes tree stands in agricultural production systems and trees in urban parks and gardens. [53]
Description	Deforestation is one of the major factors contributing to the greenhouse effect and desertification. According to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, the overwhelming direct cause of deforestation is agriculture. Subsistence farming and commercial agriculture are the main responsible while logging and fuel wood removals contribute less.
Analyzed Indexes	• Environmental Performance Index (EPI) • Environmental Vulnerability Index (EVI) • Genuine Progress Indicator (GPI) • Genuine Savings Index • Index of Sustainable Society
International Organizations	• European Environment Agency (EEA) • Food and Agriculture Organization (FAO) • Organization for Economic Co-operation and Development (OECD) • United Nations Development Programme (UNDP) • United Nations Millennium Development Goals • World Bank
Data Source	United Nations Development Programme (UNDP) [54]

3.3.31 Ecological Footprint Index

Definition	This indicator represents the surface of ecologically productive territory in the diverse categories necessary to supply the resources of energy and matter that a population consumes and to absorb its wastefulness considering its current technology.
Description	The basic idea is that every individual, process, activity, and region has an impact on the earth, via resource use, generation of waste and the use of services provided by nature. These impacts can be converted to biologically productive area. [55] This is not a proper land indicator, but it is a measure of the human impact on the world.
Analyzed Indexes	• BCFN Index – Well Being Index • Environmental Sustainability Index (ESI) • Happy Planet Index • Social Progress Index (SPI)
International Organizations	• European Environment Agency (EEA)
Data Source	Footprint Network [56]

3.4.32 GEF Benefits Index for Biodiversity [0-100]

Definition	GEF benefits index for biodiversity is a composite index of relative biodiversity potential for each country based on the species represented in each country, their threat status, and the diversity of habitat types. [57]
Description	This indicator reflects the complex, highly uneven distribution of species and threats to them across the ecosystems of the world. Biodiversity is the measure of the richness and complexity of the biological community including the number of ecological niches, trophic levels and ecological processes that capture energy, sustain food networks and recycle the materials within these systems. This indicator has been chosen because the biodiversity is a real resource for a country that must be protected, preserved and valorized.
Analyzed Indexes	• /
International Organizations	• United Nations Development Programme (UNDP) • World Bank
Data Source	World Bank [57]

3.5 Waste

3.5.33 Waste Production (Amount of Total Waste / Population) [tonnes/inhabitants/year]

Definition	This indicator represents the amount of waste generated per capita. The Amount of Total Waste includes municipal, industrial and agricultural wastes.
Description	Waste, defined by Directive 2008/98/EC Article 3 as "any substance or object which the holder discards or intends or is required to discard", potentially represents an enormous loss of resources in the form of both materials and energy; in addition, the management and disposal of waste can have serious environmental impacts. Landfills, for example, take up land space and may cause air, water and soil pollution, while incineration may result in emissions of dangerous air pollutants, unless properly regulated. [58] A high waste production, especially in the domestic sector, corresponds to an excessive use of resources and to a low efficiency in their management.
Analyzed Indexes	• BCFN Index – Well Being Index • FEEM Sustainability Index
International Organizations	• European Environment Agency (EEA) • Organization for Economic Co-operation and Development (OECD) • United Nations (UN)
Data Source	Eurostat, SweepNet, European Environment Agency (EEA), National data sources [59]

5.2.4 Institutional Dimension

The institutional sector represents a new way to improve the measure of sustainability. It is fundamental to guarantee the political and social conditions for a country development. The corruption perception, the press freedom and the democracy level themes have been selected.

4.1 Corruption

4.1.34 Corruption Perception Index [0-100]

Definition	This index has been developed by Transparency International in 1995, which scores and ranks countries/territories based on how corrupt a country public sector is perceived to be. It is a composite index, a combination of surveys and assessments of corruption, collected by a variety of reputable institutions. The CPI is the most widely used indicator of corruption worldwide.
Description	Corruption generally comprises illegal activities, which are deliberately hidden and only come to light through scandals, investigations or prosecutions. Secretary General Ban Ki-moon said at the occasion of International Anti-Corruption Day on 9 December 2009 that "Corruption suppresses economic growth by driving up costs, and undermines the sustainable management of the environment and natural resources. It breaches fundamental human rights, exacerbates poverty and increases inequality by diverting funds from health care, education and other essential services". [60] This indicator has been chosen to represent the level of health and integrity of the institutions perceived by the population. Good development policies cannot be carried out without the transparency of the public sector.
Analyzed Indexes	• BCFN – Wellbeing Index • Index of Social Vulnerability to Climate Change
International Organizations	• Organization for Economic Co-operation and Development (OECD) • United Nations Office on Drugs and Crime (UNODC) • World Bank
Data Source	Transparency International [61]

4.2 Press Freedom

4.2.35 Press Freedom Index [0-100]

Definition	This index has been developed by Freedom House in 1980 which assesses the degree of print, broadcast, and internet freedom in every country in the world, analyzing the events of each calendar year.
Description	It provides numerical rankings and rates each country media as "Free," "Partly Free," or "Not Free." Country narratives examine the legal environment for the media, political pressures that influence reporting, and economic factors that affect access to information. A free press plays a key role in sustaining and monitoring a healthy democracy, as well as in contributing to greater accountability, good government, and economic development. Most importantly, restrictions on media are often an early indicator that governments intend to assault other democratic institutions. [62] This indicator has been chosen because the press freedom is a focal point in order to guarantee an open dialogue between population and institutions and a transparent exchange of views and information. The media, if properly used, are a powerful tool to promote the population participation to the political life and to spread the voice of the people.
Analyzed Indexes	• Global Innovation Index (GII)
International Organizations	• /
Data Source	Freedom House [62]

4.3 Democracy

4.3.36 Democracy Index [0-100]

Definition	It is an index developed by Economist Intelligence Unit in 2006, which provides a snapshot of the state of democracy worldwide. The Democracy index is based on five categories: electoral process and pluralism; civil liberties; the functioning of government; political participation and political culture.
Description	Countries are placed within one of four types of regimes: full democracies; flawed democracies; hybrid regimes; and authoritarian regimes. This index is an answer to the issue that free and fair elections and civil liberties are necessary conditions for democracy, but they are unlikely to be sufficient for a full and consolidated democracy if unaccompanied by transparent and at least minimally efficient government, sufficient political participation and a supportive democratic political culture. This indicator has been chosen because democracy is fundamental to guarantee the citizens' rights and promote the active participation to the social life.
Analyzed Indexes	• BCFN – Wellbeing Index.
International Organizations	• /
Data Source	Economist Intelligence Unit [63]

5.3 Final Comparison between the Best Dimensions Model and the Sustainability Evaluation Model

Once built the framework, the Sustainability Evaluation Model has been validated comparing it with the Best Dimensions Model through the Super Decisions software.

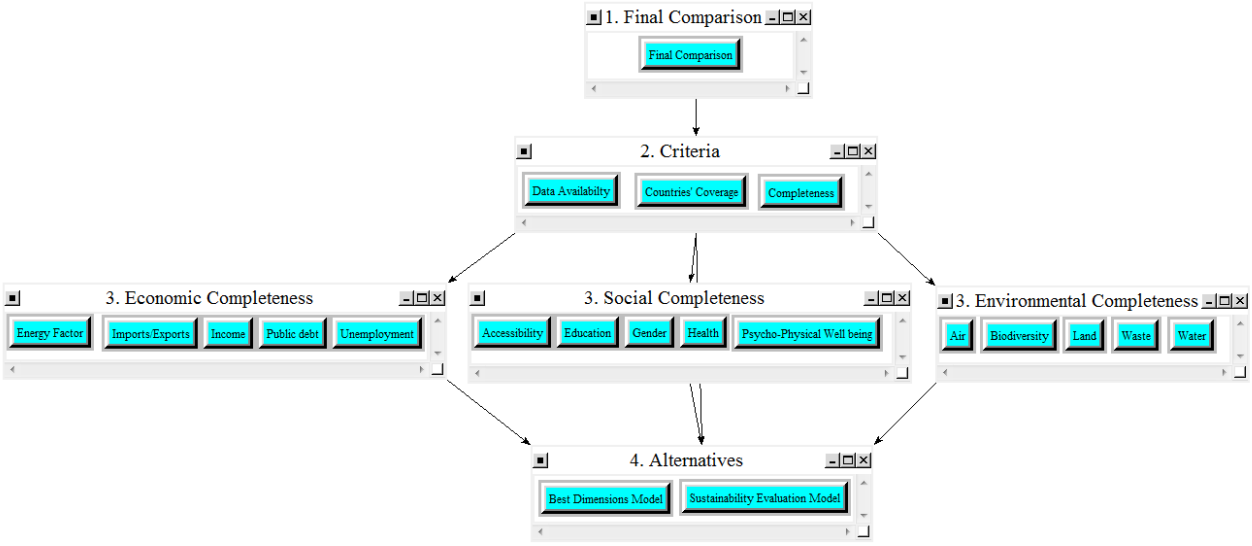
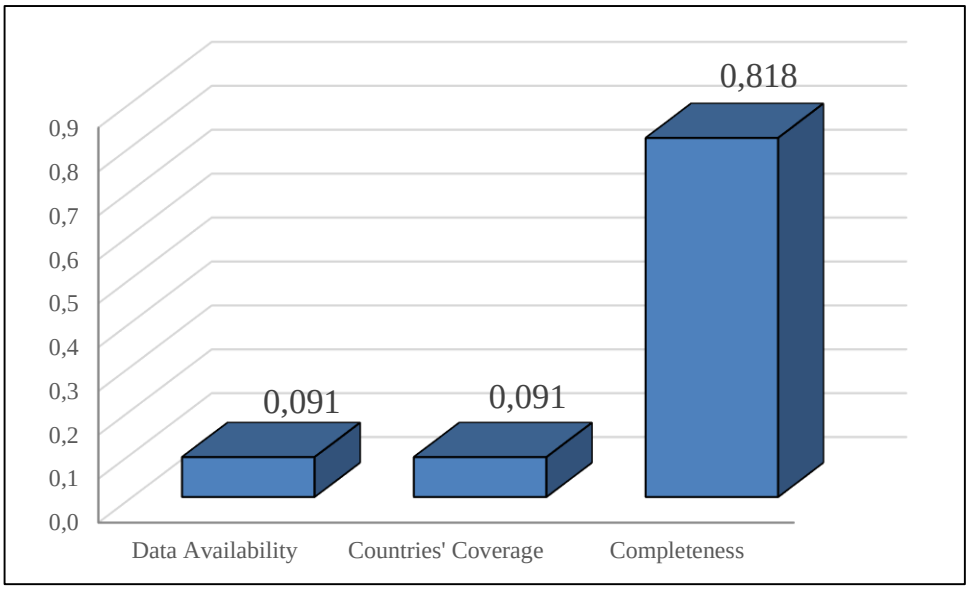


Figure 5.1. Structure between the Best Dimensions Model and the Sustainability Evaluation Model through the Super Decisions software

The same criteria, sub-criteria and relative weights of the analysis performed in Chapter 4 have been used. In particular criteria weights are reported in Graph 5.1, while sub-criteria weights remain fixed at 0.2 following an equal distribution.



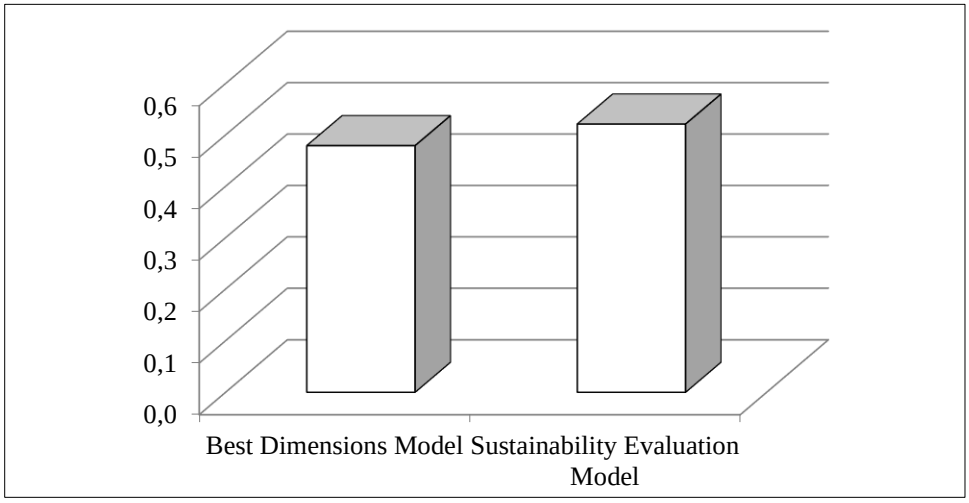
Graph 5.1. Plot of the criteria weights

Table 5.2. Criteria evaluation of the two final models. Data availability: number of indicators; countries' coverage: number of countries in which the model is applied; completeness: presence of the specific indicator

FINAL COMPARISON			
		Best Dimensions Model	Sustainability Evaluation Model
DATA AVAILABILITY		113	36
COUNTRIES' COVERAGE		29	150
COMPLETENESS	ENERGY FACTOR	2	3
	IMPORTS/EXPORTS	2	1
	INCOME	1	1
	PUBLIC DEBT	0	1
	UNEMPLOYMENT	1	1
	AIR	13	3
	BIODIVERSITY	5	1
	LAND	3	2
	WASTE	3	1
	WATER	10	1
	ACCESSIBILITY	0	5
	EDUCATION	6	2
	GENDER	0	1
	HEALTH	8	3
	PSYCHO-PHYSICAL WELLBEING	0	1

Table 5.3 Final comparison results

FINAL COMPARISON	
NAME	RESULTS
Best Dimensions Model	0,479
Sustainability Evaluation Model	**0,521**



Graph 5.2. Plot of the final comparison results

The final comparison shows, as expected, that the Sustainability Evaluation Model overcomes the Best Dimensions Model.
This little gap is justified by the fact that the Best Dimensions Model is not a real index, but it is the sum of the three indexes evaluated as the best ones among the three dimensions in the analysis of the already existing models.
The Sustainability Evaluation Model results the best because it satisfies all the completeness sub-criteria, initially established for the models evaluation, and it also shows good results in the Data Availability and Countries' Coverage criteria.

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6. Methodology

In this chapter, according to the OECD and the Joint Research Centre of the European Commission guidelines, the steps regarding the methodology applied to the Sustainability Evaluation Model are described.

6.1 Imputation of Missing Data

Missing data are present in almost all the case studies of composite indicators.
Three generic approaches for dealing with missing data can be distinguished: case deletion, single imputation or multiple imputation. The first one, case deletion, simply omits the missing records from the analysis. The disadvantages of this approach are that it ignores possible systematic differences between complete and in-complete sample and produces unbiased estimates only if deleted records are a random sub-sample of the original sample. Furthermore, standard errors will be in general larger in a reduced sample given that less information is used. As described in the "Handbook of Constructing Composite Indicators" proposed by the OECD and the Joint Research Centre of the European Commission, if a variable has more than 5% missing values, cases are not deleted, and many researchers are much more stringent than this limit. The other two approaches see the missing data as part of the analysis and therefore try to impute values through either single or multiple imputation.

Single imputations are means or draws from a predictive distribution of the missing values. The predictive distribution must be created by employing the observed data. There are, in general, two approaches to generate this predictive distribution:

- Implicit modelling: the focus is on an algorithm, with implicit underlying assumptions that should be assessed. Besides the need to carefully verify whether the implicit assumptions are reasonable and fit to the issue dealt with, the danger of this type of modelling missing data is to consider the resulting data set as complete and forget that an imputation has been done.
- Explicit modelling: the predictive distribution is based on a formal statistical model where the assumptions are made explicit.

Multiple imputation (MI) is a general approach that does not require a specification of parameterized likelihood for all data. The imputation of missing data is performed with a random process that reflects uncertainty. Imputation is done *N* times, to create *N* "complete" datasets. On each dataset the parameter of interest are estimated, together with their standard errors. Average (mean or median) estimates are combined using the *N* sets and between and within imputation variance is calculated. [1]

In the case study, four out of 15 variables, represented by the countries, presented missing data in a percentage greater than the above-mentioned threshold (5%). Therefore, according to the "Handbook of Constructing Composite Indicators", missing data have been replaced through a single implicit imputation. In particular blank cells have been filled computing a mean among "similar" countries for geographic area or socio-political situation.

This methodology has been extended to the entire dataset, comprising also those countries which presented missing data in a percentage less than 5%.

No imputation model is free of assumptions and other imputation methods could have been used. For example the Environmental Sustainability Index, proposed by Yale and Columbia Universities, uses

a case deletion approach even if the majority of the countries presents missing data which overcome the threshold.

6.2 Normalization

Normalization is required prior to any data aggregation as the indicators in a data set often have different measurement units. [1]
This procedure is necessary to bring the indicators to the same standard, by transforming them in pure, dimensionless numbers. There are many normalization methods available, but in this section only the selected Re-scaling methodology is described.

Re-scaling procedure normalizes indicators to have an identical range [0, 1] by subtracting the minimum value and dividing by the range of the indicator values.

The usefulness of this procedure is that it translates into a widening effect of the normalized indicators whose original values were extremely close, thereby enhancing even small differences. This characteristic is very important especially for some indicators, where groups of countries tend to have very similar values. The drawback of such a methodology is that it is highly sensitive to extreme values, which tend to distort the normalized values.

At technical level, the values of each indicator for all countries are translated into the 0-1 scale, where 0 applies to the minimum value, 1 to the maximum value and converting the intermediate values through the formula (6.1).

$$I_{qc}^{t} = \frac{x_{qc}^{t} - \min(x_{q}^{t_0})}{max(x_{q}^{t_0}) - min(x_{q}^{t_0})} \tag{6.1}$$

In which x_{qc}^{t} indicates the value of an indicator q for the country c at time t.

The maximum and minimum values used for this type of normalization are the lowest and highest values of a specific indicator in one year across countries. These values do not correspond necessarily to the best and worst possible values of that indicator in absolute terms. [2]
If the difference between the maximum and minimum values is relatively high for one indicator and relatively low for another one, than the effect of the former on the composite index becomes somewhat lower than that of the latter. [3]

The data that have been used for the indicators of the Sustainability Evaluation Model are referred to the most recent available datum for each country.

In Table 6.1, the normalization formulas used for each indicator are listed.

Table 6.1. Normalization formulas used for each indicator

INDICATOR	NORMALIZATION FORMULA
1. GNI (PPP) per Capita	(X – MIN) / (MAX – MIN)
2. R&D Expenditure (% of GDP)	(X – MIN) / (MAX – MIN)
3. Public Spending on Education (% of GDP)	(X – MIN) / (MAX – MIN)
4. Public Health Expenditure (% of GDP)	(X – MIN) / (MAX – MIN)
5. Unemployment, Total (% of Total Labor Force)	(X – MAX) / (MIN – MAX) *
6. Total Primary Energy Supply / GDP	(X – MAX) / (MIN – MAX) *
7. Electricity Production from Renewables / Total Electricity Production	(X – MIN) / (MAX – MIN)
8. Net Exports / (Exports + Imports of Goods and Services)	(X – MIN) / (MAX – MIN)
9. Energy Imports, Net (% of Energy Use)	For X < 0: [1] For X ≥ 0: (X – MAX) / (0 – MAX) **
10. Public Debt (% of GDP)	(X – MAX) / (MIN – MAX) *
11. Urban Population / Urban Areas	(X – MAX) / (MIN – MAX) *
12. Gender Inequality Index	(X – MAX) / (MIN – MAX) *
13. GINI Richness Distribution	(X – MAX) / (MIN – MAX) *
14. School Enrolment, Secondary (% Respect to the Sec. School Age)	(X – MIN) / (MAX – MIN)
15. Mean Years of Schooling	(X – MIN) / (MAX – MIN)
16. Life Expectancy at Birth	(X – MIN) / (MAX – MIN)
17. % of HIV Cases	(X – MAX) / (MIN – MAX) *
18. Obesity Prevalence, (% 20+ Years Old); Malnutrition Prevalence, (% < 5 Years Old)	[0.5 * (X – MAX) / (MIN – MAX)] + [0.5 * (X – MAX) / (MIN – MAX)] ***
19. Suicide Rate per 100'000 People	(X – MAX) / (MIN – MAX) *
20. Homicide Rate per 100'000 People	(X – MAX) / (MIN – MAX) *
21. Physicians per 1’000 People	(X – MIN) / (MAX – MIN)
22. Access to Electricity (% of Population)	(X – MIN) / (MAX – MIN)
23. Improved Water Source (% of Population with Access)	(X – MIN) / (MAX – MIN)
24. Food Security Index	(X – MIN) / (MAX – MIN)
25. Rail Route-km per 1’000 People	(X – MIN) / (MAX – MIN)
26. PM_{10} Emissions, Micrograms per Cubic Meter	(X – MAX) / (MIN – MAX) *
27. Total CO_2 Emissions / Total Final Consumption	(X – MAX) / (MIN – MAX) *
28. GHG Emissions, Tons of CO_2 Equivalent per Capita per Year	(X – MAX) / (MIN – MAX) *
29. Human Impact on Water	(X – MAX) / (MIN – MAX) *
30. Change in Forest Area	(X – MIN) / (MAX – MIN)
31. Ecological Footprint Index	(X – MAX) / (MIN – MAX) *
32. GEF Benefits Index for Biodiversity	(X – MIN) / (MAX – MIN)
33. Amount of Total Waste / Population	(X – MAX) / (MIN – MAX) *
34. Corruption Perception Index	(X – MIN) / (MAX – MIN)
35. Press Freedom Index	(X – MAX) / (MIN – MAX) *
36. Democracy Index	(X – MIN) / (MAX – MIN)

* Inverted Re-scaling formula, where 1 applies to the minimum value and 0 to the maximum value.

** For X < 0, exports prevail over imports, assigning the maximum value 1. For X ≥ 0, the inverted Re-scaling formula has been used, where 1 applies to the zero value (imports equal exports) and 0 to the maximum value.

*** Obesity and Malnutrition indicators have been normalized through the inverted Re-scaling formula and then aggregated in an unique index using equal weights.

6.3 Weighting

Central to the construction of a composite index is the need to combine in a meaningful way different dimensions measured on different scales. This implies a decision on which weighting model will be used and which procedure will be applied to aggregate the information.
Weights usually have an important impact on the value of a composite index and on the resulting ranking especially whenever higher weight is assigned to sub-indicators on which some countries excel or fail. This is why weighting models need to be made explicit and transparent. Moreover, the reader should bear in mind that, no matter which method is used, weights are essentially value judgments and have the property to make explicit the objectives underlying the construction of a composite.
Weighting is strongly related to how the information conveyed by the different dimensions is aggregated into a composite index. Different aggregation rules are possible.

Weights heavily influence the outcome of a composite indicator and countries ranking in a benchmarking exercise. Therefore, weights should ideally be selected according to an underlying and agreed or at least clearly stated theoretical framework.

Indicators could also be weighted based on the opinion of experts, who know policy priorities and theoretical backgrounds, to reflect the multiplicity of stakeholders' viewpoints.

Weighting imply a "subjective" evaluation, which is particularly delicate in case of complex, interrelated and multidimensional phenomena. [1]

Three different weighting methodology have been applied to the Sustainability Evaluation Model:

Equal weights, Hierarchical Tree weights and Experts' weights.

6.3.1 Equal Weighting

In many composite indicators, same weights are given to all variables when there are no statistical or empirical grounds for choosing a different scheme. Equal weighting (EW) could imply the recognition of an equal status for all sub-indicators. Alternatively, it could be the result of insufficient knowledge of causal relationships, or ignorance about the correct model to apply (like in the case of Environmental Sustainability Index), or even stem from the lack of consensus on alternative solutions. In any case, EW does not mean no weighting, because EW anyway implies an implicit judgment on the weights being equal. [1]

In the proposed model, the equal weights assigned to each indicator have assumed the value of 1/36 = 0.028, where 36 is the total number of indicators.

6.3.2 Hierarchical Tree Weighting

This weighting methodology is based on the application of equal weights to indicators comprised in the same category or group. Weighting equally categories regrouping a different number of sub-indicator could disguise different weights applied to each single sub-indicator.

In this way, it is possible to infer the relative importance given to every sub-node at every node of the hierarchical tree. In Table 6.2, the relative weights, corresponding to the contribution of each indicator to the belonging dimension, are shown.

Table 6.2. Relative weights of the hierarchical tree

DIMENSIONS	NODES	CRITERIA	SUB-CRITERIA	INDICATORS	RELATIVE WEIGHTS
Economic 1/4	GNI per capita 1/3	1. GNI Balance 1		GNI (PPP) per Capita	0,333
	Long Term Drivers 1/3	2. Research & Development 1/5		R&D Expenditure (% of GDP)	0,067
		3. Public Education 1/5		Public Spending on Education (% of GDP)	0,067
		4. Public Health 1/5		Public Health Expenditure (% of GDP)	0,067
		5. Labor 1/5		Unemployment, Total (% of Total Labor Force)	0,067
		6. Energy Intensity 1/5		Total Primary Energy Supply / GDP	0,067
	Vulnerability 1/3	7. Electricity Share from Renewables 1/4		Electricity Production from Renewables / Total Electricity Production	0,083
		8. Relative Trade Balance 1/4		Net Exports / (Exports + Imports of Goods and Services)	0,083
		9. Energy Imported 1/4		Energy Imports, Net (% of Energy Use)	0,083
		10. Public Debt 1/4		Public Debt (% of GDP)	0,083
Social 1/4	Population 1/3	11. Urban Population Density 1/3		Urban Population / Urban Areas	0,111
		12. Gender Balance 1/3		Gender Inequality Index	0,111
		13. GINI Index 1/3		GINI Richness Distribution	0,111
	Wellbeing 1/3	Education 1/3	14. School Enrolment 1/2	Secondary School Enrolment	0,056
			15. Education Policy 1/2	Mean Years of Schooling	0,056
		Health 1/3	16. Life Expectancy 1/3	Life Expectancy at Birth	0,037
			17. Infectious Disease 1/3	% of HIV Cases	0,037
			18. Obesity & Malnutrition 1/3	Obesity Prevalence, (% 20+ Years Old); Malnutrition Prevalence, (% < 5 Years Old)	0,037
		Premature Deaths 1/3	19. Suicide 1/2	Suicide Rate per 100'000 People	0,056
			20. Criminality 1/2	Homicide Rate per 100'000 People	0,056
	Accessibility 1/3	21. Physicians 1/5		Physicians per 1'000 People	0,067
		22. Energy Access 1/5		Access to Electricity (% of Population)	0,067
		23. Water Source 1/5		Improved Water Source (% of Population with Access)	0,067
		24. Food Security 1/5		Food Security Index	0,067
		25. Rail Lines Transport 1/5		Rail Route-km per 1'000 People	0,067
Environmental 1/4	Air 1/5	Local 1/2	26. PM_{10} Emissions 1	PM_{10} Emissions	0,100
		Global 1/2	27. CO_2 Intensity 1/2	Total CO_2 Emissions / Total Final Consumption	0,050
			28. GHG Emissions 1/2	GHG Emissions	0,050
	Water 1/5	29. Water Footprint 1		Human Impact on Water	0,200
	Land 1/5	30. Forest 1/2		Change in Forest Area	0,100
		31. Ecological Footprint 1/2		Ecological Footprint Index	0,100
	Biodiversity 1/5	32. Animals and Plants Biodiversity 1		GEF Benefits Index for Biodiversity	0,200
	Waste 1/5	33. Waste Production 1		Amount of Total Waste / Population	0,200
Institutional 1/4	Transparency 1/3	34. Corruption Perception Index 1			0,333
	Press Freedom 1/3	35. Press Freedom Index 1			0,333
	Democracy 1/3	36. Democray Index 1			0,333

It is also possible to combine these results in a linear way in order to approximate how much every final node of the hierarchical tree contributes towards the determination of the final proposed sustainability index values (Table 6.3.B).

By multiplying the equal weights of every hierarchically superior node of every indicator, from the bottom of the hierarchical tree to the top (e.g. contribution of Energy Access is calculated by multiplying the weights of Energy Access, Accessibility and Social Dimension, since Energy Access indicator is under the node of Accessibility which is a node of Social Dimension), it is possible to determine the overall importance weights, ranked by decreasing value and summing to one. [2]
In Table 6.3.A the weights of the four sustainability dimensions are displayed, while in Table 6.3.B the absolute weights of each indicator, obtained through the hierarchical tree, are ranked from the highest to the lowest, highlighted with the color of the related dimension.

Table 6.3.A. Dimensions weights by hierachical tree weighting

Dimension	Weight
Economic	0,25
Social	0,25
Environmental	0,25
Institutional	0,25

Table 6.3.B. Indicators contribution to the overall index by hierachical tree weighting

Indicator	Contribution to overall Index
1. GNI per Capita	0,083
34. Corruption Perception	0,083
35. Press Freedom	0,083
36. Democray Level	0,083
29. Water Footprint	0,050
32. Animals and Plants Biodiversity	0,050
33. Waste Production	0,050
11. Urban Population Density	0,028
12. Gender Balance	0,028
13. GINI Index	0,028
26. PM_{10} Emissions	0,025
30. Change in Forest Area	0,025
31. Ecological Footprint	0,025
7. Electricity Share from Renewables	0,021
8. Relative Trade Balance	0,021
9. Energy Imported	0,021
10. Public Debt	0,021
2. Research & Development Expenditure	0,017
3. Public Spending Education	0,017
4. Public Health Expenditure	0,017
5. Unempolyment Rate	0,017
6. Energy Intensity	0,017
21. Physicians per 1'000 People	0,017
22. Energy Access	0,017
23. Water Source	0,017
24. Food Security	0,017
25. Rail Lines Transport	0,017
14. Secondary School Enrolment	0,014
15. Mean Years of Schooling	0,014
19. Suicide Rate	0,014
20. Criminality Rate	0,014
27. CO_2 Intensity	0,013
28. GHG Emissions	0,013
16. Life Expectancy	0,009
17. HIV Cases	0,009
18. Obesity & Malnutrition	0,009

6.3.3 Experts' Weighting

Finally, weights obtained by experts' judgments have been applied to the Sustainability Evaluation Model through an ad-hoc questionnaire. The subjectivity of this procedure is balanced by the reliable evaluation of people involved in the sustainability sectors.

The experts belong to different countries of the Mediterranean area, which is the context where the proposed model has been validated (this topic is specifically treated in Chapter 7). The variety of opinions has allowed to obtain a general overview of the sustainability concept.

Obviously, changing the area of the model application, experts' judgments of the new context have to be collected by means of the same proposed questionnaire.

First step: to obtain experts' judgments, they have been interviewed through a questionnaire composed by 24 questions, of two typologies:

- pairwise comparisons, made between pairs of individual indicators, asking which of the two was the more important and by how much;
- choice of the order of importance among different issues.

Second step: once the answers have been collected, the mean has been computed in order to extract a single weight for each indicator.
To avoid inconsistency problems in the answers and an excessive number of questions, all the possible pairwise comparisons between the indicators have not been proposed.

Third step: in order to complete the weights matrix through the Super Decisions software, the indicators have been ranked within each category on the basis of the answers extrapolated from the questionnaire.
The ranking has been made according to the Saaty scale, where a preference of 1 indicates equality between two individual indicators, while a preference of 9 indicates that the individual indicator is 9 times more important than the other one.

Fourth step: using the above-mentioned software, the pairwise comparisons have been carried out among all the indicators, obtaining the relative weights within each category.

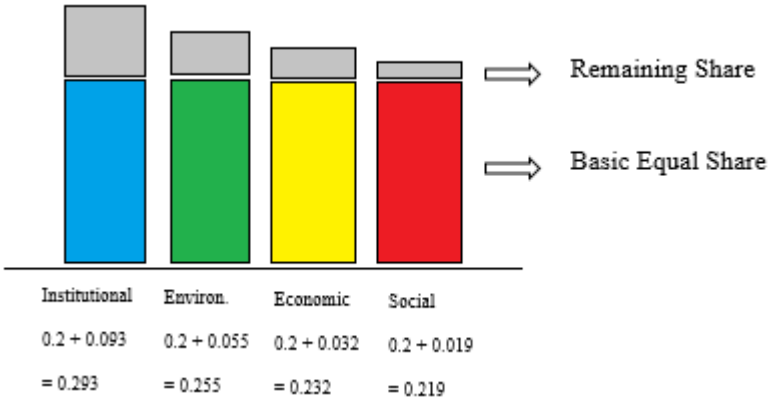
Fifth step: since the resulting weights presented big ranges within the same sector, they have been smoothed assigning a basic equal share to each indicator of the same category.
The remaining share has been distributed according to the relative weights obtained from the software. (6.2) is the used formula. In Table 6.4 and in Graph 6.1 an example of this step is shown.

The absolute experts' weights have been finally obtained using the smoothed weights, computed in the previous procedure, following the structure of the hierarchical tree.

$$Smoothed\ Weight = \underbrace{\frac{1}{(n.\ of\ indicators\ +\ 1)}}_{\text{Basic equal share}} + \underbrace{\frac{1}{(n.\ of\ indicators\ +\ 1)}}_{\text{Remaining share}} * AHP\ Relative\ Weight \tag{6.2}$$

Table 6.4. Example of the smoothing procedure

Criteria	AHP weights	Smoothed weights
Institutional	0.467	0.293
Environmental	0.277	0.255
Economic	0.160	0.232
Social	0.095	0.219



Graph 6.1. Plot of the smoothing procedure example

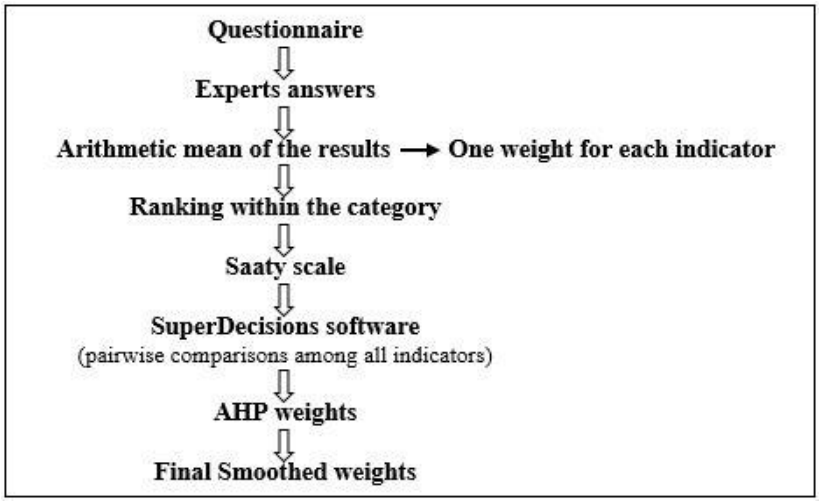


Figure 6.1. Steps for the experts' weighting procedure

In Table 6.5.A the experts' weights of the four sustainability dimensions are displayed. In Table 6.5.B the absolute experts' weights of each indicator are ranked from the highest to the lowest, highlighted with the color of the related dimension. They have been computed following the procedure explained in Paragraph 6.3.2.

Table 6.5.A. Dimensions weights by experts' weighting

Dimension	Weight
Economic	0,232
Social	0,219
Environmental	0,255
Institutional	0,293

Table 6.5.B. Indicators contribution to the overall index by experts' weighting

Indicator	Contribution to overall Index
34. Corruption Perception	0,113
36. Democracy Level	0,095
35. Press Freedom	0,085
1. GNI per Capita	0,063
33. Waste Production	0,050
29. Water Footprint	0,046
32. Animals and Plants Biodiversity	0,044
13. GINI Index	0,037
26. PM_{10} Emissions	0,030
30. Change in Forest Area	0,027
31. Ecological Footprint	0,027
5. Unemployment Rate	0,026
11. Urban Population Density	0,025
12. Gender Balance	0,025
10. Public Debt	0,022
3. Public Spending Education	0,020
2. Research & Development	0,019
4. Public Health Expenditure	0,018
6. Energy Intensity	0,017
8. Relative Trade Balance	0,017
27. CO_2 Intensity	0,015
28. GHG Emissions	0,015
9. Energy Imported	0,015
7. Electricity Share from Renewables	0,015
21. Physicians per 1'000 People	0,014
20. Criminality Rate	0,014
14. Secondary School Enrolment	0,013
15. Mean Years of Schooling	0,013
22. Energy Access	0,013
23. Water Source	0,012
24. Food Security	0,011
25. Rail Lines Transport	0,011
19. Suicide Rate	0,010
17. HIV Cases	0,009
18. Obesity & Malnutrition	0,009
16. Life Expectancy	0,007

6.4 Aggregation Methods

In order to obtain a final composite index, the normalized values of the all considered indicators have been aggregated using different aggregation techniques. According to the objectives of a model, different methods can be applied, considering the relative advantages and disadvantages. A linear and a geometric aggregation have been chosen.

6.4.1 Linear Aggregation

Among all the possible linear aggregations, the summation of weighted and normalized individual indicators, which is the most widespread method, has been used. (6.3)

$$CI_c = \sum_{q=1}^{Q} w_q \; I_{qc} \qquad (6.3)$$
$$with \sum_q w_q = 1 \;\; and \;\; 0 \leq w_q \leq 1, for\ all\ q = 1, \dots, Q \;\; and \; c = 1, \dots, M$$

Although widely used, this aggregation imposes restrictions on the nature of individual indicators. In particular, obtaining a meaningful composite indicator depends on the unit of measurement of the individual indicators. This drawback has been overcome through the normalization of the data

6.4.2 Geometric Aggregation

If multi-criteria analysis entails full non-compensability, unlike the linear aggregation, the use of a geometric aggregation (6.4) is an in-between solution.

$$CI_c = \prod_{q=1}^{Q} x_{q,c}^{w_q} \qquad (6.4)$$

The geometric aggregation has been computed only among the four sustainability dimensions, whose scores have been obtained through the summation of the weighted indicators. [4] In this way extreme low values greatly influence the final result, emphasizing the concept that, in order to be sustainable, a country has to get an high score in all the four dimensions.

6.4.3 Linear vs Geometric

Linear aggregation method is useful when all individual indicators have the same measurement unit and further ambiguities due to the scale effects have been neutralized. On the other hand geometric aggregations are better suited if the modeler wants some degree of non compensability between individual indicators or dimensions. Furthermore, linear aggregations reward base-indicators proportionally to the weights, while geometric aggregations reward those countries with higher scores.

In both linear and geometric aggregations, weights express trade-offs between indicators. A deficit in one dimension can thus be offset (compensated) by a surplus in another. This implies an inconsistency between how weights are conceived (usually measuring the importance of the associated variable) and the actual meaning when geometric or linear aggregations are used. In a linear aggregation, the

compensability is constant, while with geometric aggregations compensability is lower for the composite indicators with low values. In terms of policy, if compensability is admitted, a country with low scores on one indicator will need a much higher score on the others to improve its situation when geometric aggregation is used. Thus, in benchmarking exercises, countries with low scores prefer a linear rather than a geometric aggregation. On the other hand, the marginal utility from an increase in low absolute score would be much higher than in a high absolute score under geometric aggregation. Consequently, a country would have a greater incentive to address those sectors/activities/alternatives with low scores if the aggregation were geometric rather than linear, as this would give it a better chance of improving its position in the ranking. [1]

6.5 Sensitivity Analysis

In this section the theory concerning the robustness and correlation analysis is presented. The results are described in Chapter 9.

6.5.1 Robustness Analysis

In a complex aggregation such as the one used for the Sustainability Evaluation Model, the attitude of the representative experts is a key component of the process. Thus, it is important to check how robust the ranking is to a change in the representative experts' attitude. On the other hand, a mathematical algorithms, that may be built on some theoretical and empirical grounds, is necessary to test how robust findings are therefore, sensitivity analysis is a fundamental step during the development of any composite indicator.

There exist many ways to modify the weights provided by the experts in the hierarchical decomposition; a straightforward way is to consider more than one such expert at the time, considering each of them as a point in the weight space. Then, a robustness analysis can be performed by building a linear convex combination (6.5) of the values of the weights and run a significant number of simulation, as in a Monte Carlo approach.

This is a broad class of computational algorithms that relies on repeated random sampling to obtain numerical results; typically simulations are run many times in order to obtain the distribution of an unknown probabilistic entity. The name comes from the resemblance of the technique to the act of playing and recording the results in a real gambling casino.

$$Convex\ combination:\ a_i \geq 0\ and\ \sum a_i = 1 \qquad (6.5)$$

At each simulation, a weight was allowed to vary between 0 and 1 and the simulated weights for all the 36 indicators were then divided by the overall sum of the corresponding weights. This simulation was repeated 1000 times and the composite indicator scores for each country were calculated 1000 times.
Through a specific software for the numerical calculation, a matrix composed by 36 row has been generated corresponding to the total number of indicators included in the Sustainability Evaluation Model, and by 1000 columns, referred to the number of simulations.

Therefore the robustness analysis was performed with the 1000 sets of measures that were necessary to aggregate the indicators into the final index. Each of these sets constituted, for any practical purposes, an internally consistent assessment on sustainability identical to what was provided by

experts. These sets were thus called “artificial experts” (AEs). In this particular application, each AE represented a univocal instance of consensus among “real” experts, whose measures were combined using random weights, similarly to how the representative expert was constructed. The measures containing in the artificial experts were used to aggregate, with the summation of weighted and normalized individual indicators, the final index, using the same indicators as for the reference case. The process resulted in a distribution of the final index for each considered country, which can be ranked according to the relative median value. [2]

6.5.2 Correlation Analysis

Correlation analysis is performed to examine the relationship between the indicators in a framework. It is a basic but widely used tool for “confirming” the mathematical design of indices. A major drawback of correlation analysis though is the fact that strong correlation does not necessarily imply strong influence or representation of the indicator in the overall index. In other words, any random variable could potentially show strong correlation with the index without actually being part of the index. Yet, the higher the number of cases analyzed the lower the probability that spurious correlations occur. [4]
Correlation analysis should not be mistaken with causality analysis. Correlation simply indicates that the variation in the two data sets is similar. A change in the indicator does not necessarily lead to a change in the composite indicator and vice versa. [1]

In order to perform this analysis, the Pearson correlation coefficient (r) has been used (6.6), a measure of the linear correlation (dependence) between two variables X and Y, giving a value between +1 and −1 inclusive, where 1 is total positive correlation, 0 is no correlation, and −1 is total negative correlation.

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})\,(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}\,(X_i - \bar{X})^2}\,\sqrt{\sum_{i=1}^{n}\,(Y_i - \bar{Y})^2}} \qquad (6.6)$$

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7. Context of Application

The Sustainability Evaluation Model has been implemented not on a global scale but in a defined context. In fact the aim is to provide a tool able to make comparisons among countries which present geographical, political or cultural similarities. Once the data are collected, the constructed framework of the model can be applied in whatever scenario.
The proposed index has been calibrated in the Mediterranean region, a combination of different realities regarding the sustainability. Typically this area represents the meeting point of the three continents, characterized by a millenarian tradition and nowadays by two main factors: the economic crisis, started in the 2008, and the Arab Spring, spread in the 2010.
Moreover some projects in collaboration with the Politecnico di Milano University, are developed in this area.

In particular the selected countries are: Spain, France, Italy, Croatia, Albania, Cyprus and Greece for the European side, Turkey, Lebanon and Israel for the Middle Eastern side and Egypt, Libya, Tunisia, Algeria and Morocco for the Northern Africa side.

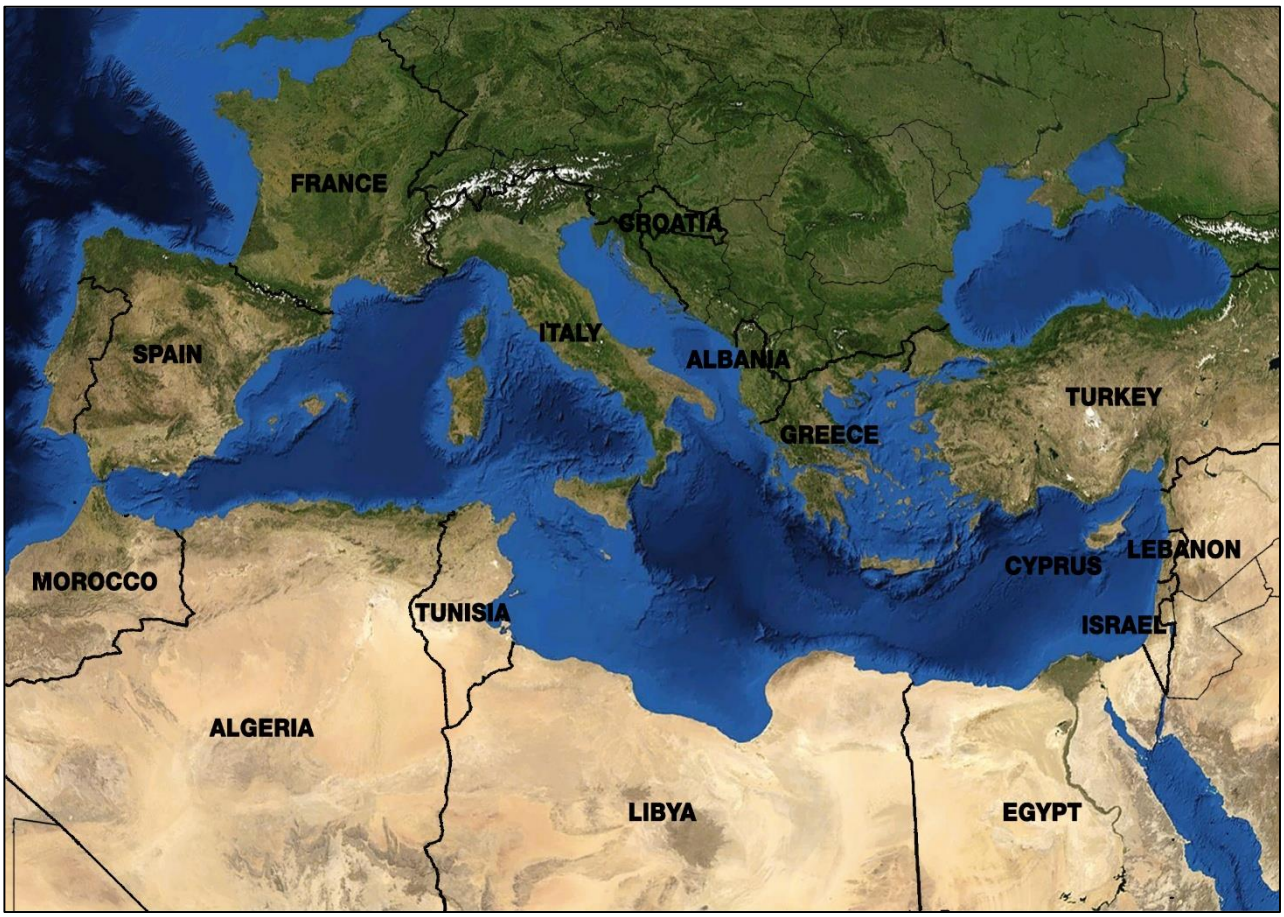

Figure 7.1. Map of the analyzed context: the Mediterranean Area

7.1 European Side

Spain, Italy and Greece, traditionally characterized by a good standard of well being, have met significant economic difficulties in the last five years. This due to the crisis that has been affecting

the countries of the Eurozone since late 2008. It is a combined government debt, banking and growth and competitiveness crisis.
Banks are undercapitalized and have faced liquidity problems. Additionally, economic growth is slow in the whole of the Eurozone and is unequally distributed across the member states. Causes of the crisis varied by nation. In several countries, private debts arising from a property bubble were transferred to sovereign debt as a result of banking system bailouts and government responses to slowing economies post-bubble. In Greece, high public sector wage and pension commitments were connected to the debt increase. The crisis have not only introduced adverse economic effects for the worst hit countries, but also had a major political impact on the ruling governments in 8 out of 17 Eurozone countries, leading to power shifts also in Greece, Italy and Spain. The Eurozone crisis has become a social crisis for the most affected countries, with Greece and Spain having the highest unemployment rates. [1]

Even France has been affecting by the economic crisis but in a milder way.

Differently Croatia and Albania have been affected by the past communist regime ended in the early nineties, which has caused slowdowns in the development respect to the other European Economies.

7.2 MENA (Middle East and North Africa) Side

Since 2010 the countries of this zone have been affecting by the Arab Spring, which is the revolutionary wave of nonviolent and violent demonstrations, protests, riots, and civil wars against dictatorships and absolute monarchies, causes of human rights violations, political corruption, economic decline, unemployment, extreme poverty, and a number of demographic structural factors such as a large percentage of educated but dissatisfied youth within the population. The protests have shared some techniques of civil resistance as well as the effective use of social media to organize, communicate and raise awareness in the face of state attempts at repression and internet censorship. [2]

The series of protests and demonstrations across the Middle East and North Africa that commenced in 2010 has sparked by the first protests that occurred in Tunisia on 18th December in Sidi Bouzid. With the success of the protests in Tunisia the phenomenon spread to other countries: Algeria, Jordan, Oman, Egypt, Yemen, Djibouti, Somalia, Sudan, Iraq, Bahrain, Libya, Kuwait, Morocco, Mauritania, Lebanon, Saudi Arabia, Syria, Iran, Israel, Palestine.

As a consequence, by the end of 2011, the governments in Tunisia, Egypt, Libya and Yemen were swept away by popular revolts, in an unprecedented show of people power. In the other countries where authoritarian rulers managed to cling on, they can no longer take the acquiescence of the masses for granted. The governments across the region have been forced into reform, aware that corruption, incompetence and police brutality will no longer be unchallenged. [3]

The Middle East has witnessed an explosion of political activity, particularly in the countries where the revolts successfully removed the long-serving leaders. Hundreds of political parties, civil society groups, newspapers, TV stations and online media have been launched, as Arabs scramble to reclaim their country from ossified ruling elites.

Removing corrupt dictators was a positive step for the future, but ordinary people remain a long time away from seeing tangible improvements to their economic opportunities.

In particular in Egypt the decisive moment that changed the region forever was the downfall of Egyptian President Hosni Mubarak, the West's key Arab ally, in power since 1980. Protests for

deeper political change continue but in the meanwhile the economy is in freefall since the start of unrest. [3]

7.3 Particular Cases

Although Israel and Turkey are considered countries with a good standard of living and they belong to the Organization for Economic Co-operation and Development (OECD), they are affected by political and social instabilities.
In the 2013 Turkey has faced a popular protest, initially against the urban development plan for Istanbul's Taksim Gezi Park. Subsequently, supporting protests and strikes took place across Turkey protesting a wide range of concerns, at the core of which were issues of freedom of the press, of expression, assembly, and the government's encroachment on Turkey's secularism. This phenomenon is the emblem of an instability climate in the recent history of the country. [4]

Israel, since the postwar, is constantly in a conflict situation because of the political tensions versus the opposed Palestinian government, leading to unstable and unsafe conditions.

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[4] <http://www.huffingtonpost.com/emre-kizilkaya/gezi-park-social-media_b_3435581.html>

8. Results and In-Depth Analysis

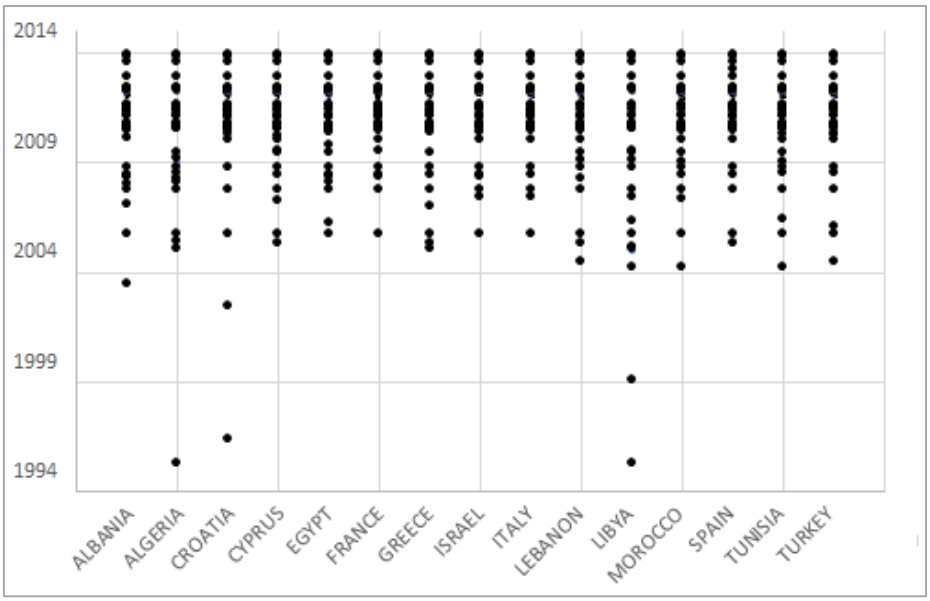
Once defined the Sustainability Evaluation Model framework, the used methodology and the context of application, the final scores have been computed. They represent a useful tool, not only to assess the sustainability level of the countries, but also to highlight strengths and weaknesses for each sector, in order to support the decision making of the relative policies. This in-depth analysis could be implemented for each of the analyzed countries, however only Egypt and Italy have been selected for illustrative purpose.

In detail, in this chapter are described:

- data analysis, concerning the years of the data and the missing data
- general final scores
- geographic-theme analysis
- single countries profiles
- focus on Egypt and Italy.

8.1 Data Analysis

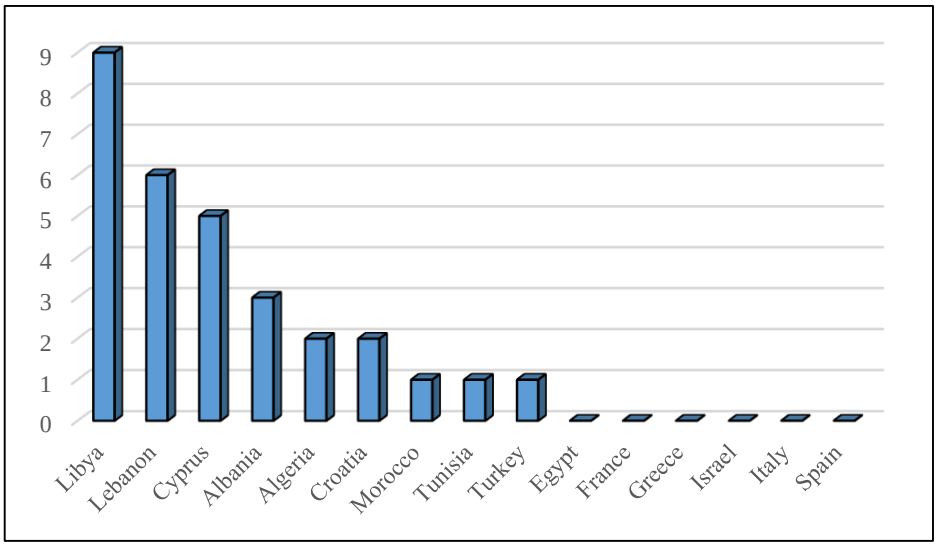
Particular attention must be given to the fact that data do not refer to a unique year, but to the most recent available data, assuming that they remain constant in the successive years. This limit can be overcome once updated data will be provided. Below the corresponding graph shows the data years of the 36 indicators of the model, for each country.



Graph 8.1. Plot of the data years

As shown by Graph 8.1, Algeria, Croatia and Libya are the countries that present the largest years range regarding the data collection. On the other hand, data of France, Israel, Italy and Spain refer to more recent years.

Below the graph showing the number of missing data per country.



Graph 8.2. Plot of the number of missing data by country

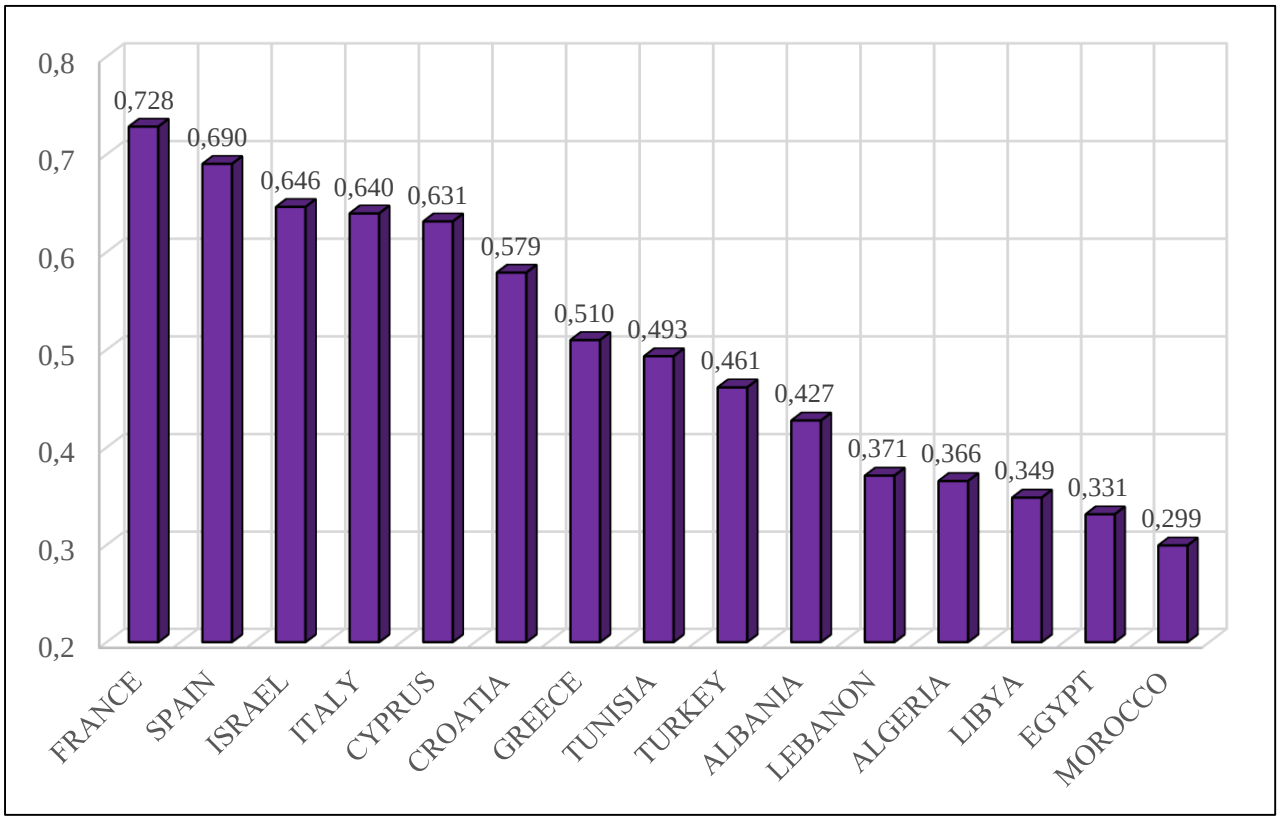
As shown by Graph 8.2, Libya, Lebanon, Cyprus and Albania, are the countries which present the highest number of missing data; in particular they exceed the threshold of the 5% of missing data respect to the total, proposed by the OECD and the Joint Research Centre European Commission in the "Handbook of Constructing Composite Indicators" (Paragraph 6.1).
It is important to remark that the replacement procedure of missing data can lead to distortions of the reality.
In Table 8.1, countries used to obtain the mean for replacing the missing data are listed. The criteria for the selection has been the closeness from the geographical point of view.

Table 8.1. Countries for replacing missing data

Country	Mean among
Albania	Croatia - Greece
Algeria	Egypt - Libya - Morocco - Tunisia
Croatia	Albania - Greece
Cyprus	Greece - Israel - Lebanon - Turkey
Lebanon	Greece - Israel - Turkey
Libya	Algeria - Egypt - Morocco - Tunisia
Morocco	Algeria - Egypt - Libya - Tunisia
Tunisia	Algeria - Egypt - Libya - Morocco
Turkey	Cyprus - Greece - Israel - Lebanon

8.2 Sustainability Evaluation Model Results

To compute the final scores of the Sustainability Evaluation Model, experts' weights geometrically aggregated have been used. These have been chosen because experts' judgments provide a specific view from the analyzed context, while the geometric aggregation emphasizes the concept that, in order to be sustainable, a country has to get a high score in all the four dimensions.



Graph 8.3. Plot of the scores by country

Analyzing the final scores, it is possible to deduce some main considerations:

- France obtains the highest score in a clear way.
- Morocco obtains the lowest score by a large margin compared to the previous country.
- Israel, Italy and Cyprus assume similar scores.
- Lebanon and Algeria assume similar scores.

Table 8.2. Final scores

RANK	COUNTRY	SCORE
1	FRANCE	0,728
2	SPAIN	0,690
3	ISRAEL	0,646
4	ITALY	0,640
5	CYPRUS	0,631
6	CROATIA	0,579
7	GREECE	0,510
8	TUNISIA	0,493
9	TURKEY	0,461
10	ALBANIA	0,427
11	LEBANON	0,371
12	ALGERIA	0,366
13	LIBYA	0,349
14	EGYPT	0,331
15	MOROCCO	0,299

In the maps below, the countries of the analyzed context are displayed according to their final scores, respectively for the Sustainability Evaluation Model, the economic dimension, the social dimension, the environmental dimension and the institutional dimension.

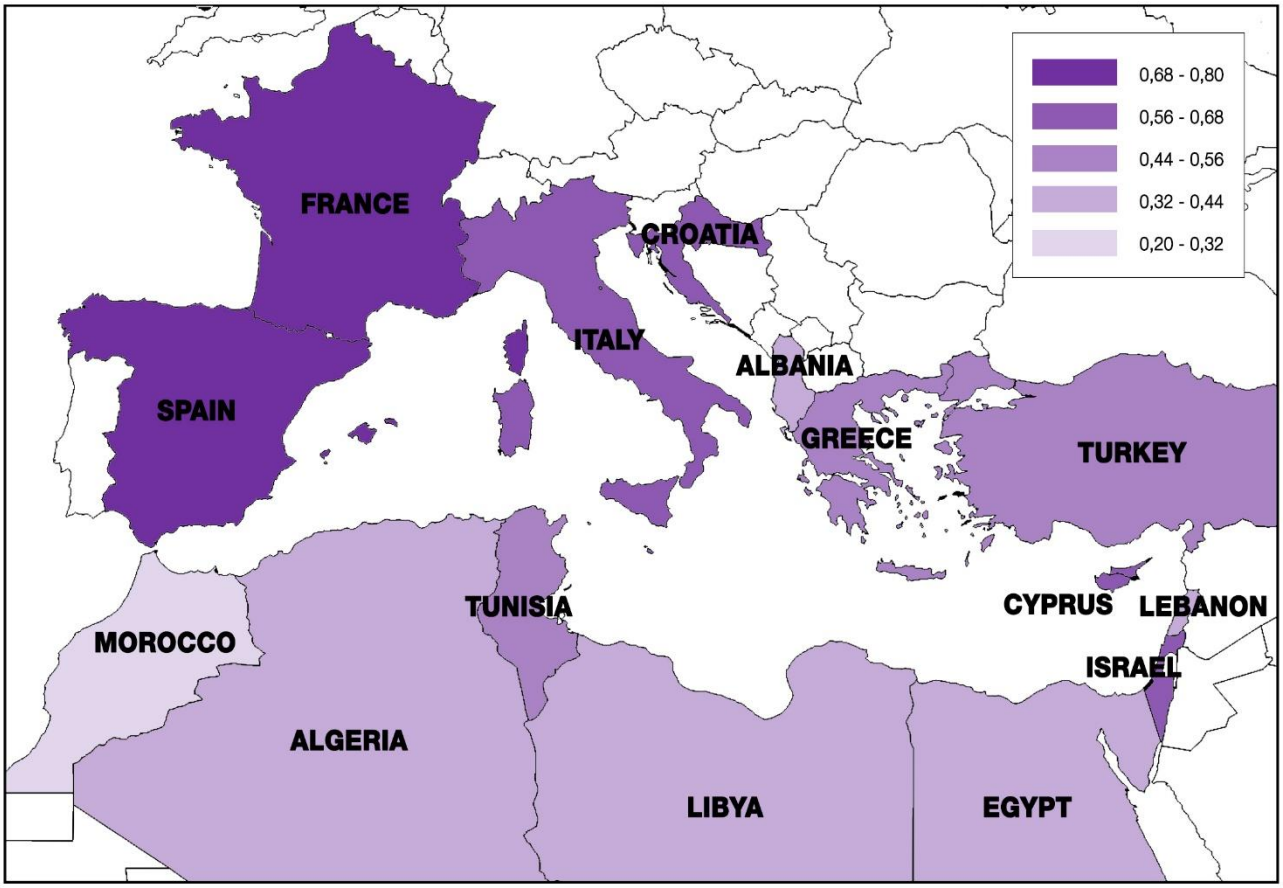


Figure 8.1. Map of the Sustainability Evaluation Model results

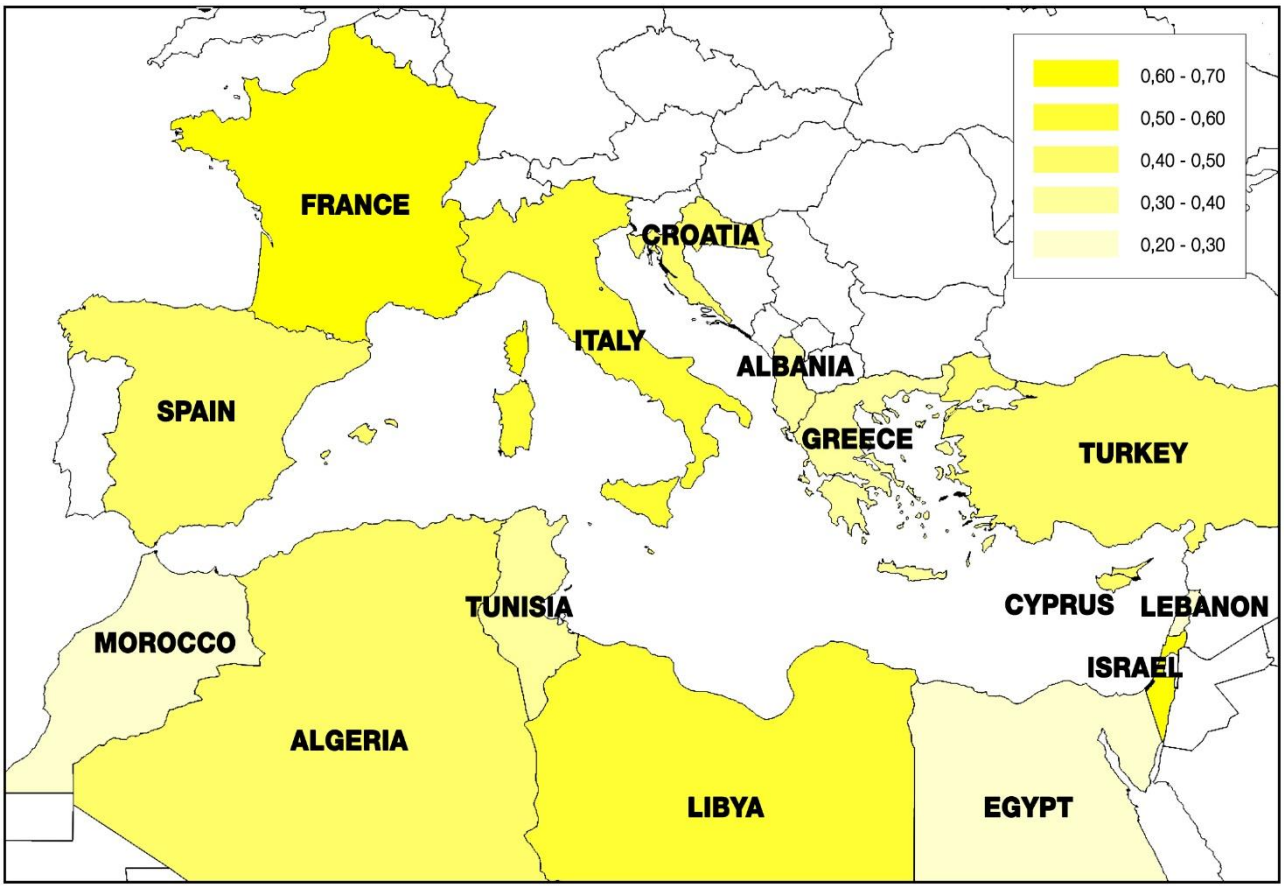


Figure 8.2. Map of the Sustainability Evaluation Model results for the economic dimension

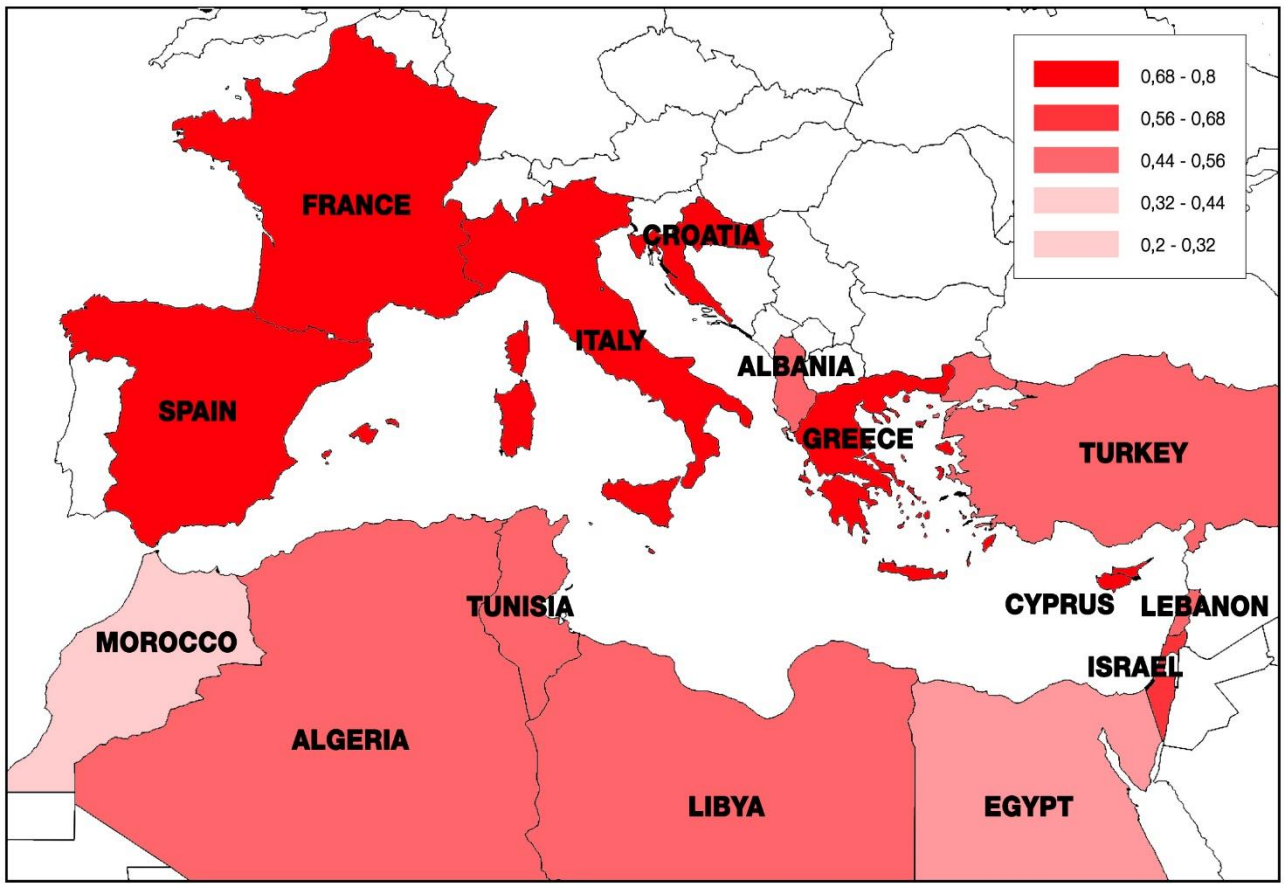


Figure 8.3. Map of the Sustainability Evaluation Model results for the social dimension

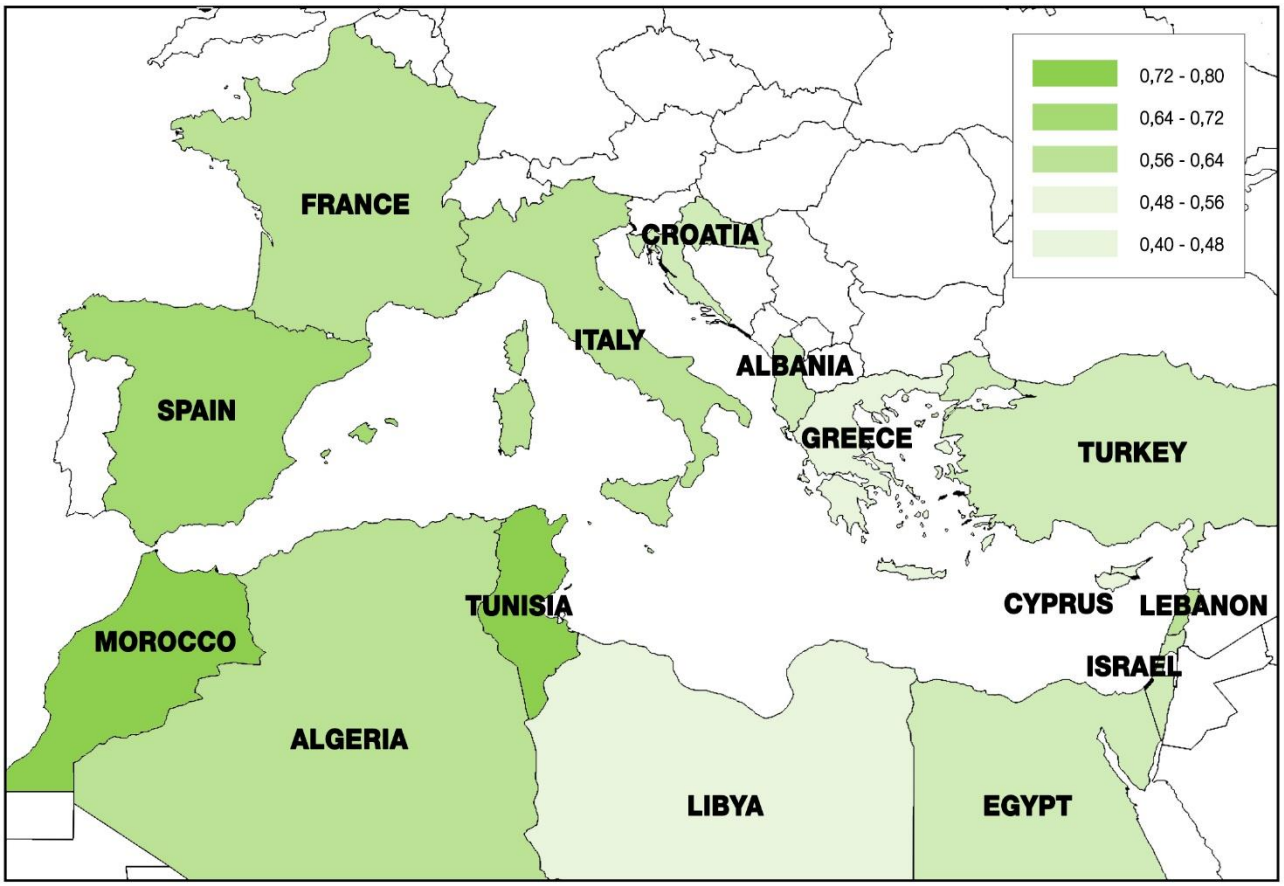


Figure 8.4. Map of the Sustainability Evaluation Model results for the environmental dimension

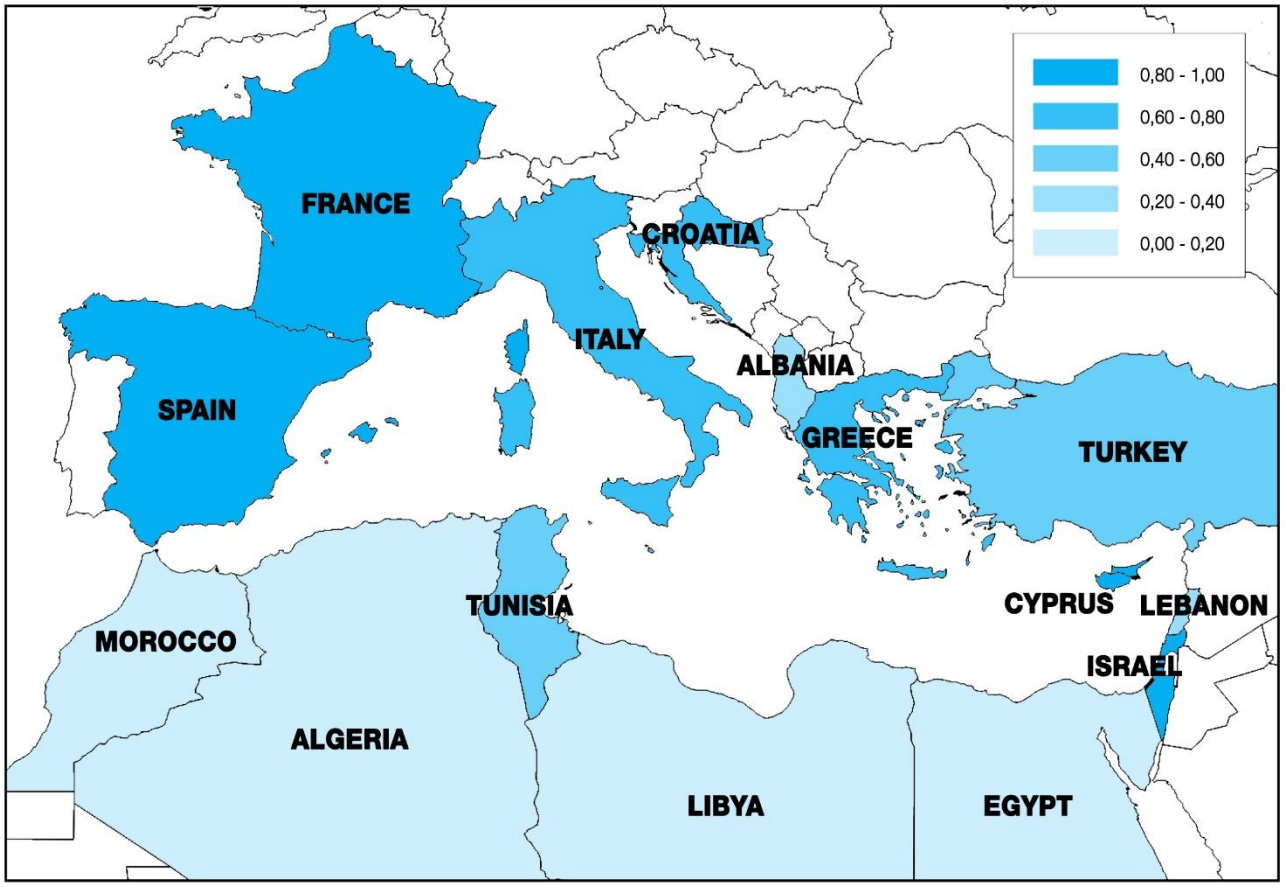
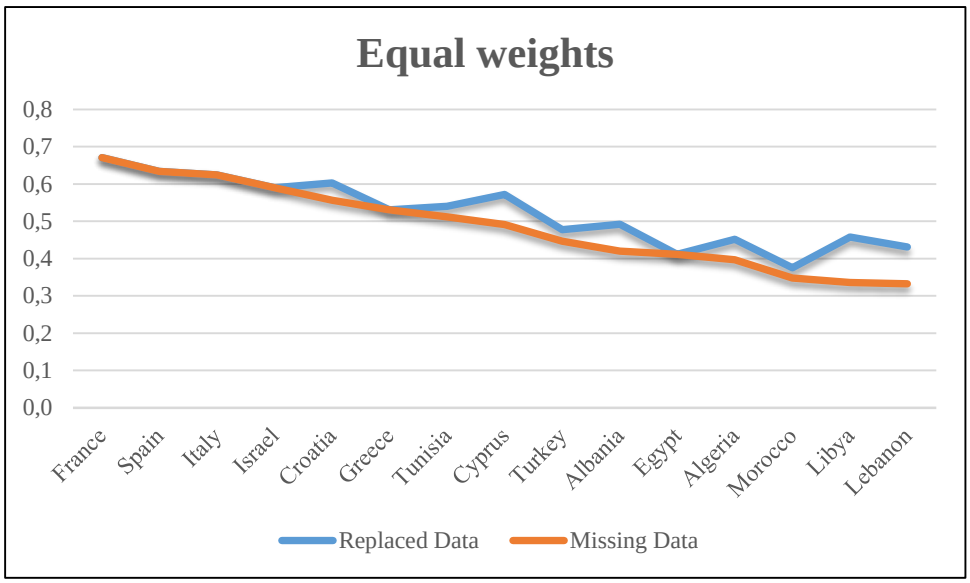
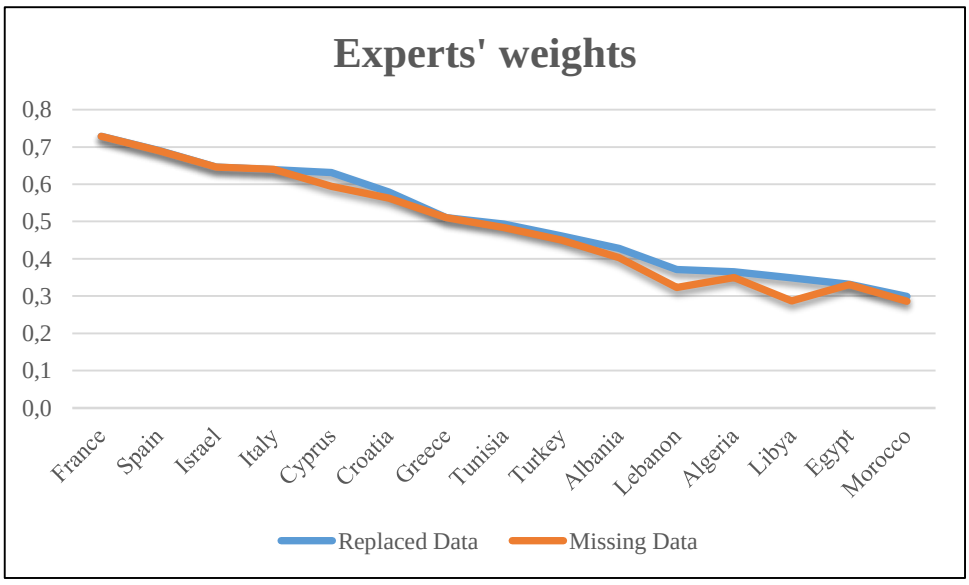


Figure 8.5. Map of the Sustainability Evaluation Model results for the institutional dimension

Below are the graphs showing the variation of the final scores respect to the replacement procedure of the missing data. It is evident that the final results obtained through the equal weights are more sensitive to the filling process than those obtained through the experts' weighting methodology. This because the missing data do not cover primary positions in the hierarchy of the weights tree and consequently the relative experts' weights are lower than the equal ones.



Graph 8.4. Replaced-Missing data variation, using equal weights



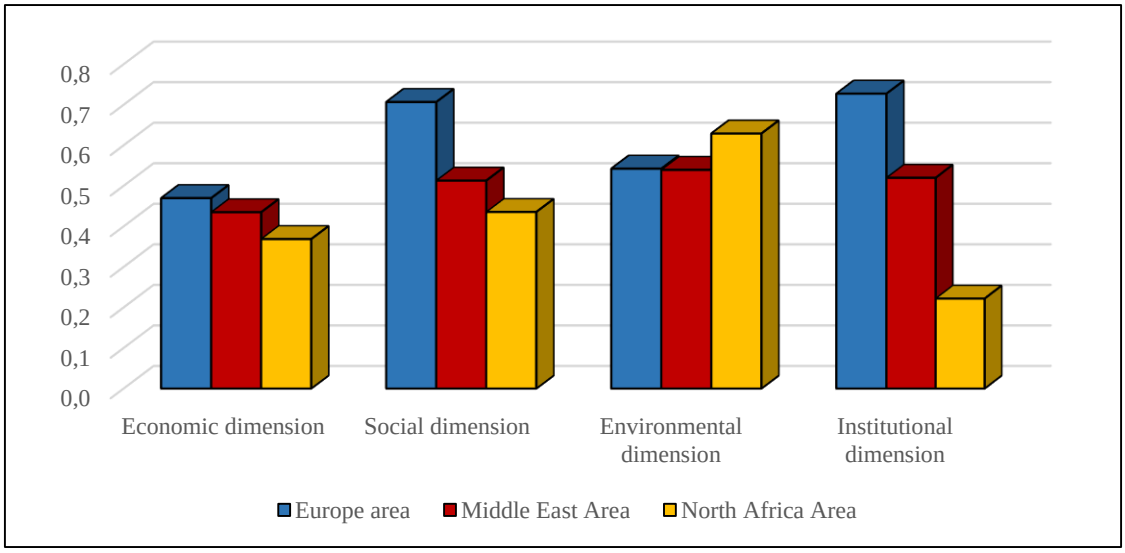
Graph 8.5. Replaced-Missing data variation, using experts' weights

8.3 Geographic-theme Analysis

In order to show particular relations, the countries have been grouped according to their location in the Mediterranean region:

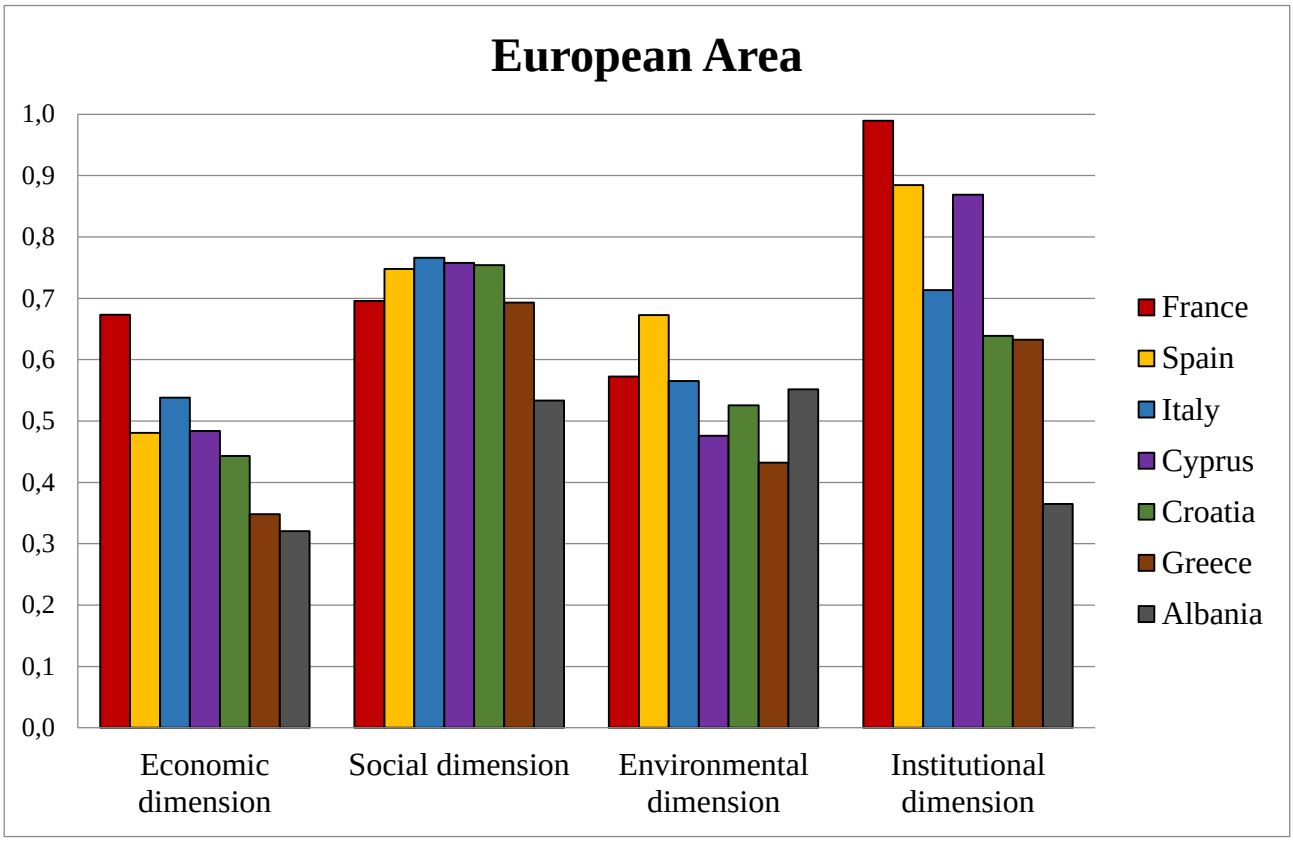
- European Area: Spain, France, Italy, Croatia, Albania, Greece and Cyprus
- Middle Eastern Area: Turkey, Lebanon and Israel
- North African Area: Egypt, Libya, Tunisia, Algeria and Morocco

Graph 8.6 shows the final scores sub-divided in the four sustainability dimensions, while Graphs 8.7, 8.8 and 8.9 highlight the same results for single countries by geographic area.



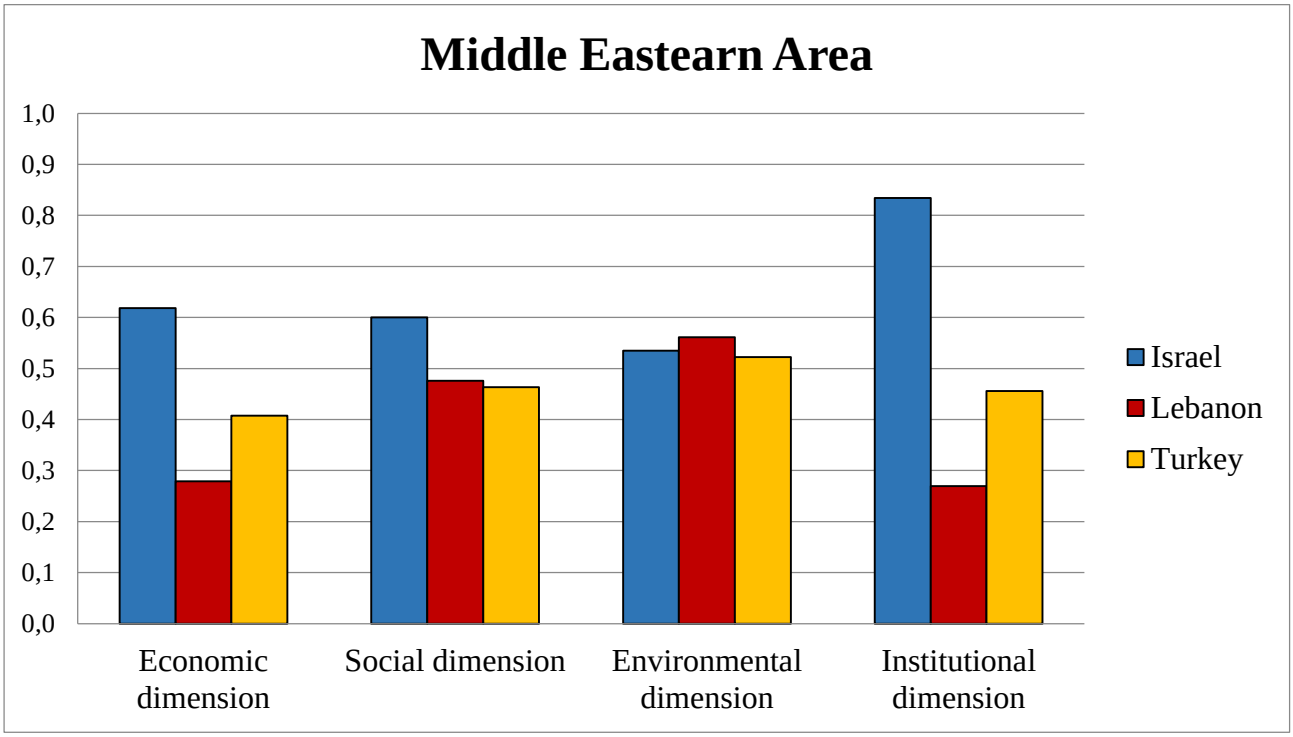
Graph 8.6. Plot of the final results for geographic areas sub-divided by dimension

In Graph 8.6 it is visualized that the highest results in three dimensions are related to the European area, followed respectively by Middle Eastern and North African areas. Environmental dimension represents a particular case, where the best score refers to the North African region. This outcome could be explained by the less economic development level, characterized by a lower number of production plants, and the climatic condition, which does not require domestic heating systems. Another important remark is represented by the big gap between the European and North African countries regarding the institutional dimension, due to the influence of authoritarian regimes.



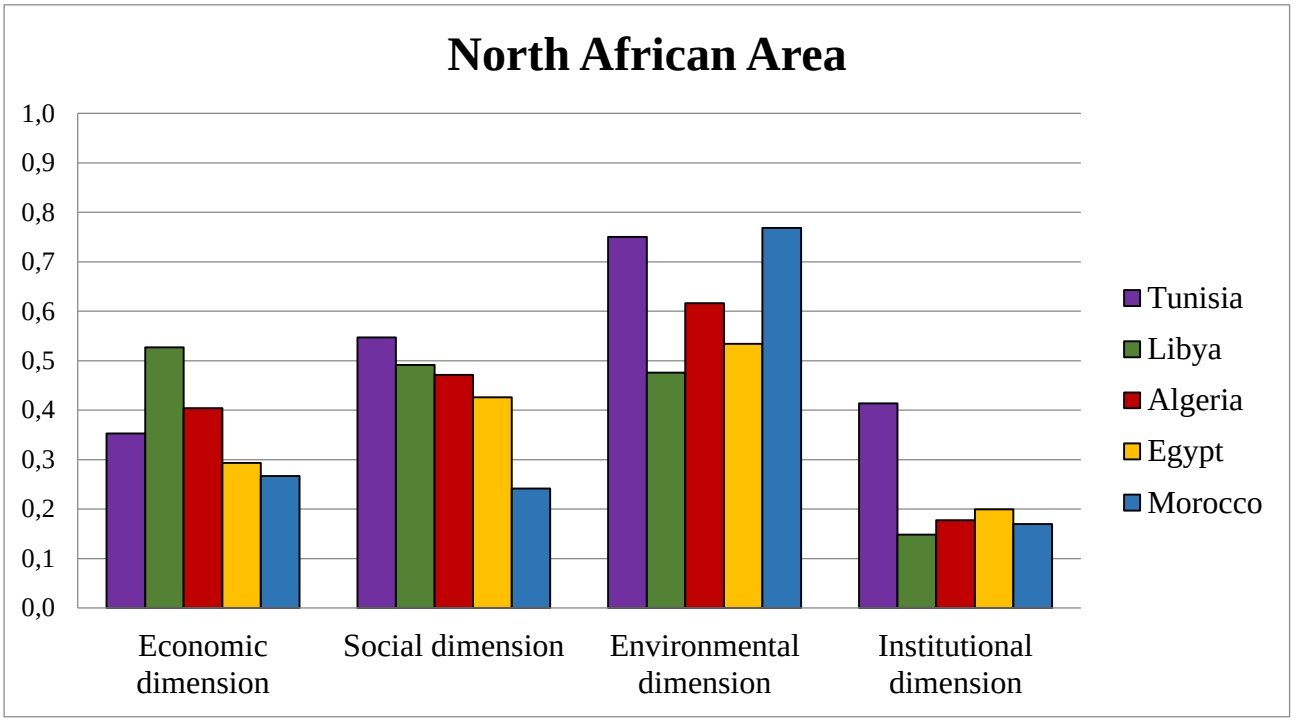
Graph 8.7. Plot of the final results for the European countries sub-divided by dimension

Particular is the case of Albania which gets the lowest scores in all the dimensions, except for the environmental one (typical trend of middle-low development countries).



Graph 8.8. Plot of the final results for the Middle Eastern countries sub-divided by dimension

Israel overcomes the other countries in all the dimensions, except for the environment. In particular, the Israeli institutional dimension results to be much more sustainable than the Turkish and Lebanese ones.



Graph 8.9. Plot of the final results for the North African countries sub-divided by dimension

As clearly represented by Graph 8.9, Morocco stresses the concept that low environmental impact corresponds to low scores in the other sustainability dimensions.

8.4 Countries' Profiles

For each country a specific analysis has been performed. In particular are described:

- The final score computed through the experts' weights and the geometric aggregation (from 0 to 1).
- The relative rank referred to the analyzed context (from 1 to 15).
- The number of replaced missing data, highlighted with a grey background in the indicators table.
- A radar chart, showing the scores for each node.
- Brief remarks on the most interesting results.
- A table showing the final scores and the relative ranks computed through the four other weighting and aggregation methods.
- Values and relative ranks for each indicator of the model.

Albania

Score	0.427
Rank	10
Replaced Missing Data	3

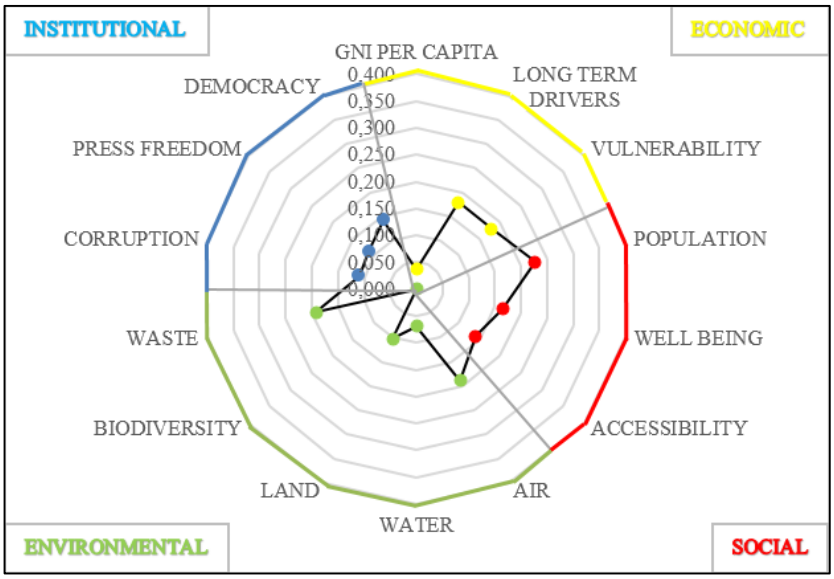
Remarks:

(-) Low value in GNI per Capita.

(+) Best share of Renewables for Electricity and Energy Intensity.

(-) Worst Homicides Rate.

(+) Good results in the Global Air Quality, probably due to a poor industrial production.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.439	10	0
Equal Weights - Linear Aggregation	0.492	9	+1
Absolute Hierarchical Tree Weights - Linear Aggregation	0.439	10	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.429	10	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	8014,01	12
2. R&D Expenditures (% GDP)	0,15	14
3. Public Spending on Education (% GDP)	3,27	12
4. Public Health Expenditure (% GDP)	2,83	12
5. Unemployment (% Total Labor Force)	14,2	11
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,09	1
7. Electricity Production from Renewables / Total Electricity Production	0,9998	1
8. Net Exports / (Exports + Imports of Goods and Services)	-0,301	14
9. Energy Imports (% Energy Use)	31,60	3
10. Public Debt (% GDP)	58,80	6
11. Urban Population / Urban Areas [inh/km^2]	8271,0	9
12. Gender Inequality Index [0-1]	0,25	9
13. GINI Richness Distribution [0-100]	34,51	8
14. School Enrolment, Secondary (% of the Official Secondary School Age)	82,40	12
15. Mean Years of Schooling [years]	10,4	3
16. Life Expectancy at Birth [years]	77,16	7
17. % of HIV Cases	0,13	2
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	21,1 - 6,3	9
19. Suicide Rate per 100'000 People	4,0	5
20. Homicide Rate per 100'000 People	3,96	15
21. Physicians per 1'000 People	1,1	14
22. Access to Electricity (% Population)	100	1
23. Improved Water Source (% Population with Access)	95	5
24. Food Security Index [0-100]	71,6	6
25. Rail Route-km per 1'000 People	0,134	7
26. PM_{10} Emissions [µg/m^3]	38	12
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	2,211	1
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	2,19	2
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,177	14
30. Change in Forest Area, 1990/2010 (%)	-1,6	14
31. Ecological Footprint Index	1,9	4
32. GEF Benefits Index for Biodiversity [0-100]	0,2	14
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,443	5
34. Corruption Perception Index [0-100]	31	13
35. Press Freedom Index [0-100]	49	8
36. Democracy Index [0-100]	5,67	9

Algeria

Score	0.366
Rank	12
Replaced Missing Data	2

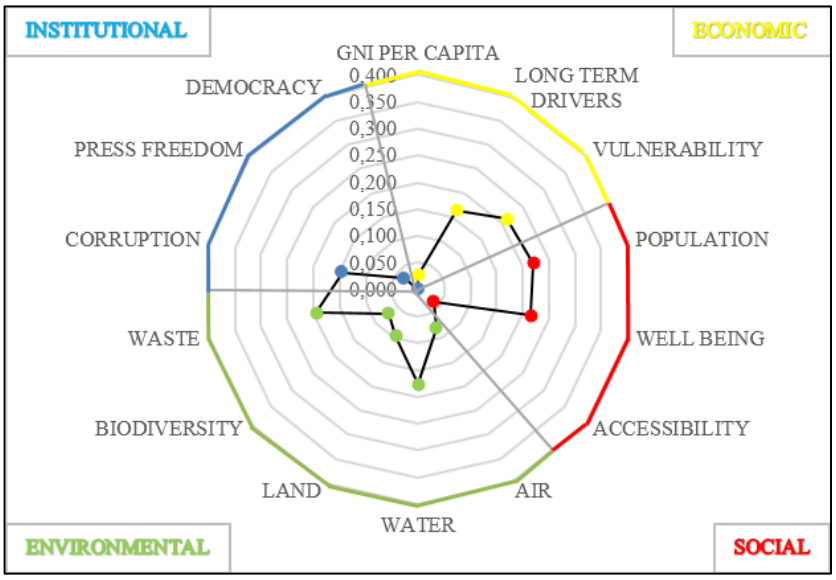
Remarks:

(-) Worst result in R&D Expenditures.

(+) Best Energy Exporters.

(-) In the last two decades, it is the worst country regarding Change in Forestry.

(-) Worst Level of Democracy.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.406	11	+1
Equal Weights - Linear Aggregation	0.452	12	0
Absolute Hierarchical Tree Weights - Linear Aggregation	0.404	12	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.362	13	-1

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	7065,39	13
2. R&D Expenditures (% GDP)	0,07	15
3. Public Spending on Education (% GDP)	4,34	8
4. Public Health Expenditure (% GDP)	3,17	10
5. Unemployment (% Total Labor Force)	10,0	6
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,15	6
7. Electricity Production from Renewables / Total Electricity Production	0,0098	13
8. Net Exports / (Exports + Imports of Goods and Services)	0,176	2
9. Energy Imports (% Energy Use)	-248,48	1
10. Public Debt (% GDP)	8,30	2
11. Urban Population / Urban Areas [inh/km^2]	3433,8	4
12. Gender Inequality Index [0-1]	0,39	12
13. GINI Richness Distribution [0-100]	35,33	9
14. School Enrolment, Secondary (% of the Official Secondary School Age)	97,61	8
15. Mean Years of Schooling [years]	7,6	10
16. Life Expectancy at Birth [years]	70,75	12
17. % of HIV Cases	0,10	1
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	17,5 - 3,7	3
19. Suicide Rate per 100'000 People	0,1	1
20. Homicide Rate per 100'000 People	1,50	8
21. Physicians per 1'000 People	1,2	12
22. Access to Electricity (% Population)	99,3	8
23. Improved Water Source (% Population with Access)	84	7
24. Food Security Index [0-100]	45,5	12
25. Rail Route-km per 1'000 People	0,093	11
26. PM_{10} Emissions [µg/m^3]	69	14
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	4,659	13
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	4,61	5
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,069	3
30. Change in Forest Area, 1990/2010 (%)	-10,5	15
31. Ecological Footprint Index	1,6	2
32. GEF Benefits Index for Biodiversity [0-100]	2,9	6
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,299	2
34. Corruption Perception Index [0-100]	36	11
35. Press Freedom Index [0-100]	61	13
36. Democracy Index [0-100]	3,83	15

Croatia

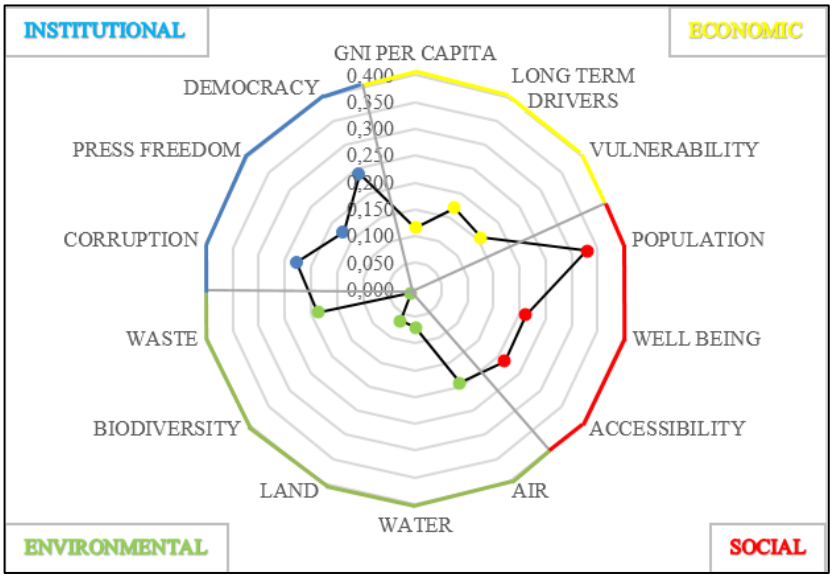
Score	0.579
Rank	6
Replaced Missing Data	2

Remarks:

(+) Highest Cities Livability level.

(+) Best ratio between Rail Lines and Population.

(-) Low value in the Relative Grey Water Footprint.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.590	6	0
Equal Weights - Linear Aggregation	0.602	4	+2
Absolute Hierarchical Tree Weights - Linear Aggregation	0.584	6	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.572	6	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	15582,60	7
2. R&D Expenditures (% GDP)	0,75	8
3. Public Spending on Education (% GDP)	4,31	9
4. Public Health Expenditure (% GDP)	6,62	5
5. Unemployment (% Total Labor Force)	15,8	12
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,12	4
7. Electricity Production from Renewables / Total Electricity Production	0,4502	2
8. Net Exports / (Exports + Imports of Goods and Services)	-0,016	7
9. Energy Imports (% Energy Use)	55,14	5
10. Public Debt (% GDP)	53,70	5
11. Urban Population / Urban Areas [inh/km^2]	1511,9	1
12. Gender Inequality Index [0-1]	0,18	7
13. GINI Richness Distribution [0-100]	32,00	4
14. School Enrolment, Secondary (% of the Official Secondary School Age)	97,96	7
15. Mean Years of Schooling [years]	9,8	7
16. Life Expectancy at Birth [years]	76,88	8
17. % of HIV Cases	0,10	1
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	21,3 - /	1
19. Suicide Rate per 100'000 People	19,7	10
20. Homicide Rate per 100'000 People	1,41	7
21. Physicians per 1'000 People	2,7	9
22. Access to Electricity (% Population)	100	1
23. Improved Water Source (% Population with Access)	99	2
24. Food Security Index [0-100]	71,6	6
25. Rail Route-km per 1'000 People	0,636	1
26. PM_{10} Emissions [µg/m^3]	22	4
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	3,027	4
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	5,68	8
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,175	13
30. Change in Forest Area, 1990/2010 (%)	3,8	11
31. Ecological Footprint Index	3,7	9
32. GEF Benefits Index for Biodiversity [0-100]	0,6	11
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,715	7
34. Corruption Perception Index [0-100]	48	6
35. Press Freedom Index [0-100]	40	6
36. Democracy Index [0-100]	6,93	7

Cyprus

Score	0.631
Rank	5
Replaced Missing Data	5

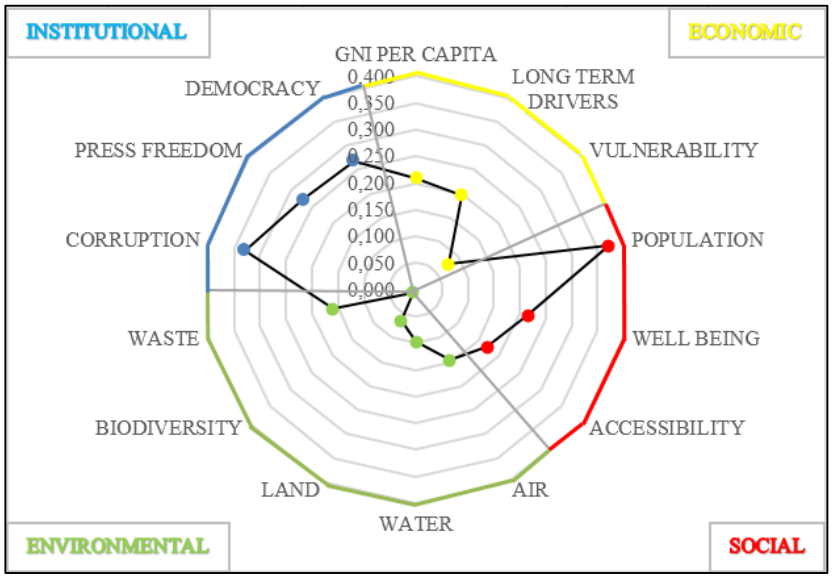
Remarks:

(+) Best investor in Public Education, but low R&D Expenditures.

(-) Great Energy Importer respect to its energy use.

(+) Best Richness Distribution due to the scarcity of population.

(+) Very high results in the institutional dimension.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.655	4	+1
Equal Weights - Linear Aggregation	0,572	6	-1
Absolute Hierarchical Tree Weights - Linear Aggregation	0.637	5	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.614	5	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	24548,07	5
2. R&D Expenditures (% GDP)	0,49	12
3. Public Spending on Education (% GDP)	7,27	1
4. Public Health Expenditure (% GDP)	3,21	9
5. Unemployment (% Total Labor Force)	11,8	8
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,11	3
7. Electricity Production from Renewables / Total Electricity Production	0,0361	11
8. Net Exports / (Exports + Imports of Goods and Services)	-0,080	11
9. Energy Imports (% Energy Use)	95,96	12
10. Public Debt (% GDP)	85,80	10
11. Urban Population / Urban Areas [inh/km^2]	2857,0	3
12. Gender Inequality Index [0-1]	0,13	4
13. GINI Richness Distribution [0-100]	29,00	1
14. School Enrolment, Secondary (% of the Official Secondary School Age)	92,83	9
15. Mean Years of Schooling [years]	9,8	8
16. Life Expectancy at Birth [years]	79,47	6
17. % of HIV Cases	0,15	3
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	23,4 - /	11
19. Suicide Rate per 100'000 People	3,6	3
20. Homicide Rate per 100'000 People	1,74	10
21. Physicians per 1'000 People	2,8	7
22. Access to Electricity (% Population)	99,9	3
23. Improved Water Source (% Population with Access)	100	1
24. Food Security Index [0-100]	71,6	6
25. Rail Route-km per 1'000 People	0,163	6
26. PM_{10} Emissions [µg/m^3]	27	9
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	4,479	12
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	8,93	12
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,148	9
30. Change in Forest Area, 1990/2010 (%)	7,5	9
31. Ecological Footprint Index	4,0	10
32. GEF Benefits Index for Biodiversity [0-100]	0,5	12
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	2,150	10
34. Corruption Perception Index [0-100]	63	2
35. Press Freedom Index [0-100]	25	2
36. Democracy Index [0-100]	7,29	6

Egypt

Score	0.331
Rank	14
Replaced Missing Data	/

Remarks:

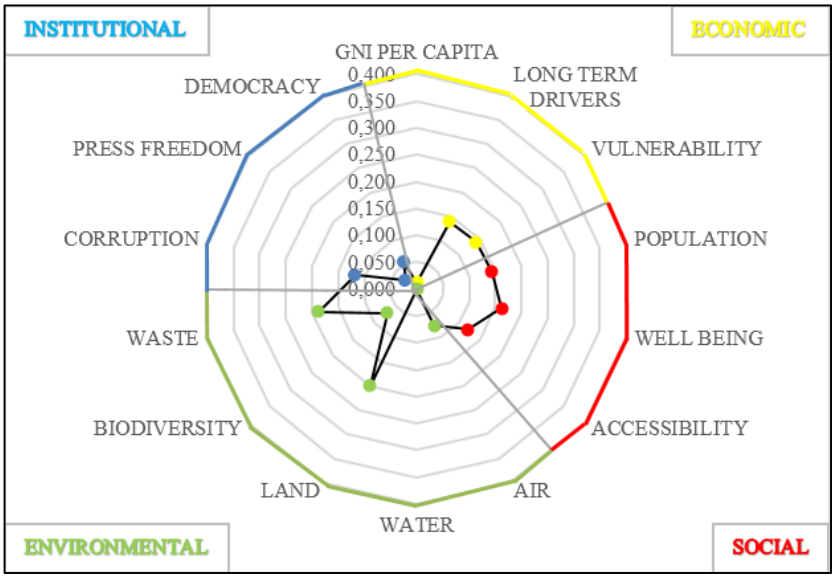
(+) Energy Exports slightly prevail over the Imports.

(-)Worst Gender Inequality Distribution.

(-) Highest rate of Obese and Malnourished people.

(-) Worst Local Air Quality.

(-) Very low results in the institutional dimension.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.356	15	-1
Equal Weights - Linear Aggregation	0.411	14	0
Absolute Hierarchical Tree Weights - Linear Aggregation	0.347	14	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.323	14	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	5654,45	14
2. R&D Expenditures (% GDP)	0,43	13
3. Public Spending on Education (% GDP)	3,76	11
4. Public Health Expenditure (% GDP)	1,97	14
5. Unemployment (% Total Labor Force)	12,7	10
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,17	7
7. Electricity Production from Renewables / Total Electricity Production	0,0951	9
8. Net Exports / (Exports + Imports of Goods and Services)	-0,126	12
9. Energy Imports (% Energy Use)	-13,60	1
10. Public Debt (% GDP)	88,00	11
11. Urban Population / Urban Areas [inh/km^2]	16577,4	15
12. Gender Inequality Index [0-1]	0,59	15
13. GINI Richness Distribution [0-100]	30,77	2
14. School Enrolment, Secondary (% of the Official Secondary School Age)	75,86	13
15. Mean Years of Schooling [years]	6,4	14
16. Life Expectancy at Birth [years]	70,68	13
17. % of HIV Cases	0,10	1
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	34,6 - 6,8	15
19. Suicide Rate per 100'000 People	0,1	1
20. Homicide Rate per 100'000 People	1,24	5
21. Physicians per 1'000 People	2,8	8
22. Access to Electricity (% Population)	99,6	6
23. Improved Water Source (% Population with Access)	99	3
24. Food Security Index [0-100]	52,5	9
25. Rail Route-km per 1'000 People	0,065	14
26. PM_{10} Emissions [µg/m^3]	78	15
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	4,125	9
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	3,74	4
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,246	15
30. Change in Forest Area, 1990/2010 (%)	59,1	1
31. Ecological Footprint Index	1,7	3
32. GEF Benefits Index for Biodiversity [0-100]	2,9	7
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,637	6
34. Corruption Perception Index [0-100]	32	12
35. Press Freedom Index [0-100]	62	14
36. Democracy Index [0-100]	4,56	13

France

Score	0.728
Rank	1
Replaced Missing Data	/

Remarks:

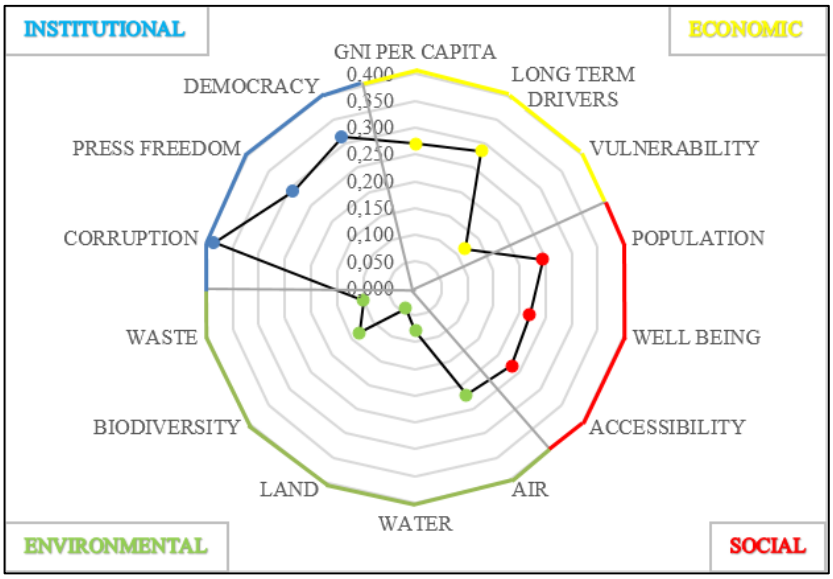
(+) Best GNI per Capita.

(+) Highest value of Life Expectancy.

(+) Very high results regarding Accessibility.

(+) Best Local Air Quality.

(+) Best results in the institutional dimension.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.745	1	0
Equal Weights - Linear Aggregation	0.670	1	0
Absolute Hierarchical Tree Weights - Linear Aggregation	0.735	1	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.719	1	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	30327,08	1
2. R&D Expenditures (% GDP)	2,25	3
3. Public Spending on Education (% GDP)	5,86	3
4. Public Health Expenditure (% GDP)	8,92	1
5. Unemployment (% Total Labor Force)	9,9	5
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,13	5
7. Electricity Production from Renewables / Total Electricity Production	0,1283	7
8. Net Exports / (Exports + Imports of Goods and Services)	-0,026	9
9. Energy Imports (% Energy Use)	47,11	4
10. Public Debt (% GDP)	90,30	12
11. Urban Population / Urban Areas [inh/km^2]	14279,9	13
12. Gender Inequality Index [0-1]	0,08	1
13. GINI Richness Distribution [0-100]	32,70	6
14. School Enrolment, Secondary (% of the Official Secondary School Age)	109,93	3
15. Mean Years of Schooling [years]	10,6	2
16. Life Expectancy at Birth [years]	82,33	1
17. % of HIV Cases	0,35	8
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	15,6 - /	5
19. Suicide Rate per 100'000 People	14,7	9
20. Homicide Rate per 100'000 People	1,09	3
21. Physicians per 1'000 People	3,4	5
22. Access to Electricity (% Population)	100	1
23. Improved Water Source (% Population with Access)	100	1
24. Food Security Index [0-100]	84,5	1
25. Rail Route-km per 1'000 People	0,514	2
26. PM_{10} Emissions [µg/m^3]	12	1
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	2,220	2
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	8,18	9
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,166	11
30. Change in Forest Area, 1990/2010 (%)	9,8	8
31. Ecological Footprint Index	5,0	12
32. GEF Benefits Index for Biodiversity [0-100]	5,3	3
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	5,460	13
34. Corruption Perception Index [0-100]	71	1
35. Press Freedom Index [0-100]	22	1
36. Democracy Index [0-100]	7,88	2

Greece

Score	0.510
Rank	7
Replaced Missing Data	/

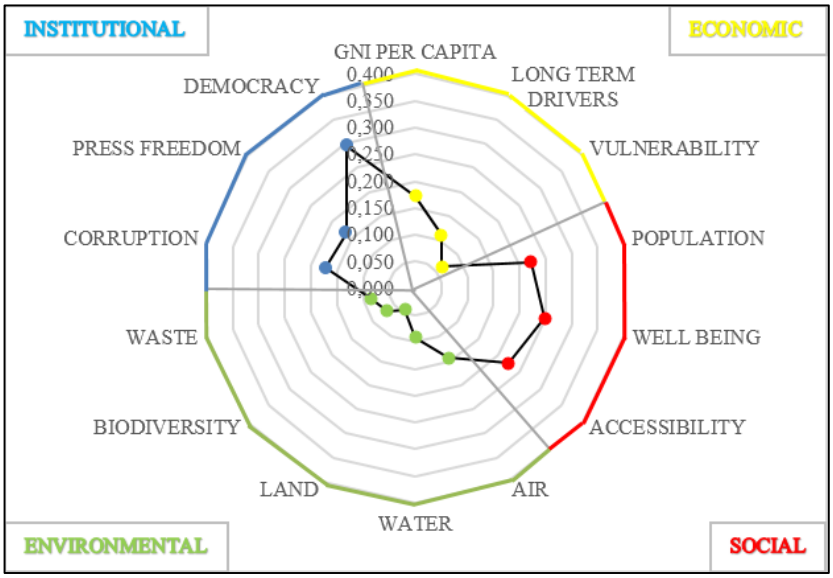
Remarks:

(-) Very high Unemployment Rate.

(-) Worst Public Debt data.

(+) Highest ratio between number of Physicians and population.

(-) Huge amount of Waste Produced per Capita.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.529	7	0
Equal Weights - Linear Aggregation	0.530	8	-1
Absolute Hierarchical Tree Weights - Linear Aggregation	0.538	7	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.521	7	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	21023,71	6
2. R&D Expenditures (% GDP)	0,60	10
3. Public Spending on Education (% GDP)	4,09	10
4. Public Health Expenditure (% GDP)	6,63	4
5. Unemployment (% Total Labor Force)	24,2	14
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,11	3
7. Electricity Production from Renewables / Total Electricity Production	0,1433	6
8. Net Exports / (Exports + Imports of Goods and Services)	-0,066	10
9. Energy Imports (% Energy Use)	61,06	6
10. Public Debt (% GDP)	156,90	15
11. Urban Population / Urban Areas [inh/km^2]	15289,6	14
12. Gender Inequality Index [0-1]	0,14	5
13. GINI Richness Distribution [0-100]	33,00	7
14. School Enrolment, Secondary (% of the Official Secondary School Age)	110,80	2
15. Mean Years of Schooling [years]	10,1	5
16. Life Expectancy at Birth [years]	80,74	4
17. % of HIV Cases	0,15	4
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	17,5 - /	7
19. Suicide Rate per 100'000 People	3,5	2
20. Homicide Rate per 100'000 People	1,55	9
21. Physicians per 1'000 People	6,2	1
22. Access to Electricity (% Population)	100	1
23. Improved Water Source (% Population with Access)	100	1
24. Food Security Index [0-100]	71,6	5
25. Rail Route-km per 1'000 People	0,226	5
26. PM_{10} Emissions [µg/m^3]	27	10
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	4,461	11
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	10,22	13
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,154	10
30. Change in Forest Area, 1990/2010 (%)	18,3	5
31. Ecological Footprint Index	5,4	14
32. GEF Benefits Index for Biodiversity [0-100]	2,8	8
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	6,229	14
34. Corruption Perception Index [0-100]	40	9
35. Press Freedom Index [0-100]	41	7
36. Democracy Index [0-100]	7,65	4

Israel

Score	0.646
Rank	3
Replaced Missing Data	/

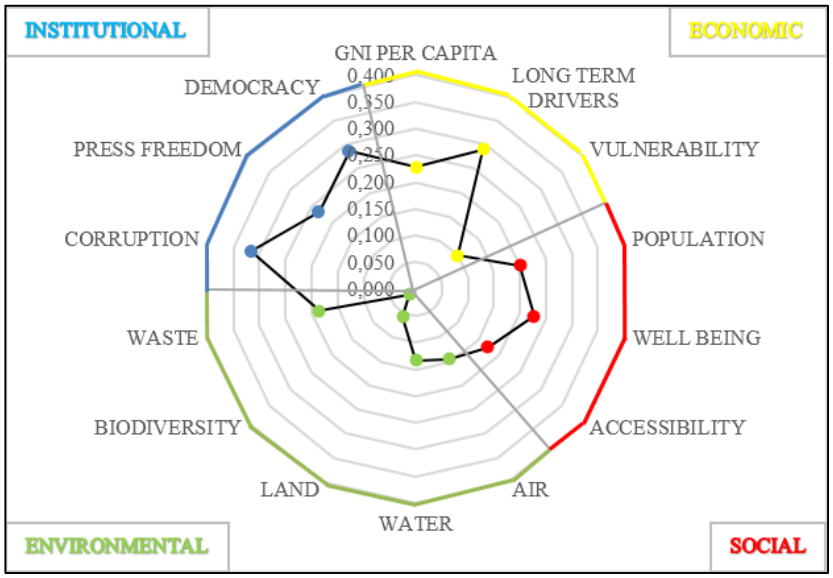
Remarks:

(+) Greatest investor in R&D.

(-) Very low use of Renewables.

(+) Highest Mean Years of Schooling data.

(-) Very bad Global Air Quality.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.656	3	0
Equal Weights - Linear Aggregation	0.590	5	-2
Absolute Hierarchical Tree Weights - Linear Aggregation	0.646	4	-1
Relative Hierarchical Tree Weights - Geometric Aggregation	0.637	4	-1

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	26249,10	2
2. R&D Expenditures (% GDP)	4,39	1
3. Public Spending on Education (% GDP)	5,59	4
4. Public Health Expenditure (% GDP)	4,76	7
5. Unemployment (% Total Labor Force)	6,9	2
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,11	3
7. Electricity Production from Renewables / Total Electricity Production	0,0045	14
8. Net Exports / (Exports + Imports of Goods and Services)	-0,002	5
9. Energy Imports (% Energy Use)	86,47	10
10. Public Debt (% GDP)	66,90	7
11. Urban Population / Urban Areas [inh/km^2]	6127,5	7
12. Gender Inequality Index [0-1]	0,14	6
13. GINI Richness Distribution [0-100]	39,20	13
14. School Enrolment, Secondary (% of the Official Secondary School Age)	101,95	5
15. Mean Years of Schooling [years]	11,9	1
16. Life Expectancy at Birth [years]	81,76	3
17. % of HIV Cases	0,20	6
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	25,5 - /	13
19. Suicide Rate per 100'000 People	5,8	6
20. Homicide Rate per 100'000 People	2,10	11
21. Physicians per 1'000 People	3,1	6
22. Access to Electricity (% Population)	99,7	5
23. Improved Water Source (% Population with Access)	100	1
24. Food Security Index [0-100]	79,3	2
25. Rail Route-km per 1'000 People	0,133	8
26. PM_{10} Emissions [µg/m^3]	21	2
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	4,762	14
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	11,74	14
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,112	5
30. Change in Forest Area, 1990/2010 (%)	16,7	7
31. Ecological Footprint Index	4,8	11
32. GEF Benefits Index for Biodiversity [0-100]	0,8	10
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,814	8
34. Corruption Perception Index [0-100]	61	3
35. Press Freedom Index [0-100]	31	4
36. Democracy Index [0-100]	7,53	5

Italy

Score	0.640
Rank	4
Replaced Missing Data	/

Remarks:

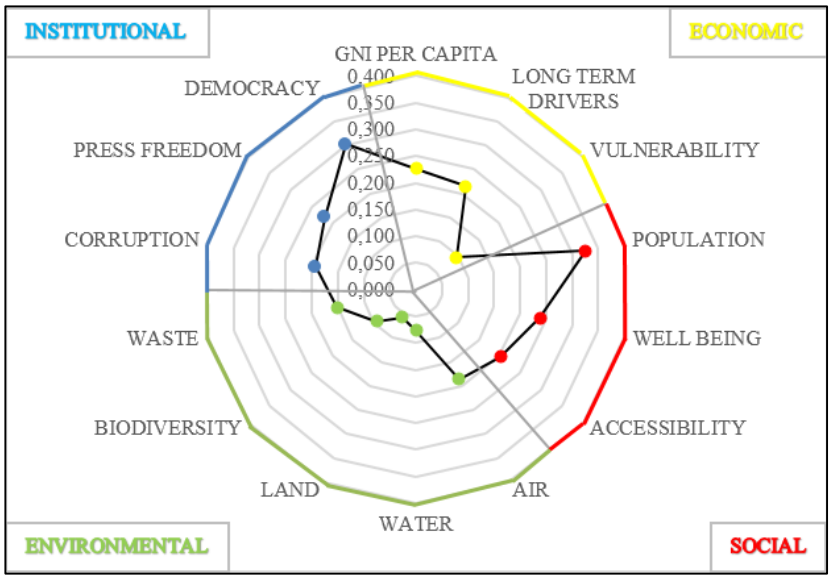
(+) Considerable Public Health Expenditures.

(-) Very high Public Debt.

(+) High Life Expectancy.

(-) Low Homicide Rate.

(-) Bad results in the Ecological Footprint Index.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.646	5	-1
Equal Weights - Linear Aggregation	0.624	3	+1
Absolute Hierarchical Tree Weights - Linear Aggregation	0.650	3	+1
Relative Hierarchical Tree Weights - Geometric Aggregation	0.643	3	+1

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	26141,81	3
2. R&D Expenditures (% GDP)	1,25	5
3. Public Spending on Education (% GDP)	4,50	7
4. Public Health Expenditure (% GDP)	7,34	2
5. Unemployment (% Total Labor Force)	10,7	7
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,10	2
7. Electricity Production from Renewables / Total Electricity Production	0,3983	3
8. Net Exports / (Exports + Imports of Goods and Services)	0,051	3
9. Energy Imports (% Energy Use)	79,40	9
10. Public Debt (% GDP)	126,90	14
11. Urban Population / Urban Areas [inh/km^2]	4722,5	6
12. Gender Inequality Index [0-1]	0,09	2
13. GINI Richness Distribution [0-100]	31,90	3
14. School Enrolment, Secondary (% of the Official Secondary School Age)	100,66	6
15. Mean Years of Schooling [years]	10,1	6
16. Life Expectancy at Birth [years]	82,09	2
17. % of HIV Cases	0,25	7
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	17,2 - /	6
19. Suicide Rate per 100'000 People	6,3	7
20. Homicide Rate per 100'000 People	0,87	2
21. Physicians per 1'000 People	3,5	3
22. Access to Electricity (% Population)	100	1
23. Improved Water Source (% Population with Access)	100	5
24. Food Security Index [0-100]	75,4	4
25. Rail Route-km per 1'000 People	0,297	4
26. PM_{10} Emissions [µg/m^3]	21	3
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	3,131	5
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	8,22	10
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,169	12
30. Change in Forest Area, 1990/2010 (%)	20,5	4
31. Ecological Footprint Index	5,0	13
32. GEF Benefits Index for Biodiversity [0-100]	3,8	4
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	2,623	11
34. Corruption Perception Index [0-100]	43	7
35. Press Freedom Index [0-100]	33	5
36. Democracy Index [0-100]	7,74	3

Lebanon

Score	0.371
Rank	11
Replaced Missing Data	6

Remarks:

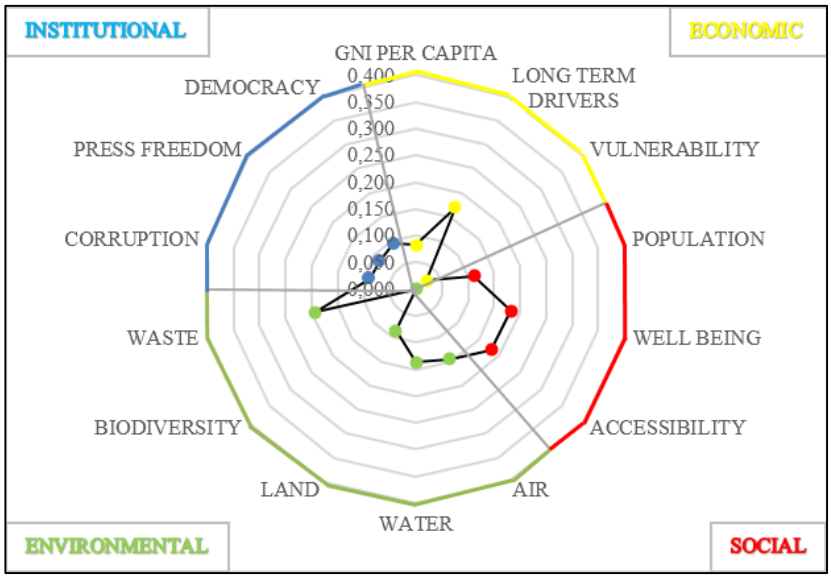
(-) Worst investor in Public Health and Education.

(+) Lowest Unemployment Rate.

(-) Low results regarding Vulnerability.

(-) Worst values regarding CO_2 Intensity.

(-) Very high Corruption Perception.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.391	13	-2
Equal Weights - Linear Aggregation	0.431	13	-2
Absolute Hierarchical Tree Weights - Linear Aggregation	0.392	13	-2
Relative Hierarchical Tree Weights - Geometric Aggregation	0.367	12	-1

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	12395,43	10
2. R&D Expenditures (% GDP)	2,62	2
3. Public Spending on Education (% GDP)	1,65	15
4. Public Health Expenditure (% GDP)	1,60	15
5. Unemployment (% Total Labor Force)	6,2	1
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,12	4
7. Electricity Production from Renewables / Total Electricity Production	0,0492	10
8. Net Exports / (Exports + Imports of Goods and Services)	-0,419	15
9. Energy Imports (% Energy Use)	96,76	13
10. Public Debt (% GDP)	119,60	13
11. Urban Population / Urban Areas [inh/km^2]	12714,6	12
12. Gender Inequality Index [0-1]	0,43	13
13. GINI Richness Distribution [0-100]	37,47	12
14. School Enrolment, Secondary (% of the Official Secondary School Age)	73,98	14
15. Mean Years of Schooling [years]	7,9	9
16. Life Expectancy at Birth [years]	79,56	5
17. % of HIV Cases	0,15	5
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	28,2 - 4,2	10
19. Suicide Rate per 100'000 People	0,1	1
20. Homicide Rate per 100'000 People	2,25	12
21. Physicians per 1'000 People	3,5	4
22. Access to Electricity (% Population)	99,9	2
23. Improved Water Source (% Population with Access)	100	1
24. Food Security Index [0-100]	71,6	6
25. Rail Route-km per 1'000 People	0,163	6
26. PM_{10} Emissions [µg/m^3]	25	8
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	5,279	15
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	5,22	7
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,108	4
30. Change in Forest Area, 1990/2010 (%)	4,5	10
31. Ecological Footprint Index	2,9	7
32. GEF Benefits Index for Biodiversity [0-100]	0,2	14
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,362	3
34. Corruption Perception Index [0-100]	28	14
35. Press Freedom Index [0-100]	53	10
36. Democracy Index [0-100]	5,05	12

Libya

Score	0.349
Rank	13
Replaced Missing Data	9

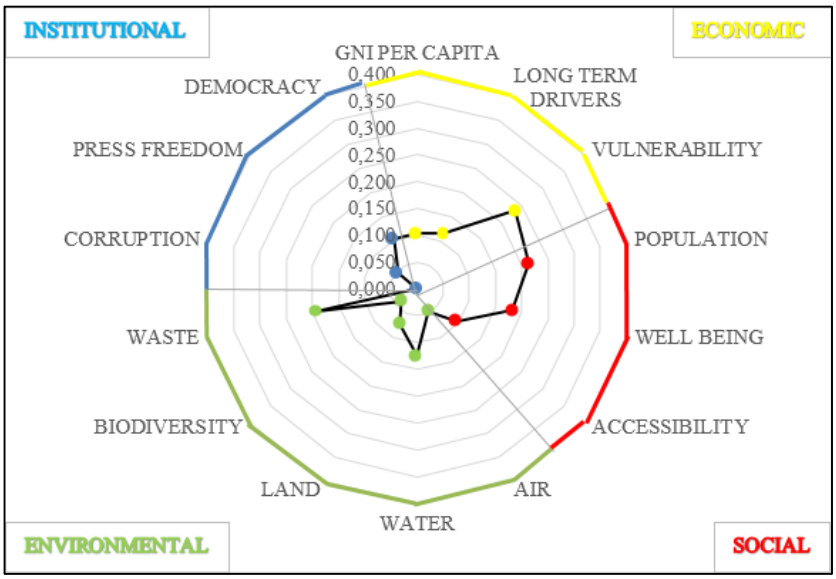
Remarks:

(+) Highest values regarding Vulnerability, but not for the Renewables Share (lowest).

(-) Very high rate of Obese and Malnourished people.

(-) Worst GHG emitter.

(-) Worst Corruption Perception.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.395	12	+1
Equal Weights - Linear Aggregation	0.458	11	+2
Absolute Hierarchical Tree Weights - Linear Aggregation	0.414	11	+2
Relative Hierarchical Tree Weights - Geometric Aggregation	0.374	11	+2

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	14362,12	8
2. R&D Expenditures (% GDP)	0,58	11
3. Public Spending on Education (% GDP)	2,67	14
4. Public Health Expenditure (% GDP)	3,02	11
5. Unemployment (% Total Labor Force)	12,5	9
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,35	8
7. Electricity Production from Renewables / Total Electricity Production	0,0000	15
8. Net Exports / (Exports + Imports of Goods and Services)	0,403	1
9. Energy Imports (% Energy Use)	-132,06	1
10. Public Debt (% GDP)	4,10	1
11. Urban Population / Urban Areas [inh/km^2]	8807,5	10
12. Gender Inequality Index [0-1]	0,22	8
13. GINI Richness Distribution [0-100]	35,76	10
14. School Enrolment, Secondary (% of the Official Secondary School Age)	104,30	4
15. Mean Years of Schooling [years]	7,3	11
16. Life Expectancy at Birth [years]	74,99	9
17. % of HIV Cases	0,10	1
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	30,8 - 5,6	14
19. Suicide Rate per 100'000 People	0,1	1
20. Homicide Rate per 100'000 People	2,86	13
21. Physicians per 1'000 People	1,9	10
22. Access to Electricity (% Population)	99,8	4
23. Improved Water Source (% Population with Access)	90	6
24. Food Security Index [0-100]	51,5	10
25. Rail Route-km per 1'000 People	0,082	12
26. PM_{10} Emissions [µg/m^3]	65	13
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	4,109	8
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	23,63	15
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,120	6
30. Change in Forest Area, 1990/2010 (%)	0,0	13
31. Ecological Footprint Index	3,1	8
32. GEF Benefits Index for Biodiversity [0-100]	1,6	9
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,363	4
34. Corruption Perception Index [0-100]	15	15
35. Press Freedom Index [0-100]	59	12
36. Democracy Index [0-100]	5,15	11

Morocco

Score	0.299
Rank	15
Replaced Missing Data	1

Remarks:

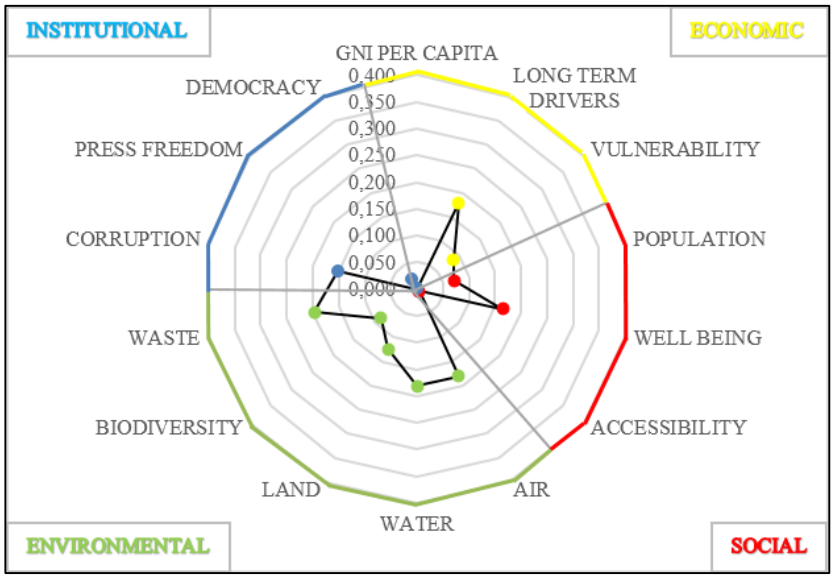
(-) Lowest values in GNI per Capita and Richness Distribution.

(-) Worst Education level.

(-) Lowest Physicians presence

(+) General high results in the environmental dimension.

(-) Very low Press Freedom and Democracy levels.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.361	14	+1
Equal Weights - Linear Aggregation	0.376	15	0
Absolute Hierarchical Tree Weights - Linear Aggregation	0.343	15	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.277	15	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	4443,56	15
2. R&D Expenditures (% GDP)	0,73	9
3. Public Spending on Education (% GDP)	5,38	5
4. Public Health Expenditure (% GDP)	2,07	13
5. Unemployment (% Total Labor Force)	9,0	3
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,12	4
7. Electricity Production from Renewables / Total Electricity Production	0,1079	8
8. Net Exports / (Exports + Imports of Goods and Services)	-0,131	13
9. Energy Imports (% Energy Use)	95,55	11
10. Public Debt (% GDP)	71,20	8
11. Urban Population / Urban Areas [inh/km^2]	11330,5	11
12. Gender Inequality Index [0-1]	0,44	14
13. GINI Richness Distribution [0-100]	40,88	15
14. School Enrolment, Secondary (% of the Official Secondary School Age)	68,88	15
15. Mean Years of Schooling [years]	4,4	15
16. Life Expectancy at Birth [years]	70,41	14
17. % of HIV Cases	0,10	1
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	17,3 - 3,1	2
19. Suicide Rate per 100'000 People	0,1	1
20. Homicide Rate per 100'000 People	1,40	6
21. Physicians per 1'000 People	0,6	15
22. Access to Electricity (% Population)	98,9	9
23. Improved Water Source (% Population with Access)	82	8
24. Food Security Index [0-100]	49,7	11
25. Rail Route-km per 1'000 People	0,066	13
26. PM_{10} Emissions [µg/m^3]	23	5
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	4,146	10
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	1,35	1
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,064	1
30. Change in Forest Area, 1990/2010 (%)	1,6	12
31. Ecological Footprint Index	1,2	1
32. GEF Benefits Index for Biodiversity [0-100]	3,5	5
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,209	1
34. Corruption Perception Index [0-100]	37	10
35. Press Freedom Index [0-100]	66	15
36. Democracy Index [0-100]	4,07	14

Spain

Score	0.690
Rank	2
Replaced Missing Data	/

Remarks:

(-) Worst Unemployment Rate.

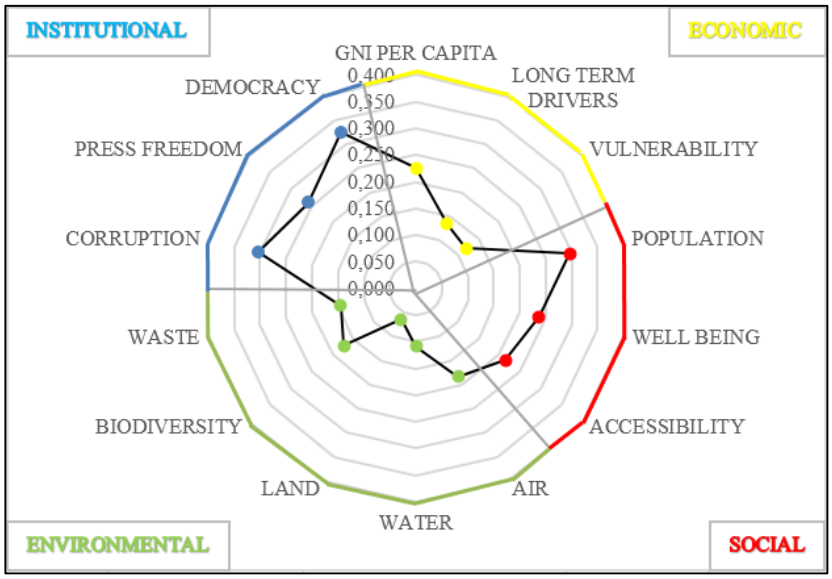
(+) Highest Life Expectancy.

(-) Worst HIV Prevalence.

(+) Lowest Homicide Rate.

(+) Highest Biodiversity value.

(+) Best Democracy level.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.707	2	0
Equal Weights - Linear Aggregation	0.634	2	0
Absolute Hierarchical Tree Weights - Linear Aggregation	0.710	2	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.697	2	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	26092,42	4
2. R&D Expenditures (% GDP)	1,33	4
3. Public Spending on Education (% GDP)	4,97	6
4. Public Health Expenditure (% GDP)	6,95	3
5. Unemployment (% Total Labor Force)	25,0	15
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,10	2
7. Electricity Production from Renewables / Total Electricity Production	0,3063	4
8. Net Exports / (Exports + Imports of Goods and Services)	0,035	4
9. Energy Imports (% Energy Use)	74,19	8
10. Public Debt (% GDP)	84,10	9
11. Urban Population / Urban Areas [inh/km^2]	8170,1	8
12. Gender Inequality Index [0-1]	0,10	3
13. GINI Richness Distribution [0-100]	32,00	5
14. School Enrolment, Secondary (% of the Official Secondary School Age)	128,51	1
15. Mean Years of Schooling [years]	10,4	4
16. Life Expectancy at Birth [years]	82,33	1
17. % of HIV Cases	0,45	9
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	24,1 - /	12
19. Suicide Rate per 100'000 People	7,6	8
20. Homicide Rate per 100'000 People	0,85	1
21. Physicians per 1'000 People	4,0	2
22. Access to Electricity (% Population)	100	1
23. Improved Water Source (% Population with Access)	100	1
24. Food Security Index [0-100]	78,3	3
25. Rail Route-km per 1'000 People	0,332	3
26. PM_{10} Emissions [µg/m^3]	24	7
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	2,925	3
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	8,53	11
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,137	7
30. Change in Forest Area, 1990/2010 (%)	31,5	3
31. Ecological Footprint Index	5,4	14
32. GEF Benefits Index for Biodiversity [0-100]	6,8	1
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	2,985	12
34. Corruption Perception Index [0-100]	59	4
35. Press Freedom Index [0-100]	27	3
36. Democracy Index [0-100]	8,02	1

Tunisia

Score	0.493
Rank	8
Replaced Missing Data	1

Remarks:

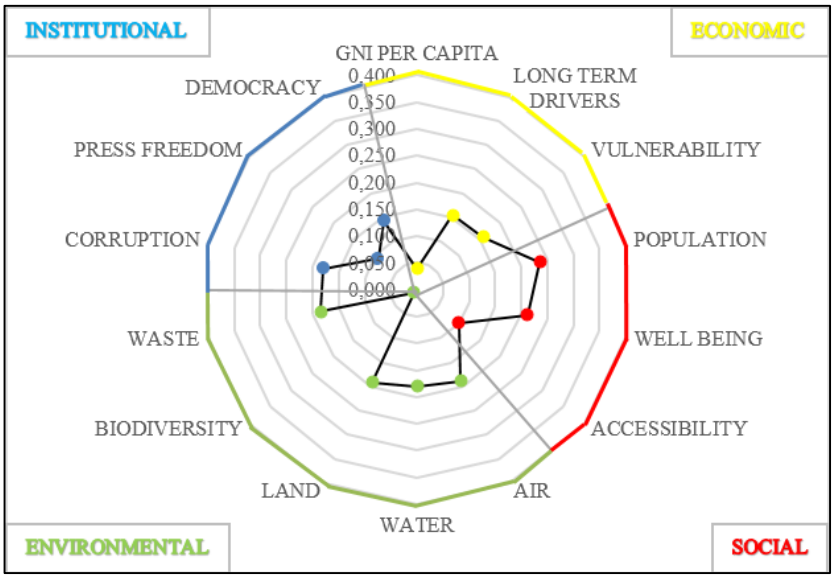
(+) Considerable Public Education investor.

(-) High Unemployment Rate.

(-) Very low Physicians presence.

(+) In the last two decades, very low values in the Deforestation Rate.

(+) High value in the Relative Grey Water Footprint.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.515	8	0
Equal Weights - Linear Aggregation	0.540	7	+1
Absolute Hierarchical Tree Weights - Linear Aggregation	0.505	8	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.482	8	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	8220,65	11
2. R&D Expenditures (% GDP)	1,10	6
3. Public Spending on Education (% GDP)	6,21	2
4. Public Health Expenditure (% GDP)	3,39	8
5. Unemployment (% Total Labor Force)	18,3	13
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,11	3
7. Electricity Production from Renewables / Total Electricity Production	0,0101	12
8. Net Exports / (Exports + Imports of Goods and Services)	-0,004	6
9. Energy Imports (% Energy Use)	20,74	2
10. Public Debt (% GDP)	46,10	4
11. Urban Population / Urban Areas [inh/km^2]	3888,3	5
12. Gender Inequality Index [0-1]	0,26	10
13. GINI Richness Distribution [0-100]	36,06	11
14. School Enrolment, Secondary (% of the Official Secondary School Age)	91,09	10
15. Mean Years of Schooling [years]	6,5	12
16. Life Expectancy at Birth [years]	74,75	10
17. % of HIV Cases	0,10	1
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	23,8 - 3,3	4
19. Suicide Rate per 100'000 People	0,1	1
20. Homicide Rate per 100'000 People	1,14	4
21. Physicians per 1'000 People	1,2	13
22. Access to Electricity (% Population)	99,5	7
23. Improved Water Source (% Population with Access)	96	4
24. Food Security Index [0-100]	58,3	8
25. Rail Route-km per 1'000 People	0,105	10
26. PM_{10} Emissions [µg/m^3]	23	6
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	3,612	6
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	2,43	3
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,065	2
30. Change in Forest Area, 1990/2010 (%)	56,5	2
31. Ecological Footprint Index	1,9	5
32. GEF Benefits Index for Biodiversity [0-100]	0,5	13
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	0,893	9
34. Corruption Perception Index [0-100]	41	8
35. Press Freedom Index [0-100]	52	9
36. Democracy Index [0-100]	5,67	10

Turkey

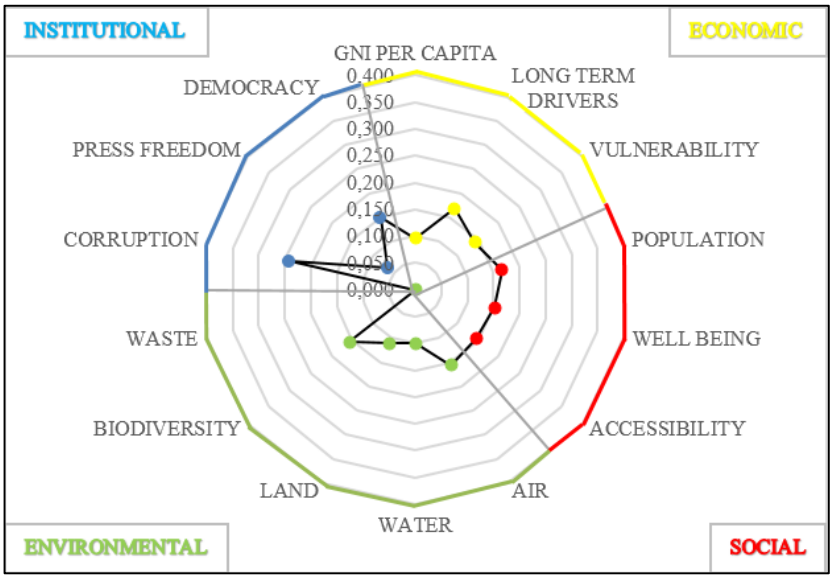
Score	0.461
Rank	9
Replaced Missing Data	1

Remarks:

(+) Very high Cities Livability level.

(-) Very low Richness Distribution level.

(-) Hugest amount of Waste Produced per Capita.



WEIGHTING - AGGREGATION METHOD	SCORE	RANK	CHANGE IN RANK
Absolute Experts' Weights - Linear Aggregation	0.463	9	0
Equal Weights - Linear Aggregation	0.477	10	-1
Absolute Hierarchical Tree Weights - Linear Aggregation	0.461	9	0
Relative Hierarchical Tree Weights - Geometric Aggregation	0.457	9	0

INDICATOR	VALUE	RANK
1. GNI (PPP) per Capita [2005 Int. $]	13625,79	9
2. R&D Expenditures (% GDP)	0,84	7
3. Public Spending on Education (% GDP)	2,86	13
4. Public Health Expenditure (% GDP)	4,99	6
5. Unemployment (% Total Labor Force)	9,2	4
6. Total Primary Energy Supply / GDP [toe/ thousands 2005 USD)	0,11	3
7. Electricity Production from Renewables / Total Electricity Production	0,2538	5
8. Net Exports / (Exports + Imports of Goods and Services)	-0,016	8
9. Energy Imports (% Energy Use)	73,11	7
10. Public Debt (% GDP)	37,60	3
11. Urban Population / Urban Areas [inh/km^2]	2289,6	2
12. Gender Inequality Index [0-1]	0,37	11
13. GINI Richness Distribution [0-100]	40,20	14
14. School Enrolment, Secondary (% of the Official Secondary School Age)	88,85	11
15. Mean Years of Schooling [years]	6,5	13
16. Life Expectancy at Birth [years]	74,54	11
17. % of HIV Cases	0,10	1
18. Obesity Prevalence (% 20+ Years Old); Malnutrition Prevalence (% < 5 Years Old)	29,3 - 3,5	8
19. Suicide Rate per 100'000 People	3,6	4
20. Homicide Rate per 100'000 People	3,27	14
21. Physicians per 1'000 People	1,7	11
22. Access to Electricity (% Population)	99,9	3
23. Improved Water Source (% Population with Access)	100	1
24. Food Security Index [0-100]	63,8	7
25. Rail Route-km per 1'000 People	0,131	9
26. PM_{10} Emissions [µg/m^3]	35	11
27. Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]	3,840	7
28. GHG Emissions [Tons CO_2 Equivalent per Capita per Year]	4,91	6
29. Human Impact on Water [Grey Water Footprint/Total Water Footprint]	0,146	8
30. Change in Forest Area, 1990/2010 (%)	17,1	6
31. Ecological Footprint Index	2,7	6
32. GEF Benefits Index for Biodiversity [0-100]	6,2	2
33. Amount of Total Waste Produced / Population [tonnes/inhabitants/year]	10,860	15
34. Corruption Perception Index [0-100]	50	5
35. Press Freedom Index [0-100]	56	11
36. Democracy Index [0-100]	5,76	8

8.5 Focus on Egypt and Italy

In this section, a more detailed description is presented for Egypt and Italy, considering the different weighting and aggregation methodologies and the single indicators.

8.5.1 Egypt

Score	**0.331**
Rank	**14**
Replaced Missing Data	/

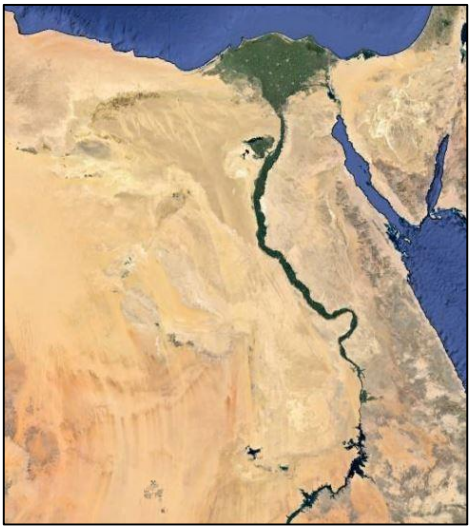
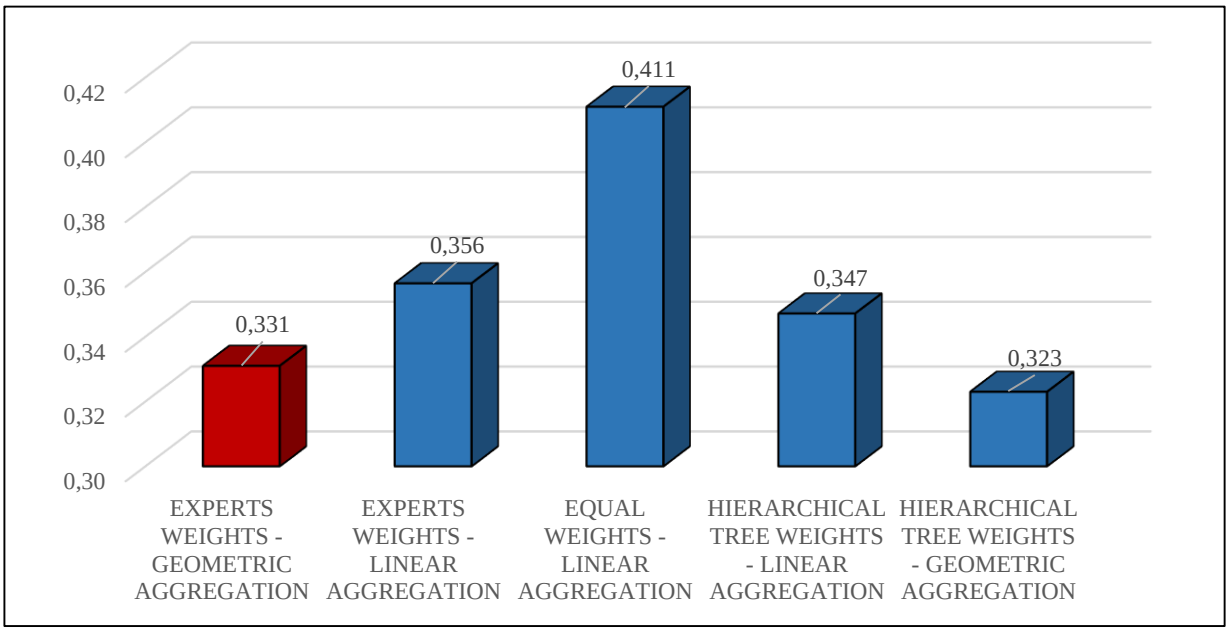


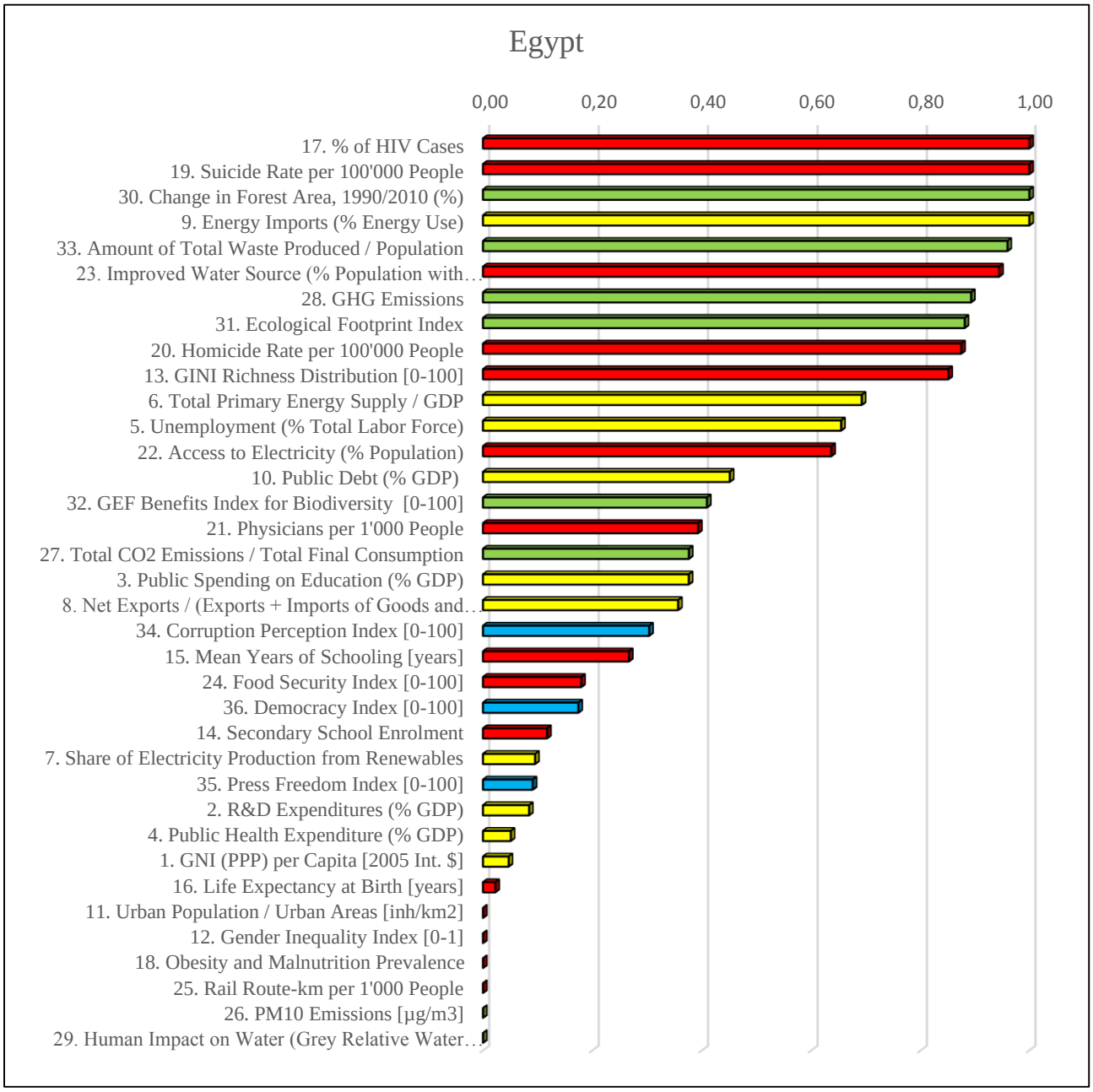
Figure 8.6. Physical map of Egypt



Graph 8.10. Plot of the final scores for Egypt by the different weighting and aggregation methodologies considered

As shown in Graph 8.10, the final reference score, displayed through the red bar, is penalized by the use of the geometric aggregation, for which the low result in the institutional dimension, with a value of 0.200, affects negatively the whole index. Moreover the best scores for Egypt correspond to indicators evaluated with low weights by the experts and, for this reason, the equal weighting procedure gets the highest result. Finally, it can be noted that, for the same aggregation method, the scores obtained by the experts' weights are similar to those of the hierarchical tree.

Indicators analysis



Graph 8.11. Plot of the normalized indicators values for Egypt respect to the analyzed context

Economic Dimension:

- Strength: **Energy Imports:** it is one of the major oil and natural gas exporter due to its reservoirs. Oil Balance: Imports – Exports = 11'249 – 14'109 [ktoe of oil equivalent]; Natural Gas Balance: 0 – 7'571 [ktoe of oil equivalent]. [1]
- Weakness: **Public Health Expenditure (% of GDP):** the percentage of the public expenditure respect to the total health expenditures is of 40,5 %, this means that the private sector is more supported. [2]
- Opportunity: **R&D Expenditures (% of GDP):** since Egypt has a very low share (0,43 % of GDP) and the corresponding experts' weight is quite high (0,019), it represents a possible investment for the economic development.

Social Dimension:

- Strength: **GINI Index**: even if Egypt presents a low value of GNI per capita, its richness distribution is homogeneous, being the best among the analyzed North African countries.
- Weaknesses: **Gender Inequality Distribution**: due to cultural and religious traditions, there is a gap between women and men in access to education, employment and healthcare. [3]
  Urban Population Density: due to the presence of wide desert areas, the urban density is very high. In particular the main four cities have more than one million inhabitants and there are nine cities with more than 400'000 inhabitants. [4]
- Opportunities: **Mean Years of Schooling - Secondary School Enrolment:** due to the low values and the corresponding high experts' weights (0,013) concerning the education indicators, the public spending on education (3,76 % of GDP) and the efficiency of the school system could be improved.

Environmental Dimension:

- Strength: **Amount of Waste per Capita**: the result of this indicator is satisfying (0,637 tonnes per capita per year) due to a low standard of richness per capita, reason of a low consumerism level, and due to one of the highest waste recycling rate.
- Weakness: **PM_{10} Emissions**: the value (78 $\mu g/m^3$) exceed the average annual threshold (40 $\mu g/m^3$) for the protection of human health, established by European Directive, due to a high urban density. [5]
- Opportunity: **Human Impact on Water (Grey Relative Water Footprint)**: this indicator, related to the water quality is low, because industries discharge their sewage-water either directly into the waterways or through the municipal system. [6] Since it is an important aspect in the experts' judgments (0,046), it could be improved through a stricter legislation and control.

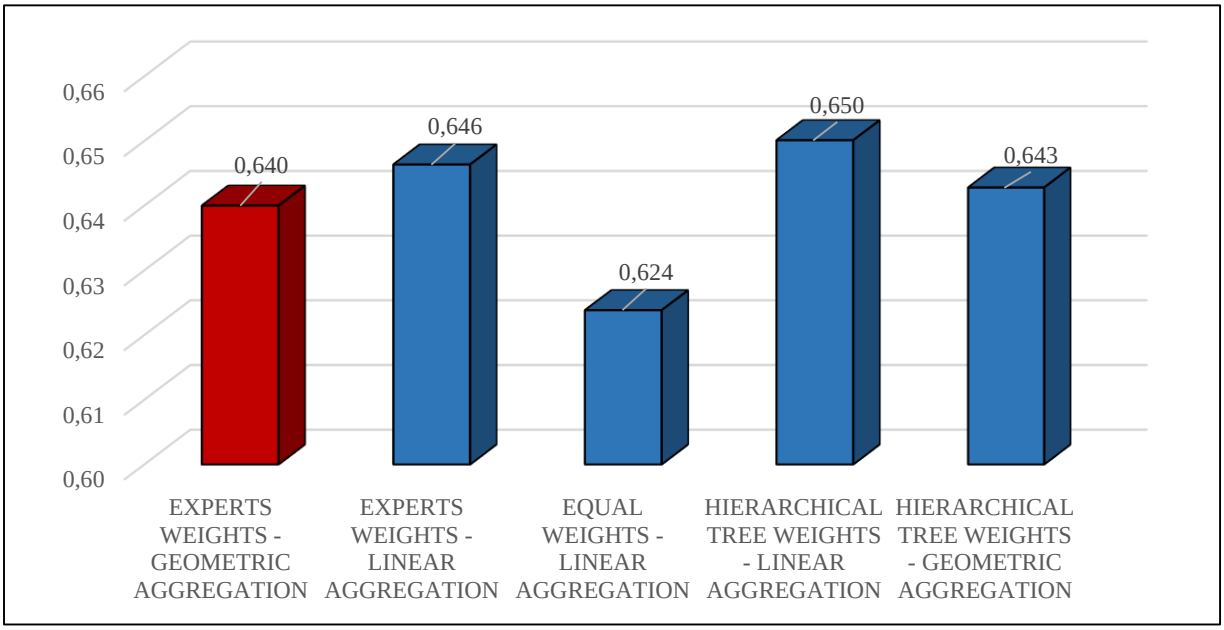
Institutional Dimension:

- Strength: /
- Weakness: **Democracy Index**: due to the last thirty years of regime under the president Hosni Mubarak and the recent political instability, the level of democracy in Egypt is one of the lowest of the studied Mediterranean region. The Democracy Index measures lacks of freedom in electoral process and pluralism, civil liberties, functioning of government, political participation, and political culture.
- Opportunities: **Corruption Perception Index**: corruption is one of the more relevant problem in Egypt, it is widespread and investors still report bribery and extortion in their interaction with government official. Some anti-corruption initiatives have been carried out in the constitution of 2012, but since not significant changes have been made, the fight against corruption must be dealt with. [7]
  Press Freedom: in the last year Egypt declined from Partly Free to Not Free due to officially tolerated campaigns to intimidate journalists, increased efforts to prosecute reporters and commentators for insulting the political leadership or defaming religion, and intensified polarization of the pro– and anti–Muslim Brotherhood press, which reduced the availability of balanced coverage. [8] Press freedom must be improved to raise the awareness of the population, leading to a higher democracy level.

8.5.2 Italy

Score	**0.640**
Rank	**4**
Replaced Missing Data	/

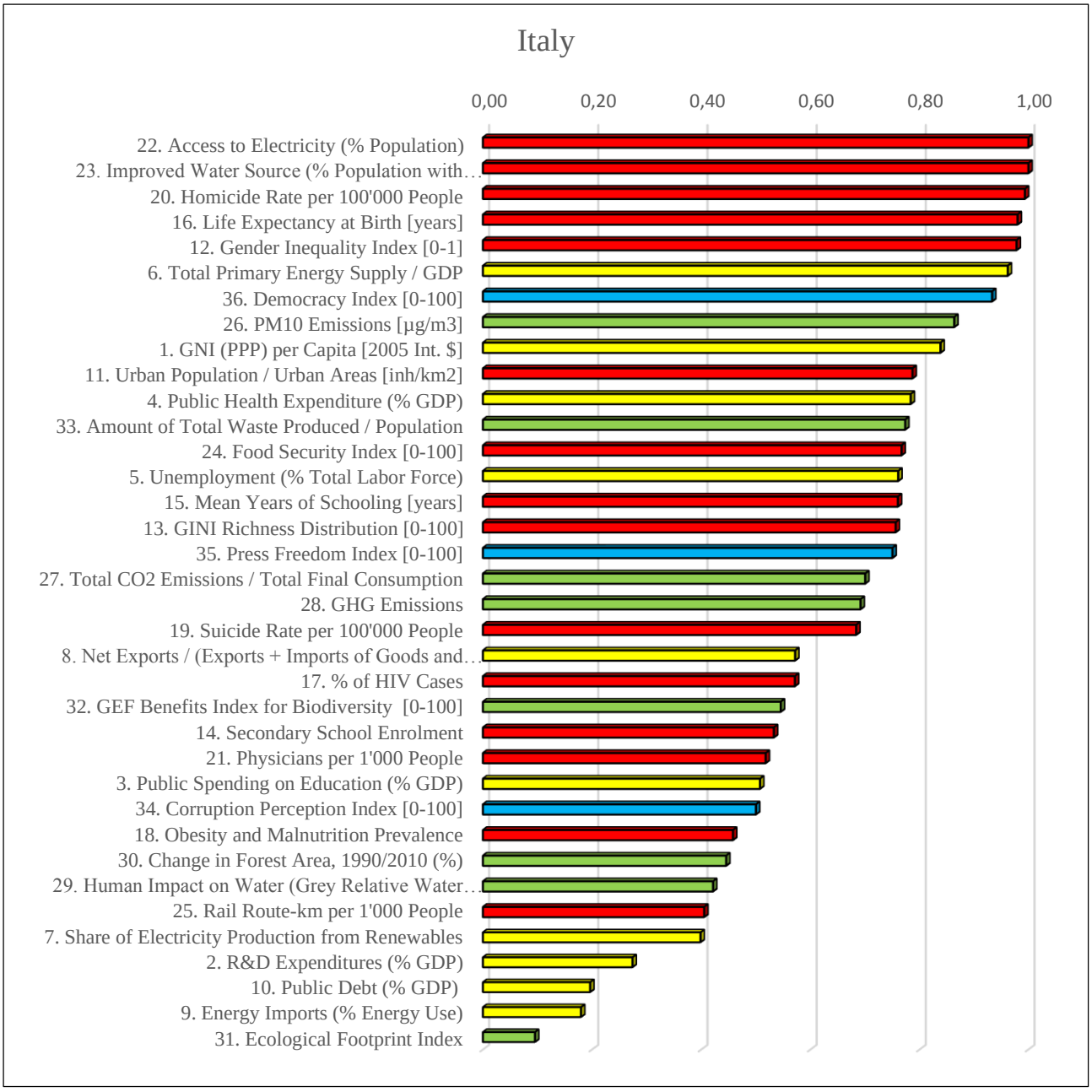
Figure 8.7. Physical map of Italy



Graph 8.12. Plot of the final scores for Italy by the different weighting and aggregation methodologies considered

As shown in Graph 8.12, the final reference result, displayed through the red bar, is influenced by the use of the geometric aggregation, for which the good scores in the social and institutional dimensions, respectively of 0.766 and 0.713 values, are lowered by the economic and environmental sectors, respectively of 0.538 and 0.565 values.
Since for Italy the highest values of the indicators are linked to weights which the experts evaluated greatly, the equal weighting procedure gets the lowest result.
Finally, it is verified that using the same aggregation method, the scores obtained through the experts' weights are almost the same of those referred to the hierarchical tree; this is due to the fact that the experts' weights follow the hierarchical tree structure.

Indicators Analysis



Graph 8.13. Plot of the normalized indicators values for Italy respect to analyzed context

Economic Dimension:

- Strenght: **Public Health Expenditure (% of GDP):** the percentage of the public expenditure respect to the total health expenditures is of 77,2 %, this means that the investments in the public health care system in Italy are considerable. [2]
- Weaknesses: **Energy Imports:** because of the scarcity of oil and natural gas reservoirs and the absence of nuclear power plants, Italy imports the greatest amount of the required energy. Energy Balance: Imports – Exports = 169’216 – 28’101 [ktoe of oil equivalent] (oil imports: 89’808 [ktoe of oil equivalent], natural gas imports: 57’616 [ktoe of oil equivalent]). [9]

Public Debt: since it is one of the highest in the studied Mediterranean area (2'089 billion € [10], 126,9 % of GDP), it represents an high level of exposure and a serious obstacle for the economic growth.

- Opportunity: **R&D Expenditures (% of GDP):** since Italy has a very low share (1,25 % of GDP) and the corresponding experts' weight is quite high (0,019), it represents a possible investment for the economic development. It reflects the significant phenomena of the migration of Italian students, researchers and professionals abroad, an inestimable loss for the country.

Social dimension:

- Strengths: **Life Expectancy at Birth**: Italy gets a high score (82 years) due to a general satisfying standard of wellbeing, thanks to a good health system and cultural factors.
  Gender Inequality Index: even if Italy has not yet reached the complete parity between sexes, in particular regarding the work and political sectors, its level is one of the highest in the studied Mediterranean area.
- Weakness: **Rail Route km per 1'000 People**: among the analyzed European countries, Italy presents one of the lowest values, in fact the railway network is not very widespread. This is an important lack in the transport accessibility and in the opportunity to move for job or touristic reasons.
- Opportunity: **Mean Years of Schooling (People Aged 25+)**: it is not one of the highest values among the analyzed Mediterranean countries (10,1 years). In order to improve this indicator, which gets a significant experts' weight (0,013), the compulsory school years, actually fixed at 10 years, could be increased. Moreover incentives in the university system should be implemented to guarantee a proper accessibility.

Environmental dimension:

- Strength: **PM_{10} Emissions [µg/m^3]**: the daily mean of the PM_{10} emissions in the city with a population greater than 100'000 inhabitants is 21 µg/m^3, which is below the average annual threshold (40 µg/m^3) for the protection of human health, established by European Directive. [5]
- Weakness: **Ecological Footprint Index**: the value of this indicator is one of the worsts among the analyzed Mediterranean countries, result of high population consumptions and a low production efficiency. [11]
- Opportunity: **Human Impact on Water (Grey Relative Water Footprint)**: this indicator, related to the water quality is quite low, mostly because of the industrial and agricultural discharges particularly in the Pianura Padana area. Since this indicator obtains a high weight from the experts' judgements (0,046), stricter legislations and controls regarding water quality should be improved. [12]

Institutional dimension:

- Strength: **Democracy Index**: in Italy the level of democracy, determined by freedom in electoral process and pluralism, civil liberties, functioning of government, political participation, and political culture, is one of the highest in the studied Mediterranean area.
- Weakness: **Corruption Perception Index**: due to the historical presence of organized crime associations and to a cultural factor, Italy ranks at the last places among the analyzed European countries. Italy does not have an independent and dedicated anti-corruption authority, causing

a corruption cost of 60 € billion each year (half of the European Union) as estimated by Italy's Court of Auditors. [13]

- Opportunity: **Press Freedom Index**: freedoms of speech and of the press in Italy are constitutionally guaranteed and generally respected in practice, despite ongoing concerns regarding concentration of media ownership. Journalists occasionally face physical threats or attacks from organized crime networks and other political or social groups. Since the related experts' weight is one of the highest (0,085), national and local actions should be carried out to improve the media freedom level. [14]

Bibliography:

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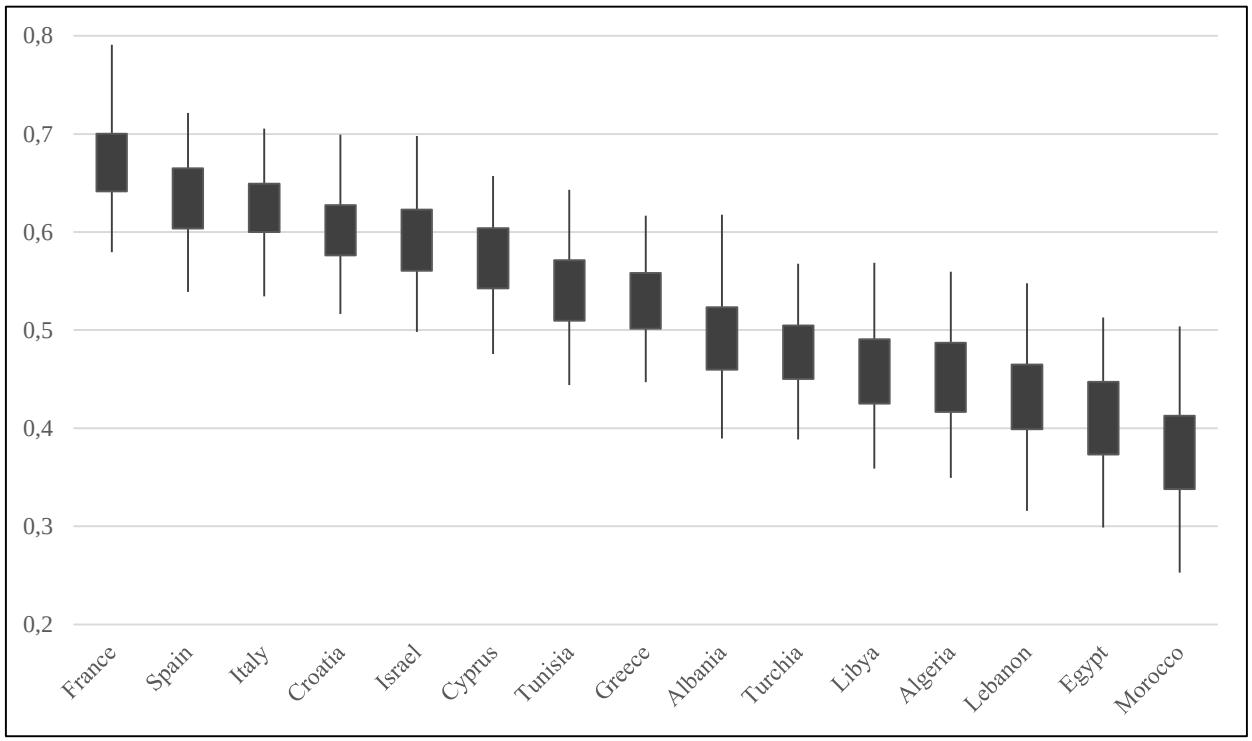
[14] <http://www.freedomhouse.org/report/freedom-press/2012/italy#.UyhNMfl5OAU>

9. Sensitivity Analysis Results

9.1 Robustness Analysis Results

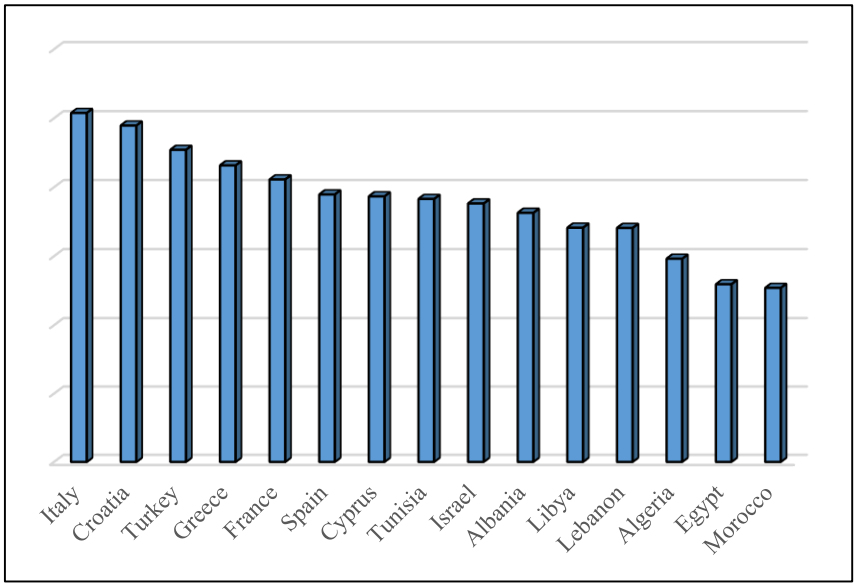
In this paragraph results obtained through the Monte Carlo analysis, explained in Section 6.5.1, are described. The scores have been computed through the simulation of 1000 random weights, for the 36 indicators which compose the proposed model, linearly aggregated.



Graph 9.1. Distribution of the Sustainability Evaluation Model over 1000 simulations

Table 9.1. Countries' maximum, minimum and standard deviation for the Monte Carlo analysis

Country	Maximum	Minimum	Standard Deviation
France	0,791	0,579	0,029
Spain	0,721	0,539	0,032
Italy	0,705	0,535	0,025
Croatia	0,699	0,517	0,026
Israel	0,698	0,498	0,031
Cyprus	0,657	0,476	0,031
Tunisia	0,643	0,444	0,031
Greece	0,617	0,447	0,028
Albania	0,618	0,390	0,032
Turchia	0,568	0,388	0,029
Libya	0,569	0,359	0,033
Algeria	0,560	0,349	0,035
Lebanon	0,548	0,316	0,033
Egypt	0,513	0,299	0,037
Morocco	0,504	0,253	0,037



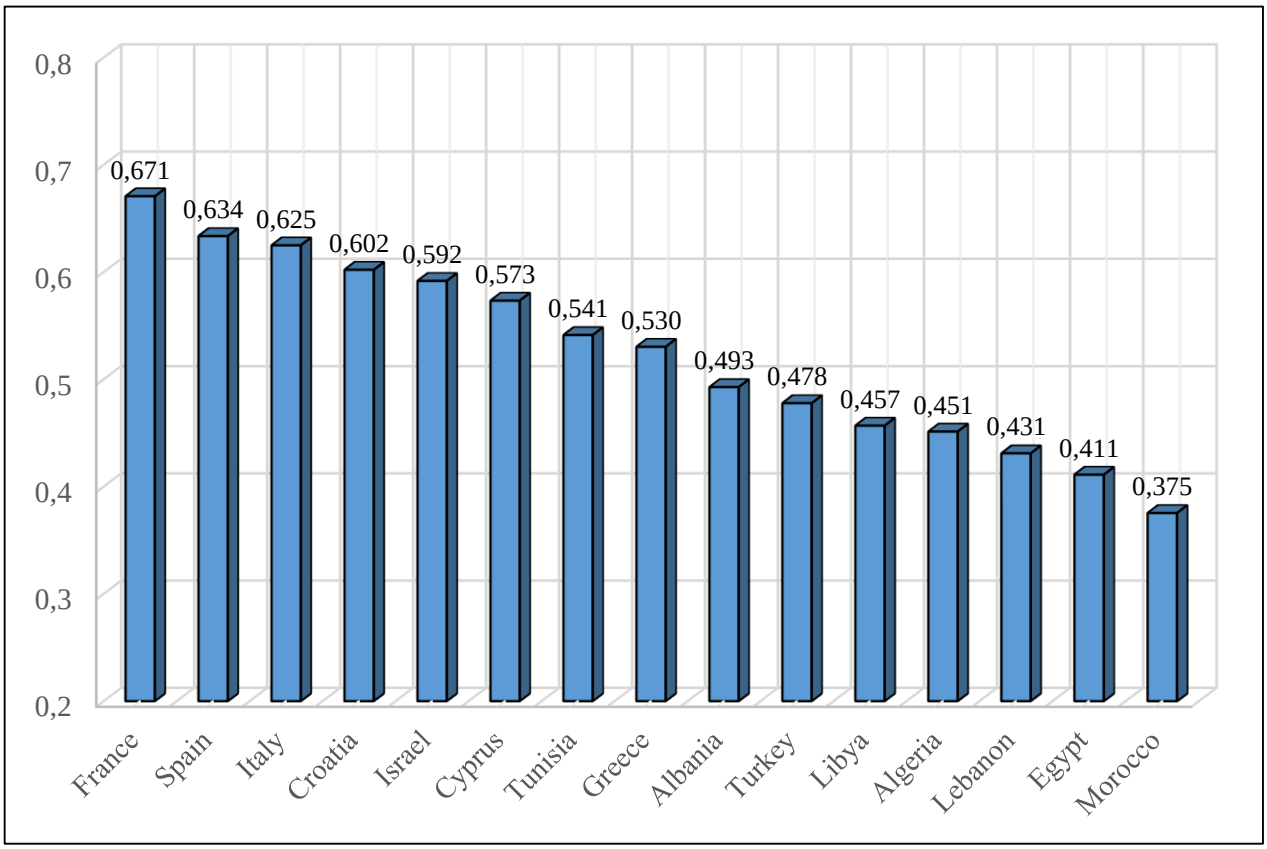
Graph 9.2. Robustness rank

Simulation of 1000 random weights, obtained through the Monte Carlo approach, has the function to underline the values of the data rather than the weighting methodology.
In fact the robustness analysis highlights the homogeneity in the distribution of the normalized data of each country. In this sense, a nation is defined robust when its normalized data assume almost always the same value.
This kind of analysis could be strongly affected by missing data, but in the performed analysis this drawback has been overcome by the replacement of the blank cells (Section 6.1).

Graph 9.1 and Table 9.1 show the standard deviation and the maximum and minimum values assumed by the composite index among all the simulations for each country.
Small standard deviation (displayed by the width of the black box) correspond to robust results.
The level of robustness is visible in Graph 9.2, where countries are ranked according to the standard deviation.

As overall remark, since the ranking of the country does not change considerably, the Sustainability Evaluation Model can be considered robust. In particular Italy, Croatia and Turkey present more homogeneous values, while data of Algeria, Egypt and Morocco contain more heterogeneous normalized data.

Graph 9.3 shows the median values of the 1000 simulations.



Graph 9.3. Median of all the simulated Sustainability Evaluation Model values

9.2 Correlation Analysis Results

In this section the results regarding the correlation analysis, explained in Paragraph 6.5.2, are presented. The scores of the 36 indicators which compose the framework have been correlated with the Sustainability Evaluation Model, through the evaluation of the Pearson coefficient (r), for the three different weighting methodology, in order to understand how the experts' weights influence the correlation. Table 9.2 shows the indicators which are more strongly correlated with the proposed index, divided by dimension.

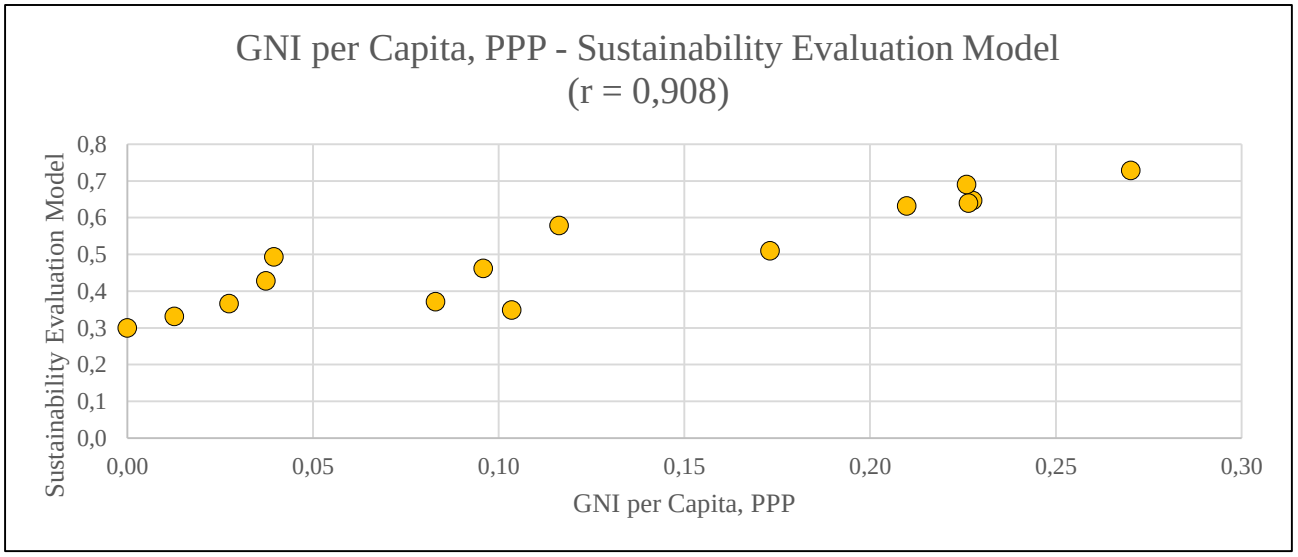
Table 9.2. Indicators strongly correlated with the Sustainability Evaluation Model

Dimension	Indicator	Equal Weights (r)	Hierarchical Tree Weights (r)	Experts' Weights (r)
ECONOMIC	GNI (PPP) per Capita	0,863	0,926	0,908
	Public Health Expenditure (% of GDP)	0,855	0,827	0,814
SOCIAL	Gender Inequality Index	0,884	0,882	0,849
	Life Expectancy at Birth	0,805	0,837	0,831
	Food Security Index	0,807	0,825	0,848
ENVIRONMENTAL	Ecological Footprint Index	-0,814	-0,860	-0,835
INSTITUTIONAL	Corruption Perception Index	0,752	0,826	0,854
	Press Freedom Index	0,927	0,966	0,966
	Democracy Index	0,914	0,936	0,935

As shown in Table 9.2, the weighting methodology does not greatly influence the correlation between the indicators and the final index.

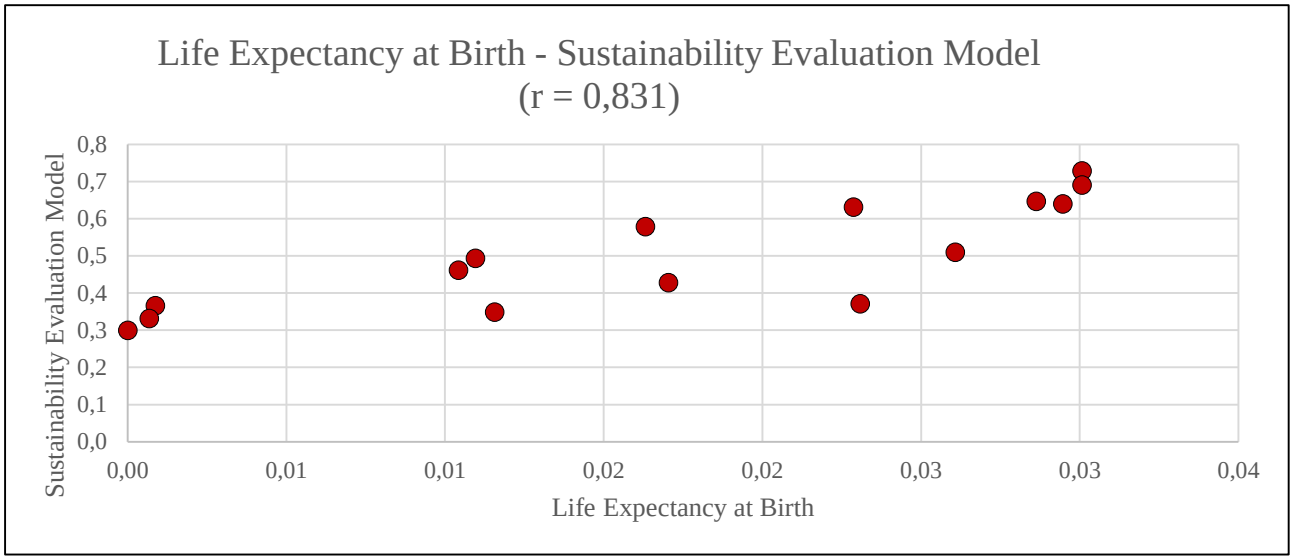
Among the indicators with the highest Pearson coefficient (r), one significant for each dimension has been chosen to represent the graphical results:

- Economic dimension: GNI per Capita, PPP
- Social dimension: Life Expectancy at Birth
- Environmental dimension: Ecological Footprint Index
- Institutional dimension: Democracy Index.



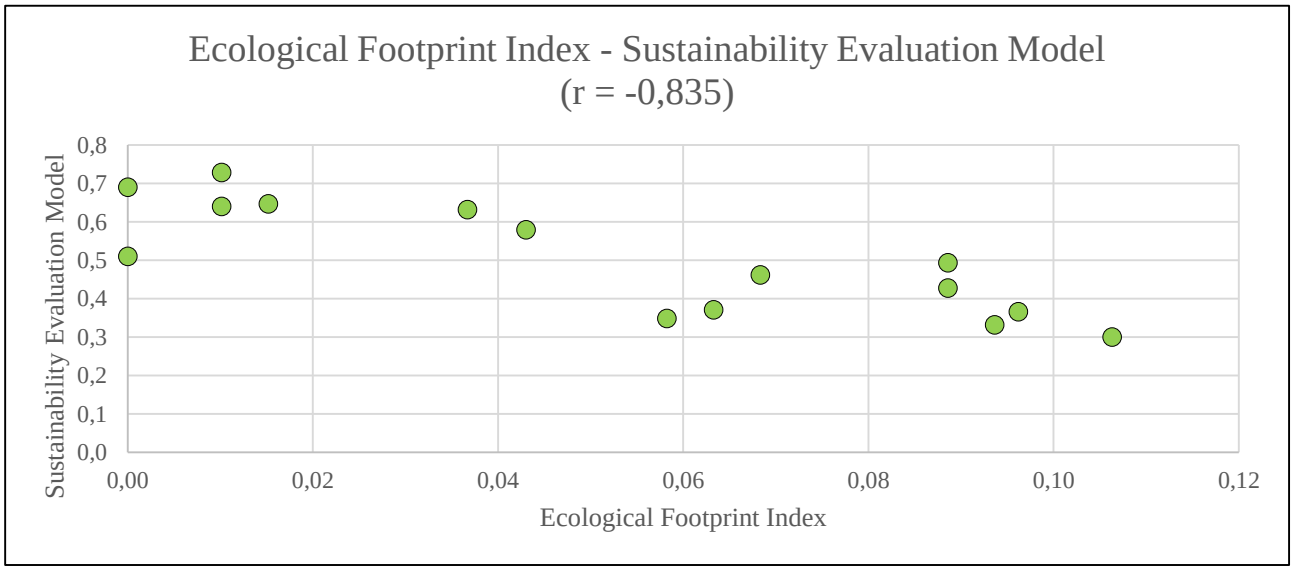
Graph 9.4. Correlation between GNI per Capita, PPP and Sustainability Evaluation Model by country

The GNI per Capita, PPP correlates significantly with the Sustainability Evaluation Model, with an *r* value of 0,908. The high correlation can be explained by the fact that higher is the GNI of a country, greater is the possibility of investments in the sustainability dimensions.



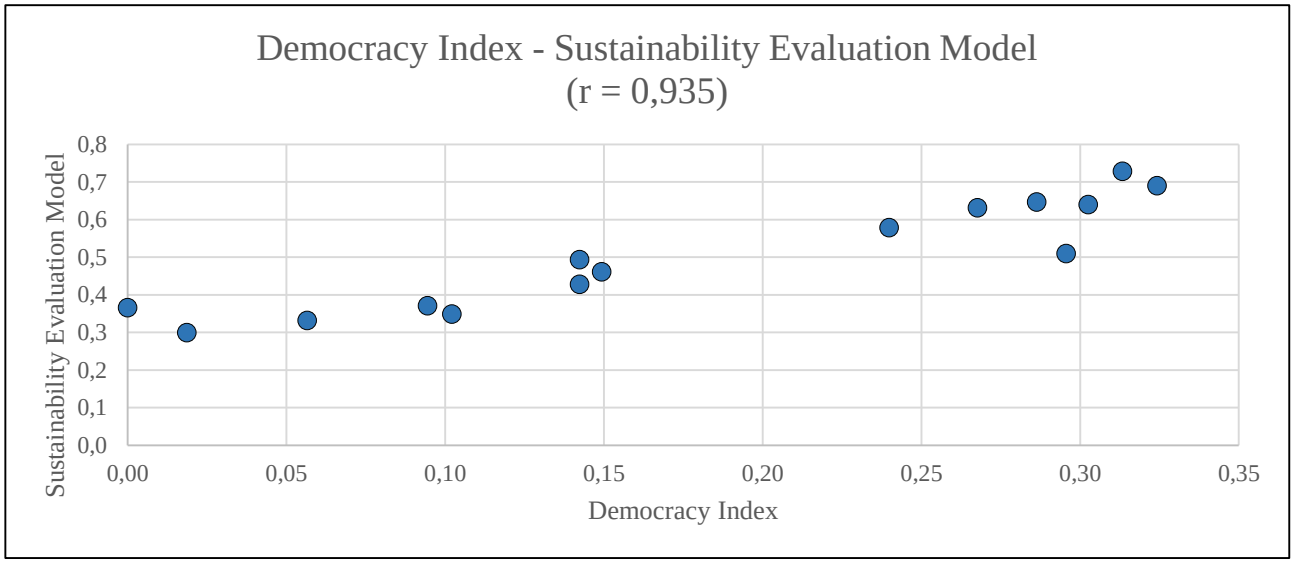
Graph 9.5. Correlation between Life Expectancy at Birth and Sustainability Evaluation Model by country

The Life Expectancy at Birth correlates significantly with the Sustainability Evaluation Model, with an *r* value of 0,831. The high correlation can be explained by the fact that this indicator is linked to different aspects included in the Sustainability Evaluation Model through specific indicators as: Public Health Expenditure, % of HIV Cases, Obesity and Malnutrition Prevalence, Physicians per 1'000 People, Improved Water Source Access, Food Security, Access to Electricity.



Graph 9.6. Correlation between Ecological Footprint Index and Sustainability Evaluation Model by country

The Ecological Footprint Index correlates significantly in a negative way with the Sustainability Evaluation Model, with an *r* value of -0,835. This significant relation shows that countries with high population consumptions and a low production efficiency, corresponding to a high Ecological Footprint, are related to nations with high Sustainability Evaluation Model scores. This because a high sustainability standard, particularly in the economic and social sector, could lead to wastes of resources.



Graph 9.7. Correlation between Democracy Index and Sustainability Evaluation Model by country

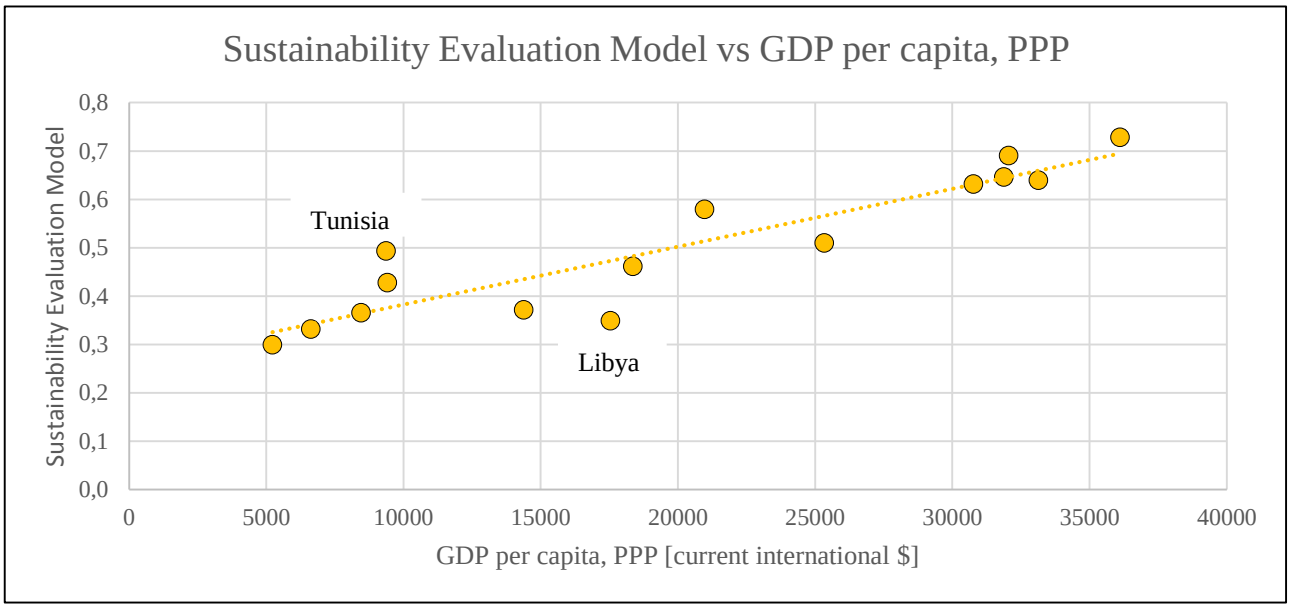
The Democracy Index correlates significantly with the Sustainability Evaluation Model, with an *r* value of 0,935. The high correlation can be explained by the fact that democracy is the basis to meet the population needs. It is possible to state that, in order to reach a sustainable development, a country has to ensure a high democracy level.

9.3 Comparisons respect to Other Indexes

In this section the Sustainability Evaluation Model has been compared with a representative index for each of the economic, social and environmental dimensions. The institutional dimension has not been taken into account because its most significant indexes have already been included in the framework of the Sustainability Evaluation Model.
The comparisons have been useful to assess the nations behavior, in particular highlighting those countries which deviated from the mean trend.

The following indexes have been selected for each dimension:

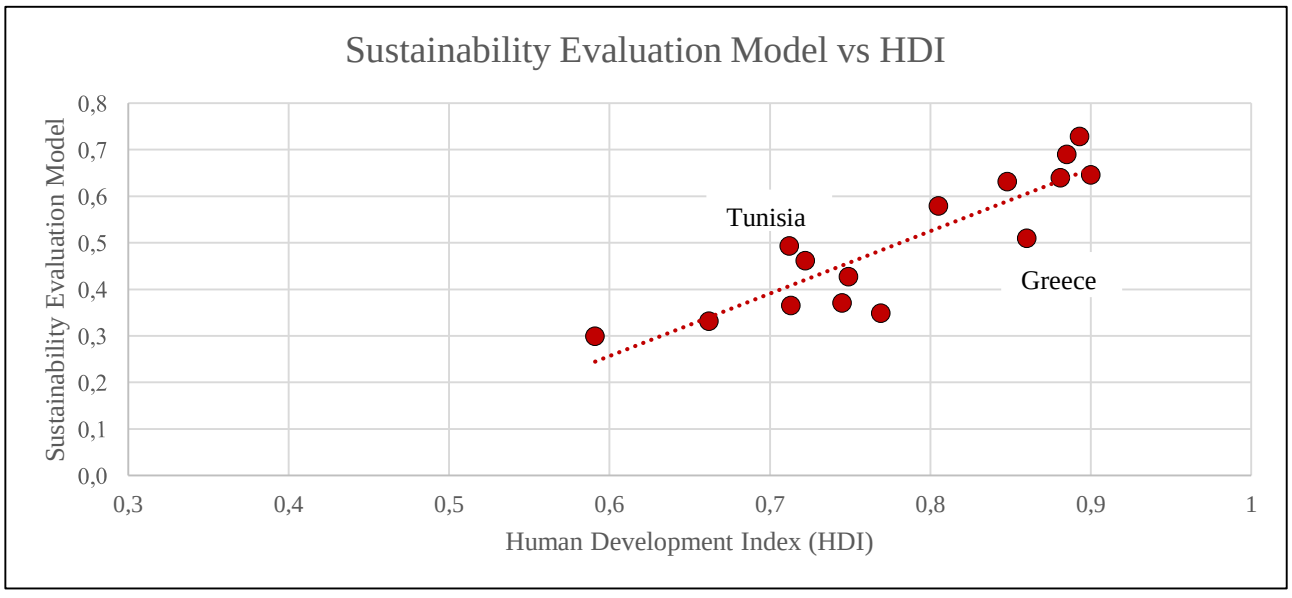
- Economic: GDP per capita based on Purchasing Power Parity (PPP), referred to 2012. It represents the basic information regarding the economy of a country.
- Social: Human Development Index (HDI), referred to 2012, published by the United Nations Development Programme (UNDP). It is one of the most used reference index due to its ability to represent in a simple way the social level of a nation.
- Environmental: Environmental Sustainability Index (ESI), referred to 2005, developed by Yale and Columbia Universities. It is one of the most complete indexes which takes into account all the environmental spheres.



Graph 9.8. Plot of the comparison between the Sustainability Evaluation Model and the GDP per capita, PPP

Analyzing Graph 9.8, it is possible to state that richer is a country, higher is the relative sustainable development level, due to a greater capacity to invest in the sustainability sectors. Two countries, however, clearly deviate from the mean trend:

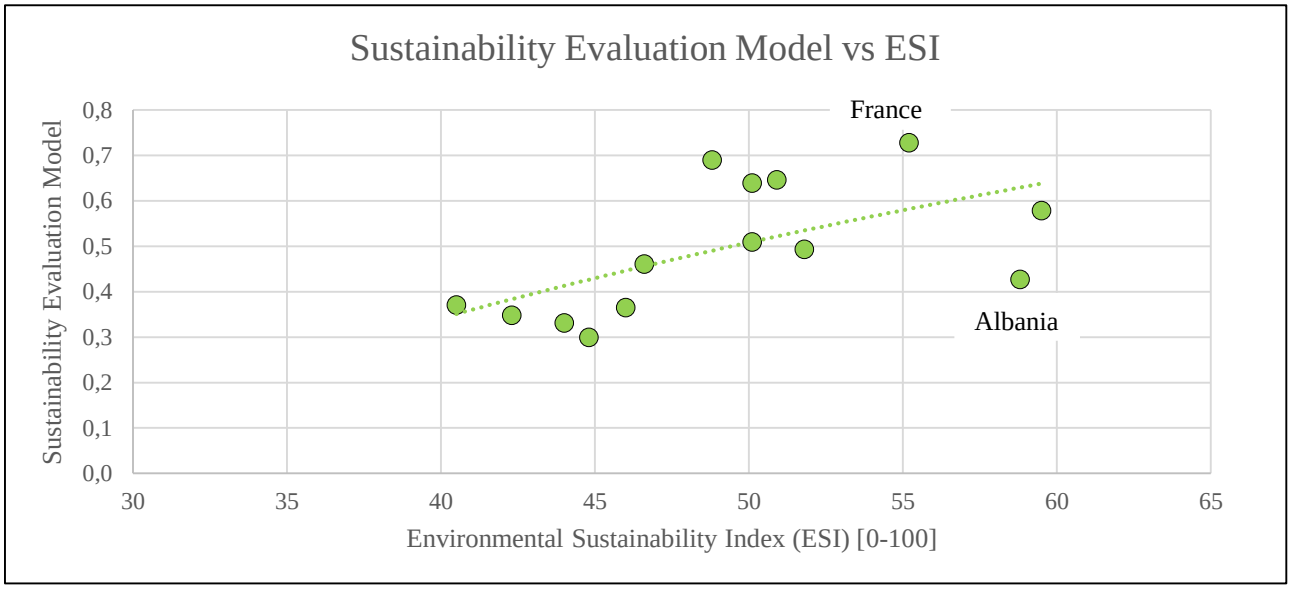
- Libya: for its GDP per Capita, the sustainability level, computed through the Sustainability Evaluation Model, results too low. In fact Libya gets low scores for the social and the environmental dimensions, and the worst result among the analyzed countries regarding the institutional one. The high level of GDP per Capita is due to the significant presence of energy reservoirs, which however negatively influences the environmental quality.
- Tunisia: the low score in the GDP per Capita does not correspond to similar results in the Sustainability Evaluation Model. This because it presents the best scores among the North African countries in the social and institutional dimensions and it ranks second among all the analyzed countries concerning the environment. The relative low GDP per Capita and environmental impact could be explained by a low development of the production system.



Graph 9.9. Plot of the comparison between the Sustainability Evaluation Model and the Human Development Index (HDI)

Graph 9.9 shows that high scores in the Human Development Index are related to high sustainability levels. The countries which do not follow the mean trend are:

- Greece: for its HDI level, it presents a relative low Sustainability Evaluation Model score. In fact Greece gets the lowest results among the European countries concerning the economic and environmental dimensions. In particular it has been strongly affected by the recent economic crisis, which has led to a high unemployment rate and public debt.
- Tunisia: it shows a good Sustainability Evaluation Model score, not related to a same level of the Human Development Index. This is due to the very high result in the environmental dimension, which increase the overall sustainability value.



Graph 9.10. Plot of the comparison between the Sustainability Evaluation Model and the Environmental Sustainability Index (ESI)

Finally, looking at Graph 9.10, it is evident that there are two countries which greatly deviate from the mean trend:

- Albania: even if it obtains a high Environmental Sustainability Index score, its sustainability level is quite low because influenced by scarce economic results, characterized by a low standard of richness.
- France: it gets the highest Sustainability Evaluation Model score which does not correspond to the best Environmental Sustainability Index result. This could be explained by the fact that high levels of production and personal richness are the cause of environmental pollution and wastes.

10. Concluding remarks

10.1 Drawbacks

During the elaboration of this thesis, some possible drawbacks have been recognized. In order to carry out a complete analysis, some significant assumptions have been made. Here the main ones are listed.

- **Not selected indicators**: it has not been possible to choose some meaningful indicators because of the lack of consistent and exhaustive data in the analyzed context. E.g. the *Waste Recycling Rate* indicator - data available only at local scale and only for the European countries. However, the goal of constructing a representative index of the sustainability concept has been satisfied as far as possible. (See Appendix D)
- **Missing data**: some of the analyzed countries had not available data for few particular indicators. In order to allow more equitable comparisons among countries, the replacement of missing data has been performed. This does not represent a standard procedure, but it is the result of a subjective choice. Moreover, the replacement method, consisting in the computation of the mean among similar countries of the context, could be substituted by other valid methods. (See Paragraph 6.1, Graph 8.2)
- **Years of the data**: the data were not present for a unique year. During the collection process, the last available year for each indicator has been considered, therefore the assumption of constant data in the following years has been taken. (See Graph 8.1)
- **Weighting and aggregation methodologies**: the weighting and aggregation methodologies used to compute the final scores represent a subjective decision, dependent on the aim of the analysis and on the ideas of the decision-makers. In this thesis the subjectivity of the method has been managed constructing a robust framework. In fact, taking into account different weighting and aggregation methodologies, as highlighted by the robustness analysis, the ranks of the countries do not considerably change. (See Paragraph 6.3, 6.4, 6.5, 9.1)
- **Institutional dimension updating**: it is important to keep updated data especially for the institutional dimension because it can be strongly affected by sudden political changes (e.g. the overthrow of a regime).
- **Diversity of the data source**: during the collection process, different data sources have been used because of the lack of a unique database including all the selected indicators. Inconsistencies in the value of the same indicators may occur among different data sources. Therefore, where possible, World Bank and United Nations databases have been preferred. (See APPENDIX C)
- **Number of indicators**: the Sustainability Evaluation Model is composed by a significant number of indicators which could lead to difficulties in the data collection. This is due to the choice, during the construction process, of favoring the completeness criteria over the readiness in the data collection. Therefore, the proposed framework is a compromise between the completeness and the data collection criteria, where the former has assumed more importance. (See Paragraph 5.1)

10.2 Conclusions

The aim of this thesis has been to build a model able to measure the level of sustainability of a nation based on its four main dimensions.
The key point has been to provide a robust framework, developed through a rigorous and detailed methodology, applicable to any context at national scale. In this sense, the final scores have to be considered, not as the main output of this work, but as a validation tool for the structure of the model.
The Sustainability Evaluation Model wants to be a new composite index, different from those already existing in literature, due to the presence of the recent institutional dimension and to the capacity of the selected indicators to investigate all the sustainability sectors without going into the specificity. This latter aspect allows the collection of the data, essential to obtain significant results of an index.

The Mediterranean region, chosen for the calibration of the model, represents a well-defined context, which has allowed comparisons among countries having in common the same geographical area.

Another crucial point has been the application of different weighting and aggregation methods, in particular the experts' weights, obtained through an ad-hoc questionnaire proposed to people belonging to the analyzed context, which have given relevance to the main needs of a nation.

The ranks among countries based on the different methodologies have pointed out the robustness of the framework, in fact not considerable changes in positions have been detected. This remark has been further stressed by the sensitivity analysis, in which the index has been computed using a huge number of random weights.

Analysing the final scores obtained through the experts' weighting and the geometric aggregation methodologies, France stands out as the nation with the best sustainable development level among all the countries of the studied context. On the other hand Morocco results the worst nation regarding sustainability.
Grouping the nations by geographical area, it emerges that European countries get the highest scores in all the sustainability dimensions, except for the environmental one, where North African countries result to be the most sustainable.
A depth study has been carried out for Egypt and Italy, evaluating the final scores according to the different weighting and aggregation methodologies and highlighting strengths, weaknesses and opportunities relative to the values of the single indicators.
Moreover, through a correlation analysis, it has been possible to note that GNI per Capita, Life Expectancy at Birth, Ecological Footprint Index and Democracy Index were among the indicators, present in each dimension of the index framework, which better correlated with the Sustainability Evaluation Model.
Final comparisons assessed between the Sustainability Evaluation Model and other known indexes representative of the economic, social and environmental dimensions, have been performed. Therefore it has been possible to identify the countries which deviated from the mean trend, explaining the corresponding reasons. In particular, GDP per capita, Human Development Index (HDI) and Environmental Sustainability Index (ESI) have been used.

In conclusion, it is important to underline that sustainable development is an actual and very debated issue which needs continuous improvements and the attention of the entire population.
As declared by the United Nations Secretary General Ban Ki-moon: "… sustainable development is eternally affecting and influencing human lives for us and our children and generations to come. … That is why I believe sustainable development is the number one priority at this time." (Global Green Growth Forum, Copenhagen, October 2013).

11. Acknowledgements

First of all we would like to express our gratitude to Prof. Emanuela Colombo, who has inspired us for the elaboration of this thesis, sharing her great passion for the subject. Her teachings regarding the sustainable development concept will be useful not only for academic aspects, but also for the human ones.

We would also thank Eng. Gabriele Cassetti and Eng. Lorenzo Mattarolo, which have helped us during all the period of the thesis, being always available with precious advices and attentions.

Finally, a big thank goes to our classmates, which due to their different multicultural origins have made the two years of Master of Science Degree an enriching and unforgettable experience.

Davide

I would like particularly to thank my large family that in these years has allowed me to pursue my studies, supporting me in an atmosphere of sharing and serenity.

Special thanks go to my girlfriend Chiara that always encourages me to reach my dreams.

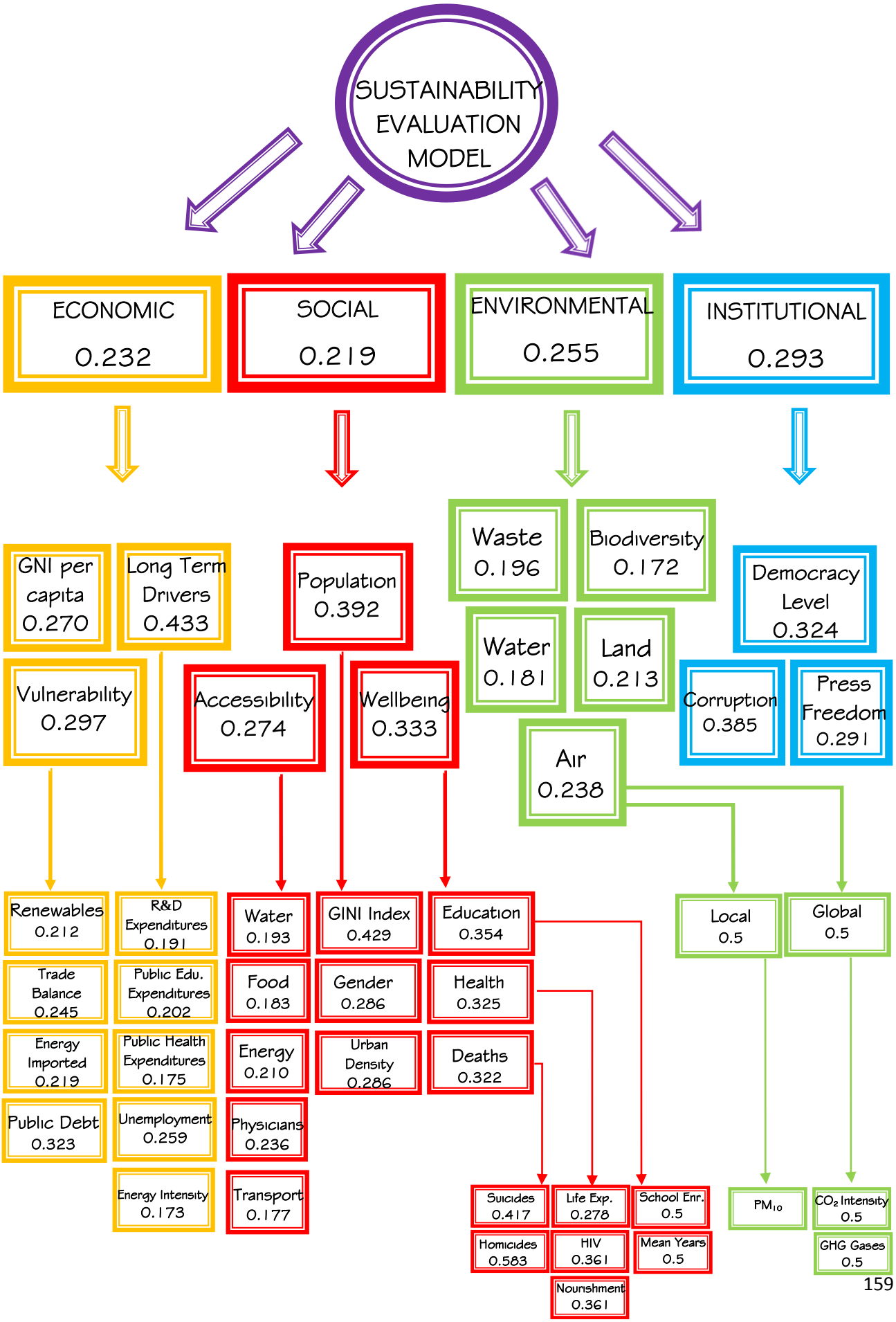
Maurizio

A special thank to my friends Alberto and Daniele, the two people with whom I have shared the majority of my funniest days. I'm sure that we will remain friends for long long time.

My thanks also go to Pancic, a very nice girl who never misses the opportunity to give me a priceless smile.

I cannot finish without thanking my parents and my sister for their patience, love and endless support over all these years.

APPENDIX A


SUSTAINABILITY EVALUATION MODEL
ECONOMIC 0.232
SOCIAL 0.219
ENVIRONMENTAL 0.255
INSTITUTIONAL 0.293
GNI per capita 0.270
Long Term Drivers 0.433
Vulnerability 0.297
Accessibility 0.274
Population 0.392
Wellbeing 0.333
Waste 0.196
Biodiversity 0.172
Water 0.181
Land 0.213
Air 0.238
Democracy Level 0.324
Corruption 0.385
Press Freedom 0.291
Renewables 0.212
R&D Expenditures 0.191
Trade Balance 0.245
Public Edu. Expenditures 0.202
Energy Imported 0.219
Public Health Expenditures 0.175
Public Debt 0.323
Unemployment 0.259
Energy Intensity 0.173
Water 0.193
Food 0.183
Energy 0.210
Physicians 0.236
Transport 0.177
GINI Index 0.429
Gender 0.286
Urban Density 0.286
Education 0.354
Health 0.325
Deaths 0.322
Suicides 0.417
Homicides 0.583
Life Exp. 0.278
HIV 0.361
Nourishment 0.361
School Enr. 0.5
Mean Years 0.5
Local 0.5
Global 0.5
PM10
CO2 Intensity 0.5
GHG Gases 0.5

APPENDIX B

Sustainability Indexes

FEEM Sustainability Index

Developed by	Fondazione Eni Enrico Mattei, Ca' Foscari University of Venice, Edge Hill University, in 2013.
Abstract	FEEM SI is an aggregate index comprised of 23 indicators related to economic, social and environmental dimensions. It provides projections of sustainability performances at the national and supranational scale up to the year 2030. It presents the relevance of multi-attribute aggregation methodologies using the Choquet-integral aggregation. First, a normalization of each sustainability indicator has been performed with the use of a benchmarking procedure with a smooth target of sustainability. Furthermore, an ad-hoc questionnaire has been implemented to assess the importance of each sustainability indicator and their interaction with other indicators through expert elicitation. After normalizing each sustainability indicator and computing consensus importance of each sustainability indicator and their interactions for the Choquet-integral aggregation procedure, the overall sustainability index has been calculated.
Advantages	• It evaluates the sustainability through its three main pillars • Because of the simplicity of the indicators, the data are easily available
Disadvantages	• The number of indicators makes the model quite complex • The subjectivity regarding the weights cannot be totally overcome (experts' questionnaires and interviews) • Lack of land, waste and local air pollution indicators in the environmental dimension • Lack of wellbeing and accessibility indicators (water, transport, health) in the social dimension
Bibliography	Cruciani Caterina, Giove Silvio, Pinar Mehmet, Sostero Matteo, Fondazione Eni Enrico Mattei, Ca' Foscari University of Venice, Edge Hill University, Constructing the FEEM Sustainability Index: a Choquet-integral Application. 2013.

BCFN Index – Well Being Index

Developed by	Barilla Center for Food & Nutrition, in 2011.
Abstract	It measures the level of well-being in the population, taking into account these aspects: psycho-physical, behavioral, material, environmental, educational, social and political well-being. It is composed by the weighted average of 41 indicators divided in the above-mentioned seven categories.
Advantages	• It tries to quantify an issue which cannot be discretized, considering not only the global thematic as the politic or the environment, but also the family relations and the not-market activities
Disadvantages	• The high number of indicators and their specificity makes the model complex • Difficulties in the data collection • It is applied to only 10 benchmarking nations
Bibliography	Barilla Center for Food & Nutrition in collaboration with The European House-Ambrosetti, La misurazione del benessere delle persone: il BCFN Index. Parma, 2010.

Index of Sustainable Society

Developed by	Sustainable Society Foundation, in 2006.
Abstract	It is used for monitoring the progress of a country on its way to sustainability, for setting priorities with respect to sustainability, to make comparisons between countries, for education purposes and for further research and development. It is composed by the un-weighted average of 24 indicators classified in three categories: human wellbeing, environmental wellbeing and economic wellbeing.
Advantages	• It takes into account all the three main pillars of sustainability • It is useful as a monitoring and a policy instrument for national and regional governments • It is useful for educational purposes at all levels
Disadvantages	• It has not suitable indicators for consumption and for depletion of resources • Concerning the environmental sector, it does not take into account the waste issue • Equal weight could not represent in a proper way the reality
Bibliography	<http://www.ssfindex.com/ssi/>

Happy Planet Index (HPI)

Developed by	Centre of Well-being at NEF (New Economics Foundation), in 2012.
Abstract	It measures the extent to which countries deliver long, happy, sustainable lives for the people that live in them. The Happy Planet Index is the result of the aggregation of three index: it is computed as the product between the well-being index and the life expectancy index divided by the ecological footprint index.
Advantages	• It's a simple model composed only by three indexes without weights • It links well-being and environmental aspects
Disadvantages	• The economic theme is totally missing • It is not seen as a measure of happiness, but mostly as a measure of the ecological efficiency of supporting well-being • Happiness is very subjective and personal (cultural influences and complex impact of policies on happiness)
Bibliography	Saamah Abdallah, Juliet Michaelson, Sagar Shah, Laura Stoll and Nic Mark, the New Economics Foundation, The Happy Planet Index: 2012 Report - a global index of sustainable well-being. 2012.

Composite Performance Index for Sustainability

Developed by	Rajesh Singh, H.R. Murty, S.K. Gupta, A.K. Dikshit, in 2007.
Abstract	It measures and evaluates the industries in terms of sustainable performances. It is composed by a weighted average of 60 indicators classified in five categories: organizational governance, technical aspects, economic performance, environment performance and social performance. The weights are assigned using the Analytic Hierarchy Process.
Advantages	• It takes into account the three main pillars of sustainability under a specific point of view • It can be useful for assessing the performance of industries as well identifying environmental practices to be followed for their sustainability
Disadvantages	• It is an index for an industrial level evaluation of sustainability • Difficulties in the data collection due to the specificity of the information required • Lack of indicators regarding the possible water or land pollution and the amount of waste produced • Subjectivity linked to the weights (questionnaire and interviews)
Bibliography	R.K. Singh, H.R Murthy, S.K Gupta, A.K Dikshit, Development of composite sustainability performance index for steel industry. 2007.

Compass Index of Sustainability

Developed by	Alan Atkisson and R. Lee Hatcher, in 1997.
Abstract	It is a method for clustering, aggregating, and scaling indicators and evaluation results on an absolute 0-100 performance scale. Its purpose is to simplify and visualize a complex indicator set in ways that decision-makers, the media, and the general public could readily understand and put sustainability performance assessment on an absolute performance scale, so that progress is being measured and assessed against the required conditions for sustainability instead of against the performance of other cities, companies, or other actors. It is computed through the arithmetic average of indicators divided in four categories: nature, economy, society and wellbeing.
Advantages	• It deals with the main sustainability categories • It covers both technical and process management aspects for framing, defining and measuring sustainability • It helps to establish ideal or absolute systems-based performance standards as the operational goal for a wide variety of sustainable development initiatives, in both the public and private sphere
Disadvantages	• As a qualitative tool, the sustainability compass does not analyze complex interactions but it merely processes the available information • Equal weights could not represent in a proper way the reality
Bibliography	Alan Atkisson and R. Lee Hatcher, The Compass Index of Sustainability: Prototype for a comprehensive sustainability information system. 2005.

Global Innovation Index (GII)

Developed by	Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO) as co-publishers, and their Knowledge Partners, in 2013 (6th edition).
Abstract	The GII is a recognition of the key role that innovation serves as a driver of economic growth and prosperity. It is composed by 84 indicators split in seven pillars: institutions, human capital and research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs, creative outputs. Each pillar is divided into three sub-pillars, each sub-pillar is composed of three to six individual indicators. The GII includes three indices and one ratio (Innovation Input Sub-Index; Innovation Output Sub-Index; Global Innovation Index; Innovation Efficiency Ratio). Weighted average is used to compute sub-pillars and pillars scores.
Advantages	• Institutional, economic and environmental sectors analyzed • It is a leading reference on innovation for researchers and for public and private decision makers • It has evolved into a valuable benchmarking tool to facilitate public-private dialogue
Disadvantages	• Few social indicators • Environmental sector very poor • The huge number of indicators leads to have a complex model and to problems with the availability of data
Bibliography	Cornell University, INSEAD, and WIPO, The Global Innovation Index 2013: The Local Dynamics of Innovation. Geneva, Ithaca, and Fontainebleau, 2013. <http://www.globalinnovationindex.org/content.aspx?page=GII-Home>

Index of Human Insecurity (IHI)

Developed by	Global Environmental Change and Human Security (GECHS) Project, in 2000.
Abstract	The IHI is a mechanism to help identify vulnerable or insecure regions, and also to help inform policy and aid decision makers in development assistance efforts. It considers what the potential impact of global change may be on human insecurity. It is computed through an equally weighted average of 16 indicators divided in four categories: environment, economy, society, institutions.
Advantages	• It is a simple model that includes all the main sustainability dimensions • The IHI can be used to project how human insecurity may change over time • Data are easily available
Disadvantages	• Lack of indicators concerning air pollution, distribution of richness, wellbeing and health • All the indicators obtain the same weight • It is an analysis on the insecurity level in a country rather than on the sustainability
Bibliography	Steve Lonergan, Kent Gustavson, and Brian Carter, The Index of Human Insecurity. 2000. <http://www.gechs.org/>

Social Progress Index (SPI)

Developed by	Social Progress Imperative in 2013.
Abstract	The final goal of this index is to improve the lives of people around the world, particularly the least well of, by helping decision-makers in government, the private sector and nonprofits to provide useful, timely information that will allow better use of available resources to solve pressing social and environmental problems. The SPI is composed by 52 indicators divided into three dimensions (basic human needs, foundation of wellbeing, opportunity) each subdivided into four components. The index is computed through an equally weighted methodology.
Advantages	• Strong presence of social indicators • Presence of institutional indicators
Disadvantages	• The huge number of indicators leads to have a complex model and to problems with the availability of data • Lack of the economic dimension • Not many indicators about the environmental sphere • All the indicators obtain the same weight
Bibliography	Michael E. Porter, Scott Stern and Roberto Artavia Loria, Social Progress Index 2013: A publication of the social progress imperative. 2013. <http://www.socialprogressimperative.org/about/the-imperative>

Weighted Index of Social Progress (WISP)

Developed by	Richard J. Estes,University of Pennsylvania, in 1976.
Abstract	WISP is judged to be a more comprehensive, valid, and reliable instrument for assessing changes in social development over time than other indices used to measure international social progress. It is composed by 40 social indicators subdivided into 10 sub-indexes (three for education, seven for health status, five for women status, one for defense effort, five for economy, three for demography, three for environment, five for social chaos, three for cultural diversity and five for welfare effort). In the WISP composition, a weighted average methodology was used: the study's statistical weights were derived through a two-stage varimax factor analysis in which each indicator and sub-index was analyzed for its relative contribution toward explaining the variance associated with changes in social progress over time.
Advantages	• Evaluation on all the three main dimensions of sustainability • Presence of indicators concerning human rights and culture • Complete in the social dimension • Presence of weights among the sub-indexes
Disadvantages	• Few indicators concerning the environmental and economic dimensions • Complexity of the model
Bibliography	Richard J. Estes, Development challenges of the "new world"; Richard J. Estes, Chapter 28, Global change and indicators of social development.

Economic Indexes

Internal Market Index (IMI)

Developed by	European Commission, in 2001.
Abstract	The aim of this index is to measure whether 'real world' benefits / 'outcomes' such as higher incomes, better social cohesion, lower prices, increased possibilities to work and live abroad, a cleaner environment, easier access to capital, etc. are effectively delivered. The Internal Market Index is composed by 20 indicators using the Principal Components Method that implicitly provides an 'objective' weighting between variables and deals appropriately with correlation between variables.
Advantages	• It reduces the complexity of financial markets to a single number which can be easily monitored • Presence of environmental indicators • Analysis of the weights
Disadvantages	• The model is applied only to the European area • Difficulties in collecting data due to the specificity of the indicators.
Bibliography	Internal Market Scoreboard, Internal Market Index 2002: Technical details of the methodology. November 2001. <http://www.jrc.cec.eu.int/uasa>

Index of Sustainable Economic Welfare (ISEW)

Developed by	Herman Daly and John B. Cobb, in 1989.
Abstract	It is an economic indicator, designed to approximate the progress of a nation citizen more accurately than what GDP does. The ISEW is composed by the sum and the subtraction of seven indicators of economic nature with the same weight.
Advantages	• Simplicity of the model due to the low number of indicators • Rather than simply adding together all expenditures like the Gross Domestic Product, consumer expenditure is balanced by such factors as income distribution and cost associated with pollution and other unsustainable costs
Disadvantages	• It does not take into account some main themes like the public debt and the expenditures on health and education • Equal weights could not represent in a proper way the reality
Bibliography	Giorgio Guenno, Silvia Tizzi, The index of sustainable economic welfare (ISEW) for Italy - Nota Di Lavoro 5.98. 1998.

Genuine Savings Index

Developed by	Pearce and Atkinson, in1993; Bohringer and Jochem, in 2007.
Abstract	It is a sustainability indicator built on the concepts of green national accounts. It measures the true rate of savings in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution. The Genuine Savings Index is composed by the sum and the subtraction of six indicators with the same weights.
Advantages	• Simplicity of the model due to the low number of indicators • It deducts the value of depletion of natural resources, the pollution damages, the value of resource depletion, the net foreign borrowing • It treats current expenditures on education as saving rather than as consumption as it increases countries' human capital
Disadvantages	• Equal weights could not represent in a proper way the reality • Positive Genuine Savings could be associated with non-optimal natural resource prices, which result in resource assets being extracted unsustainably • The model assumes stationary technology and constant population, that lead to a rude approximation of the real situation
Bibliography	Simon Dietz, Eric Neumayer, Genuine savings: a critical analysis of its policy-guiding value. 2004. <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTEEI/0,,contentMDK:20502388~menuPK:1187778~pagePK:148956~piPK:216618~theSitePK:408050,00.html> <http://www.compendiosustentabilidade.com.br/compendiodeindicadores/indicadores/default.asp?paginaID=26&conteudoID=403&it_idioma=2>

Economic Vulnerability Index (EVI)

Developed by	Committee for Development Policy, in 1999.
Abstract	This index is defined by the risk for (poor) countries to see their development hampered by the shocks they face, natural or external. There are two main kinds of exogenous shocks, then two main sources of vulnerability: 1) environmental or "natural" shocks, namely natural disasters; 2) external (trade and exchange related) shocks. The Economic Vulnerability Index is computed through the weighted average of eight indicators classified under two main categories: Exposure and Shock. The weights are equally established on the basis of the model structure.
Advantages	• Simplicity of the model due to the low number of indicators • For effectiveness and equity reasons, structural vulnerability (EVI) should be considered as one of the main relevant criteria of aid allocation • In order to avoid the arbitrariness of equal weighting, some measures of vulnerability weigh the components by their estimated impact on the rate of growth or its instability
Disadvantages	• The model is too specific • Other domestic shocks, as those ones generated by political instability, or more generally by unforeseen political changes, are not taken into account
Bibliography	Patrick Guillaumont, CERDI, CNRS and Université d'Auvergne, EVI and its Use: Design of an Economic Vulnerability Index and its Use for International Development Policy. 2007.

Genuine Progress Indicator (GPI)

Developed by	Based on Marilyn Waring studies in the UN System of National Accounts, in 1980s; no profit association Redefining Progress, in 1994.
Abstract	It is a metric that has been suggested to replace, or supplement, gross domestic product (GDP) as a measure of economic growth. GPI is designed to take fuller account of the health of a nation economy by incorporating environmental and social factors which are not measured by GDP. The Genuine Progress Indicator is computed by the un-weighted sum and subtraction of 24 indicators classified into five categories: income weighted private consumption (+), value of non-market services generating welfare (+), private defensive cost of natural deterioration (-), cost of deterioration of nature and natural resources (-), increase in capital stock and balance of international trade (+).
Advantages	• Even if it has been created to replace the GDP, so a pure economic indicator, it exhaustively takes into account the main environmental issues • GPI measures the no-profit activities and the damage to the environment • It takes into account the distribution of richness (Gini index)
Disadvantages	• Difficult availability of data due to the type of the indicators • The GPI, respect to the GDP, corrects for income inequality but does not include corrections for the degree of political freedom or degree of equality between genders • Measures such as GPI are more vulnerable than GDP to political manipulation
Bibliography	Ida Kubiszewski, Robert Costanza, Carol Franco, Philip Lawn, John Talberth, Tim Jackson, Camille Aylmer, Beyond GDP: Measuring and achieving global genuine progress. *Ecological Economics*, 2013. <http://genuineprogress.net/>

Environmental Indexes

Environmental Sustainability Index (ESI)

Developed by	Yale Center for Environmental Law and Policy, Yale University, Center for International Earth Science Information Network, Columbia University, in 1999-2005.
Abstract	The Environmental Sustainability Index benchmarks the ability of nations to protect the environment over the next several decades. It does so by integrating 76 indicators – tracking natural resource endowments, past and present pollution levels, environmental management efforts, and the capacity of a society to improve its environmental performance – into 21 data sets of environmental sustainability. It is computed by the equally weighted average of the indicators divided into five wide categories: environmental systems, environmental stresses, human vulnerability to environmental impacts, social and institutional capacity, global stewardship.
Advantages	• It is one of the most complete model concerning environmental sustainability • Presence of indicators about environmental governance, eco efficiency, private sector responsiveness, science and technology, participation in international collaborative efforts • It's a useful mechanism for benchmarking environmental performance
Disadvantages	• Complexity of the model due to the huge number of indicators • Difficult availability of data due to their specificity • The equal weight methodology could not represent in a proper way the reality
Bibliography	Yale Center for Environmental Law and Policy, Yale University, Center for International Earth Science Information Network, Columbia University, 2005 Environmental Sustainability Index. *Benchmarking National Environmental Stewardship*, 2005. <http://sedac.ciesin.columbia.edu/data/collection/esi/> <http://www.yale.edu/esi/ESI2005.pdf>

Environmental performance index (EPI)

Developed by	Yale University and Columbia University in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission, published in 2012.
Abstract	It is a method of quantifying and numerically benchmarking the environmental performance of a state's policies, designed to supplement the environmental targets set forth in the United Nations Millennium Development Goals. The 2012 EPI ranks 132 countries on 22 performance indicators in the following 10 categories: environmental burden of disease, water (effects on human health), air pollution (effects on human health), air pollution (ecosystem effects), water resource (ecosystem effects), biodiversity and habitat, forestry, fisheries, agriculture, and climate change. These categories track performance and progress on two broad policy objectives: environmental health and ecosystem vitality. Weights were determined based on expert judgments on the suitability of the data or the quality of the underlying data.
Advantages	• It properly describes the environmental health and the ecosystem vitality of a nation • It considers some not-trivial aspects as the irrigation stress, the pesticide regulation and the marine trophic index • It could be a very useful instrument in order to define appropriate policies to reduce the environmental stresses on human health and promote ecosystem vitality
Disadvantages	• Due to the specificity of some indicators, data are not easily collectible • It does not treat the waste thematic • Experts' weights could lead to differences of opinion regarding the relative importance of the categories
Bibliography	Yale Center for Environmental Law and Policy, Yale University Center for International Earth Science Information Network, Columbia University, EPI 2012 - Environmental Performance Index and Pilot Trend Environmental Performance Index. 2012. <http://epi.yale.edu/files/2012_epi_report.pdf> <http://sedac.ciesin.columbia.edu/data/collection/epi>

Ecological Footprint (EF)

Developed by	William Rees and Mathis Wackernagel, in 1997.
Abstract	The ecological footprint is a standardized measure of demand for natural capital that may be contrast with the planet's ecological capacity to regenerate. It is the surface of ecologically productive territory in the diverse categories necessary to supply the resources of energy and matter that a population consume and to absorb its wastefulness considering its current technology. It is composed by six sub-indicators concerning land use types. By weighting each area in proportion to its bio-productivity, different types of areas can be converted into the common unit of global hectares, and it is make possible the aggregation.
Advantages	• The majority of the resources that people consume and the wastes they generate can be quantified and tracked • It is possible to estimate how much of the Earth (or how many planet Earths) it would take to support humanity if everybody followed a given lifestyle • It can be used to measure and manage the use of resources throughout the economy
Disadvantages	• Complexity of the methodology • Possible misinterpretation of the index • The EF model prior to 2008 treated nuclear power in the same manner as coal power (different CO_2 emissions) • The method seems to reward the replacement of original ecosystems with high-productivity agricultural monocultures by assigning a higher bio-capacity to such regions • Calculating the ecological footprint for densely populated areas, such as a city or small country with a comparatively large population (e.g. New York and Singapore respectively) may lead to the perception of these populations as "parasitic" • Rural farmers in developed nations may easily consume more resources than urban inhabitants, due to transportation requirements and the unavailability of economies of scale
Bibliography	J.R. Siche, F. Agostinho, E. Ortega, A. Romeiro, Sustainability of nations by indices: Comparative study between environmental sustainability index, ecological footprint and the emergy performance indices. 2006. <http://www.footprintnetwork.org/en/index.php/GFN/>

Living Planet Index (LPI)

Developed by	The World Wide Fund for Nature (WWF) in collaboration with the Institute of Zoology (IoZ), the research division of the Zoological Society of London (ZSL), in 1997.
Abstract	It is a composite indicator that measures changes in the size of wildlife populations to indicate trends in the overall state of global biodiversity. Trends within a particular population only show what is happening to a species within a particular area. To create a robust index, comprehensive population data are collected for as many species and populations as possible from around the world. Each species trend is aggregated to produce an index for the terrestrial, marine and freshwater systems. The three system indices are weighted equally within tropical and temperate regions which are then aggregated to produce the global LPI.
Advantages	• It offers insights into which habitats or ecosystems have species that are declining most rapidly • It can be used to define the impact humans are having on the planet and for guiding actions to address biodiversity loss
Disadvantages	• Complexity of the model due to the huge amount of information • It could create false alarmism regarding the possible extinction of a species when the collected data are not exhaustive.
Bibliography	WWF, Zoological Society of London, Global Footprint Network, European Space Agency, Living Planet Report 2012: Biodiversity, biocapacity and better choices. 2012.

Environmental Vulnerability Index (EVI)

Developed by	South Pacific Applied Geoscience Commission (SOPAC) and the United Nations Environment Program, in 2005.
Abstract	It was developed to provide insights into the processes that can negatively influence the sustainable development of countries, with particular reference to vulnerability to natural hazards. It is composed by the weighted average of 50 indicators divided up in the issue categories for use as required: climate change, biodiversity, water, agriculture and fisheries, human health aspects, desertification and exposure to natural disasters. Final vulnerability is classified in three components: the likelihood of hazard, resistance of the environment and acquired vulnerability.
Advantages	• It provides a lot of rare environmental indicators, such as weather changes, volcanos-earthquakes-tsunamis hazard, fishing effort
Disadvantages	• Complexity of the model due to the specificity of the indicators • Absence of a proper methodology to obtain the weights • EVI ignores the ways a country activities can create vulnerability in another (environmental change in places due to processes that are often regional and global in scope) • When applied to developing and least developed countries, it has the unfortunate effect of seeing as negative processes that often have positive social outcomes
Bibliography	Ursula Kaly, Lino Briguglio, Helena McLeod, Susana Schmall, Craig Pratt and Reginald Pal, Environmental Vulnerability Index (EVI) to summarize national environmental vulnerability profiles. 1999. <http://www.vulnerabilityindex.net/>

Social Indexes

Human Development Index (HDI)

Developed by	Mahbub ul Haq, Amartya Sen, published by United Nations Development Programme (UNDP), in 1990.
Abstract	HDI is a summary measure of key dimensions of human development. It measures the average achievements in a country through four indicators in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. It is computed through the geometric mean of normalized indices from each of the three dimensions.
Advantages	• Simplicity of the model due to the low number of indicators • Availability of data due to the simplicity of the indicators • Geometric mean captures how well rounded a country performance across the three dimensions • It gives a simplified idea of the human development in a country and it can be easily understood by non specialists
Disadvantages	• It could be an oversimplified way to describe the human development • Lack of human rights indicators
Bibliography	<http://hdr.undp.org/en/statistics/hdi>

Inequality–Adjusted Human Development Index

Developed by	Foster, Lopez-Calva and Szekely, published by United Nations Development Programme (UNDP), in 2005.
Abstract	The IHDI accounts for inequalities in HDI dimensions by "discounting" each dimension's average value according to its level of inequality. The IHDI equals the HDI when there is no inequality across people but falls further below the HDI as inequality rises. In this sense, the IHDI is the actual level of human development (taking into account inequality), while the HDI can be viewed as an index of the "potential" human development that could be achieved if there was no inequality. The "loss" in potential human development due to inequality is the difference between the HDI and the IHDI and is expressed as a percentage. The IHDI is computed through the geometric mean of three adjusted indices: inequality-adjusted life expectancy index, inequality-adjusted education index, inequality-adjusted income index.
Advantages	• Simplicity of the model due to the low number of indicators • Availability of data due to the simplicity of the indicators • Geometric mean captures how well rounded a country performance across the three dimensions • It can be easily understood by non specialists • Tanking into account inequality it is the actual level of human development • It can help inform policies towards inequality reduction and to evaluate the impact of various policy options aimed at inequality reduction
Disadvantages	• It could be an oversimplified way to describe the human development • It is not association sensitive, so it does not capture overlapping inequalities
Bibliography	<http://hdr.undp.org/en/statistics/ihdi/>

Gender Inequality Index (GII)

Developed by	United Nations Development Programme (UNDP), in 2010.
Abstract	The GII reflects gender-based disadvantages for as many countries as data of reasonable quality allow. The index shows the loss in potential human development due to inequality between female and male achievements in three dimensions. It varies between 0, where women and men fare equally, and 1, where either gender fares as poorly as possible in all measured dimensions. GII is composed by five indicators divided in three dimensions: reproductive health, empowerment and labor market. Its aggregation method is based on the general mean of general means of different orders; the first aggregation is by the geometric mean across dimensions; these means, calculated separately for women and men, are then aggregated using a harmonic mean across genders.
Advantages	• Simplicity of the model due to the low number of indicators • Aggregating across dimensions for each gender group by the geometric mean makes the GII association sensitive • It can be easily understood by non specialists • It can be useful to help governments and others understand the ramifications of gaps between women and men • It's constrained by the need for international comparability, but it could be readily adapted for use at the national or local level
Disadvantages	• It uses national parliamentary representation that excludes participation at the local government level and elsewhere in community and public life • The labor market dimension lacks information on incomes, employment and on unpaid work mostly done by women • Asset ownership, gender-based violence and participation in community decision-making are also not captured, mainly due to limited data availability • It may give unreliable results about the concept of gender inequality because of the lack of data in the above-mentioned areas
Bibliography	<http://hdr.undp.org/en/statistics/gii/>

Multidimensional Poverty Index (MPI)

Developed by	Oxford Poverty & Human Development Initiative and the United Nations Development Programme (UNDP), in 2010.
Abstract	MPI is an international measure of acute poverty. It complements traditional income-based poverty measures by capturing the severe deprivations that each person faces at the same time with respect to education, health and living standards. MPI assesses poverty at the individual level. If someone is deprived in a third or more of 10 (weighted) indicators, the global index identifies them as 'MPI poor', and the extent, or intensity, of their poverty is measured by the number of deprivations they are experiencing. The index is computed assigning each person a deprivation score according to his or her household's deprivations in each of the 10 component indicators. The maximum score is 100%, with each dimension equally weighted. The MPI value is the mean of deprivation scores (above 33.3%) for the population and can be expressed as a product of two measures: the multidimensional headcount ratio and the intensity (or breadth) of poverty.
Advantages	• Simplicity of the model due to the low number of indicators • It can be easily understood by non specialists • The MPI approach can be adapted using indicators and weights that make sense at the country level to create tailored national poverty measures • It shows aspects in which the poor are deprived and help to reveal the interconnections among those deprivations. This enables policymakers to target resources and design policies more effectively
Disadvantages	• Intra-household inequalities may be severe, but these could not be reflected • It is a comparison only among developing countries
Bibliography	<http://www.ophi.org.uk/multidimensional-poverty-index/> <http://hdr.undp.org/en/statistics/mpi/>

Gini Index

Developed by	Corrado Gini, in 1912.
Abstract	It measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A Gini coefficient of zero expresses perfect equality, where all values are the same (for example, where everyone has the same income). A Gini coefficient of 100 expresses maximal inequality among values (for example where only one person has all the income). However, a value greater than 100 may occur if some persons have negative income or wealth. For larger groups, values close to or above 100 are very unlikely in practice. It is composed by only two indicators and it is calculated as the ratio of the area between the Lorenz Curve and the equal-distribution line (the concentration area) to the area of maximum concentration.
Advantages	• The few number of indicators makes the model simple • It is applied worldwide
Disadvantages	• The data have been collected inconstantly, so there are lacks in the series
Bibliography	Lorenzo Giovanni Bellù, Agricultural Policy Support Service - Policy Assistance Division – FAO, Paolo Liberati, University of Urbino "Carlo Bo" - Institute of Economics, Inequality Analysis: The Gini Index. *EASYPol, On-line resource materials for policy making*, 2006.

Well-being Index

Developed by	Gallup – Healthways, in 2012.
Abstract	It is the preeminent source for well-being data in the United States. The Well-being Index provides real-time measurement and insights needed to improve health, increase productivity and lower healthcare costs. Public and private sector leaders use data on the factors proven to impact well-being to develop and prioritize strategies to help their communities thrive and grow. It is an arithmetic mean of six sub-indices: Life Evaluation, Physical Health, Emotional Health, Healthy Behavior, Work Environment and Basic Access.
Advantages	• The few number of indicators makes the model simple • Lack of the limits of subjectivity due to the absence of weights • It deepens carefully the health issue, both from the physical and emotional point of view
Disadvantages	• Data collection through public interviews, which it is not the best reliable method among the available • It is applied only to the United States
Bibliography	Gallup – Healthways, 2012 State of Well-Being: Community, State and Congressional District Well-Being Reports. 2013.

Overall Health System Attainment

Developed by	World Health Organization (WHO), in 2000.
Abstract	It measures how well a country achieves all five goals of the health system simultaneously (health, responsiveness, fairness of financial contribution, level and distribution of health and responsiveness), relative to the maximum it could be expected to achieve its given level of resources and non-health system determinants. The five component goals are weighted through weights based on a survey carried out by WHO to elicit stated preferences of individuals in their relative valuations of the goals of the health system.
Advantages	• The few number of indicators makes the model simple • It is applied worldwide • Enhance responsiveness of the health system to the legitimate expectations of the population
Disadvantages	• Lack of other important health indicators • Level of uncertainty due to the surveys
Bibliography	Murray Christopher JL, Lauer Jeremy, Tandon Ajay, Frenk Julio, Overall Health System Achievement for 191 Countries. *Discussion Paper Series: No. 28*, 2000.

Human Poverty Index (HPI 1-2)

Developed by	United Nations (UN), in 1997.
Abstract	It concentrates on the deprivation in the three essential elements of human life already reflected in the Human Development Index: longevity, knowledge, a decent standard of living and social exclusion. It is composed by four indicators aggregated through an un-weighted average, derived separately for developing countries (HPI-1) and a group of select high-income OECD countries (HPI-2) to better reflect socio-economic differences.
Advantages	• The few number of indicators makes the model simple • It highlight sectors where a political intervention is necessary
Disadvantages	• It uses equal weights • It is an oversimplified way to describe the human poverty
Bibliography	Chakravarty Satya R. and Majumder Amita, Measuring Human Poverty: A Generalized Index and an Application Using Basic Dimensions of Life and Some Anthropometric Indicators. *Journal of Human Development, Vol. 6, No. 3*, November 2005.

Index of Human Progress

Developed by	Fraser Institute (Canada), in 2001.
Abstract	It has been built to overcome the limits of the Human Development Index (which arbitrarily adjusts the Gross National Income (GNI) per capita to limit its impact in the index). The Index of Human Progress uses 10 equally weighted development indicators, six more than the Human Development Index, allowing us to draw clearer distinctions among countries though it reduces the number of countries that can be included in the Index. The categories of the indicators are: health, education, technology and unadjusted GDP per capita.
Advantages	• The few number of indicators makes the model simple • It is more complete than the Human Development Index • It describes the recent progress and current state of development
Disadvantages	• It uses equal weights for the four main dimensions • Respect the Human Development Index, it is applied to less countries due to the higher number of indicators
Bibliography	Emes Joel and Hahn Tony, Measuring Development: An Index of Human Progress. *Public Policy Sources - Number 36*, 2001.

Socio-Economic-Institutional Indexes

Global Competitiveness Index (GCI)

Developed by	World Economic Forum, in 2004.
Abstract	It is a highly comprehensive index for measuring national competitiveness, taking into account the microeconomic and macroeconomic foundations of national competitiveness. It defines competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. It is composed by 91 indicators, aggregated through an arithmetic mean, classified in nine categories: institutions, infrastructure, macro-economy, health and primary education, higher education and training, market efficiency, technological readiness, business application, innovation.
Advantages	• Completeness of the treated issues • The weights reflect the development level of each country, in fact they differ country by country
Disadvantages	• The high number of indicators makes the model complex • Difficult availability of the data due to the specific information
Bibliography	Sala-i-Martin, Xavier and Elsa V. Artadi, World Economic Forum, The Global Competitiveness Index. *Global Competitiveness Report 2004/2005,* 2005.

CSGR Globalization Index

Developed by	University of Warwick, in 1997.
Abstract	It measures the economic, social and political dimensions of globalization for many countries on an annual basis over the period 1982 to 2001, and combines these into an overall globalization index, or score, for each of these countries during this time period. These indices are also available by region of the world (as defined by the World Bank). The index enables to address questions such as: is a particular country more globalized than in was 20 or 30 years ago? Which were the most and least globalized countries of the last decade? The comparability allows investigating in depth the relationship between globalization and key economic variables such as economic growth, inequality, and government spending. It is composed by a weighted average of 16 indicators, classified in three categories: Economic, Social and Political Globalization.
Advantages	• The statistically optimal weights have been chosen to maximize the information of the index. This method avoids any subjective bias on the part of the researcher as to which weights are important
Disadvantages	• Difficulty in collecting the data • It takes into account minor indicators as the: Number of films imported and exported or Number of international letters delivered and sent, per capita
Bibliography	Lockwood Ben, Redoano Michela, Centre for the Study of Globalization and Regionalization, The CSGR Globalization Index: an Introductory Guide. *Working Paper 155/04*, 2005.

Innovation Union Scoreboard (IUS) and Summary Innovation Index (SII)

Developed by	European Commission, under the Lisbon Strategy, in 2000.
Abstract	The Innovation Union Scoreboard 2013 gives a comparative assessment of the innovation performance of the EU27 Member States and the relative strengths and weaknesses of their research and innovation systems. It is composed by three main types of weighted indicators: Enablers, Firm activities and Outputs; which characterize eight innovation dimensions, capturing in total 25 indicators. The IUS expresses once more the feeling of the need of all European countries to carry out comparisons between their respective performance through the application of benchmarking and scoreboard tools, the findings of which are then typically processed into country rankings.
Advantages	• It takes into account interesting aspects, which are rarely considered (e.g. New doctorate graduates, International scientific publications)
Disadvantages	• The number of indicators makes the model quite complex • The subjectivity regarding the weights cannot be totally overcame
Bibliography	Schibany Andreas, Streicher Gerhard, How not to compare innovation performance: a critical assessment of the European Innovation Scoreboard. *Conference paper for the 2nd PRIME Indicators Conference on STI Indicators for Policy*, 2008.

Country Policy and Institutional Assessment (CPIA)

Developed by	World Bank, from mid-1970s.
Abstract	The CPIA is a diagnostic tool that is intended to capture the quality of a country policies and institutional arrangements such as its focus on the key elements that are within the country control, rather than on outcomes (such as growth rates) that are influenced by elements outside the country control. More specifically, the CPIA measures the extent to which a country policy and institutional framework supports sustainable growth and poverty reduction, and consequently the effective use of development assistance. The outcome of the exercise yields both an overall score and scores for all of the 16 criteria that compose the CPIA. This tool was developed and first employed in the mid-1970s and over the years the World Bank has periodically updated and improved it to reflect the lessons of experience and the evolution of thinking about development. It is composed by the arithmetic average of 16 indicators classified in four categories: Economic Management, Structural Policies, Policies for Social Inclusion/Equity and Public Sector Management and Institutions.
Advantages	• The ratings are generally reliable and correlate well with similar indicators and there is no evidence of upward bias
Disadvantages	• It uses equal weights
Bibliography	World Bank, International Development Association (IDA), Country Policy and Institutional Assessment (CPIA). 2006.

Institutional Indexes

Bertelsmann Transformation Index (BTI)

Developed by	Bertelsmann Stiftung Foundation, in 1977.
Abstract	It analyses and evaluates the quality of democracy, a market economy and political management in 128 developing and transition countries. It measures successes and setbacks on the path toward a democracy based on the rule of law and a market economy flanked by sociopolitical safeguards. A total of 17 criteria are subdivided into 49 questions. Answers are to be given on a scale of one to 10. The results of the questions are averaged to give one score per country/territory.
Bibliography	Donner Sabine, Dr. Hartmann Hauke, Jäger Matthias, BTI 2012: Codebook for Country Assessments - Transformation Index of the Bertelsmann Stiftung. 2012.

Index of Social Vulnerability to Climate Change

Developed by	Tyndall Centre for Climate Change Research and School of Environmental Sciences University of East Anglia, in 2004.
Abstract	The aim of the index is to fill an academic and policy demand for the first assessment of national level social vulnerability to climate change in Africa. By developing an index, this puts social vulnerability in a language and format that can be added to the existing biophysical vulnerability assessments to create holistic and integrated studies of the potential impacts of climate change. It is composed by five main weighted categories (economic well-being and stability, demographic structure, institutional stability and strength of public infrastructure, global interconnectivity and natural resource dependence).
Bibliography	Vincent Katharine, Tyndall Centre for Climate Change Research, Creating an index of social vulnerability to climate change for Africa. *Working Paper 56*, August 2004.

The Political Risk Services Index

Developed by	Political Risk Services (PRS) group, in 2001.
Abstract	It provides a decision-focused political risk model with three industry forecasts at the micro level. The PRS system forecasts risk for investors in two stages, first identifying the three most likely future regime scenarios for each country over two time periods and then by assigning a probability to each scenario over each time period, 18 months and five years. For each regime scenario, PRS's experts then establish likely changes in the level of political turmoil and 11 types of government intervention that affect the business climate. After calculating consolidated scores for all regimes (100% of possibilities), the PRS system converts these numbers into letter grades (on a scale from A+ to D-) for three investment areas: financial transfers (banking and lending), foreign direct investment (e.g. retail, manufacturing, mining), and exports to the host country market. PRS' unique system provides only industry specific forecasts, not a generic macro level assessment, as is usually the case. Users can customize the PRS forecasting model to individual projects or the particular exposures of a firm with an optional weighting system, adding or subtracting variables and adjusting the model to fit specific firm or project attributes. The 18-month risk factors are: turmoil, equity restrictions, operations restrictions, repatriation restrictions, exchange controls, tariff barriers, other import barriers, payment delays, fiscal and monetary expansion, labor policies, foreign debt. The five-year risk factors are: investment restrictions, trade restrictions, domestic economic problems, international economic problems.
Bibliography	Professors Coplin William D. and O'Leary Michael K., Maxwell School of Citizenship & Public Affairs, Syracuse University with the U.S. Department of State, the Central Intelligence Agency, Political Risk Services Methodology (PRS).

Political Rights and Civil Liberties Ratings

Developed by	Freedom House, in 2013.
Abstract	It is an annual evaluation of the state of global freedom as experienced by individuals. The survey measures freedom, described as the opportunity to act spontaneously in a variety of fields outside the control of the government and other centers of potential domination, according to two broad categories: political rights and civil liberties. The index is computed through a checklist of 10 political rights questions and 15 civil liberties questions. The total score awarded to the political rights and civil liberties checklist determines the political rights and civil liberties rating. Each rating of one through seven, with one representing the highest and seven the lowest level of freedom, corresponds to a range of total scores. The survey findings are reached after a multilayered process of analysis and evaluation by a team of regional experts and scholars. Although there is an element of subjectivity inherent in the survey findings, the ratings process emphasizes intellectual rigor and balanced and unbiased judgments.
Bibliography	Freedom House, Freedom in the World 201 - Democratic Breakthroughs in the balance - Selected data from Freedom House's annual survey of political rights and civil liberties. 2013

Institutional Environment and Sovereign Credit Ratings

Developed by	Butler Alexander W. and Fauver Larry, in 2003.
Abstract	A country sovereign credit rating is a key indicator of its financial system development and openness. Sovereign credit ratings reflect a country perceived willingness and ability to repay its sovereign debts. Thus, such credit ratings can be interpreted as a rating agency's view of the ex-ante risk of sovereign debt repudiation. Sovereign credit ratings are strong predictors of a country equity market returns and valuations. A country sovereign credit ratings can directly impact the ability of firms in that country to access global capital markets. It uses 17 indicators: credit rating, 10-year bond rate, GDP per capita, inflation percentage, underdevelopment index, default dummy, voice of the people, political stability, government effectiveness, regulatory quality, rule of law, corruption control, legal environment composite, emerging market dummy, foreign debt per GDP, common law dummy.
Bibliography	Bibliography: Butler Alexander W. and Fauver Larry, Institutional Environment and Sovereign Credit Ratings. *Financial Management*, Autumn 2006.

Democracy Index

Developed by	Economist Intelligence Unit, in 2006.
Abstract	The index provides a snapshot of the state of democracy worldwide for 165 independent states and two territories. This covers almost the entire population of the world and the vast majority of the world's states (micro states are excluded). The Democracy index is based on five categories: electoral process and pluralism; civil liberties; the functioning of government; political participation and political culture. Countries are placed within one of four types of regimes: full democracies; flawed democracies; hybrid regimes; and authoritarian regimes. This index is an answer to the issue that free and fair elections and civil liberties are necessary conditions for democracy, but they are unlikely to be sufficient for a full and consolidated democracy if unaccompanied by transparent and at least minimally efficient government, sufficient political participation and a supportive democratic political culture.
Advantages	• The results are easy to understand due to the four main categories in which the countries are placed
Disadvantages	• The high number of indicators makes the model complex • Subjectivity aspect because it is based on surveys and interviews
Bibliography	The Economist Intelligence Unit, Democracy index 2012: Democracy at a standstill - A report from The Economist Intelligence Unit. 2012.

Press Freedom Index

Developed by	Freedom House, in 1980.
Abstract	The index assesses the degree of print, broadcast, and internet freedom in every country in the world, analyzing the events of each calendar year. It provides numerical rankings and rates each country media as "Free," "Partly Free," or "Not Free." Country narratives examine the legal environment for the media, political pressures that influence reporting, and economic factors that affect access to information. A free press plays a key role in sustaining and monitoring a healthy democracy, as well as in contributing to greater accountability, good government, and economic development. Most importantly, restrictions on media are often an early indicator that governments intend to assault other democratic institutions.
Advantages	• Under the legal category, it assess the laws and regulations that could influence media content as well as the extent to which the government uses these tools to restrict the media's ability to function • The political category encompasses the editorial pressure by the government of other actors, censorship and self-censorship, the ability of reporters to cover the news and violence against journalists • Under the economic category, it examines structure, transparency and concentration of media ownership, costs of production and distribution and the impact of advertising, subsidies and bribery on content
Disadvantages	• It is a composite index, built as a combination of surveys and assessments of corruption, and so it could neglect phenomena hidden in the surveys • Subjectivity aspect because it is based on surveys and interviews
Bibliography	Freedom House, Freedom of the Press 2013 - Middle East Volatility amid Global decline - selected data from freedom house's annual press freedom index. 2013.

Bribe Payers Index (BPI)

Developed by	Transparency International, in 1999.
Abstract	It ranks 28 of the world's largest economies according to the perceived likelihood of companies from these countries to pay bribes abroad. The countries and territories ranked in the Index cover all regions of the world and represent almost 8% of the total world outflow of goods, services and investments. It examines different types of bribery across sectors, including, for the first time, bribery among companies ('private-to-private' bribery). Foreign bribery has significant adverse effects on public well-being around the world. It distorts the fair awarding of contracts, reduces the quality of basic public services, limits opportunities to develop a competitive private sector and undermines trust in public institutions.
Bibliography	Hardoon Deborah and Heinrich Finn, Transparency International, Bribe Players Index – 2011. 2011.

Corruption Perception Index (CPI)

Developed by	Transparency International, in 1995.
Abstract	It scores and ranks countries/territories based on how corrupt a country public sector is perceived to be. It is a composite index, a combination of surveys and assessments of corruption, collected by a variety of reputable institutions. The CPI is the most widely used indicator of corruption worldwide. The Index scores 177 countries and territories on a scale from 0 (highly corrupt) to 100 (very clean). No country has a perfect score, and two-thirds of countries' score below 50. This indicates a serious, worldwide corruption problem. The world urgently needs a renewed effort to crack down on money laundering, clean up political finance, pursue the return of stolen assets and build more transparent public institutions. Corruption generally comprises illegal activities, which are deliberately hidden and only come to light through scandals, investigations or prosecutions. There is no meaningful way to assess absolute levels of corruption in countries or territories on the basis of hard empirical data. Possible attempts to do so, such as by comparing bribes reported, the number of prosecutions brought or studying court cases directly linked to corruption, cannot be taken as definitive indicators of corruption levels. Instead, they show how effective prosecutors, the courts or the media are in investigating and exposing corruption. Capturing perceptions of corruption of those in a position to offer assessments of public sector corruption is the most reliable method of comparing relative corruption levels across countries.
Advantages	• It forces governments around the world to take notice of corruption (but recognize the problem is only part of the solution)
Disadvantages	• It is not so easy collecting the data for the less-developed and developing countries, because the sources are independent institutions specialized in governance and business climate analysis • It measures the corruption only in the public sector (administrative and political corruption) • It is a composite index, built as a combination of surveys and assessments of corruption, and so it could neglect phenomena hidden in the surveys • Subjectivity aspect because it is based on surveys and interviews
Bibliography	Transparency International, Corruption Perception Index - 2013. 2013.

Global Terrorism Index

Developed by	Institute for Economics and Peace (IEP), in 2002.
Abstract	It is the first index to systematically rank and compare 158 countries according to the impact of terrorism. The GTI uses four indicators to measure the impact of terrorism: the number of terrorist incidents, the number of deaths, the number of casualties and the level of property damage. These indicators are used to create a weighted five years average for each country, which takes into account the lasting effects of terrorism. The score given to each country therefore indicates the impact of a terrorist attack on a society in terms of the fear and subsequent security response. It summarizes changing trends in terrorism over time, as well as analyzing its different dimensions in terms of geographic activity, methods of attack, organizations involved, and its national context in terms of economic development and governance. The index has also been compared to other socio-economic indicators to determine what factors are commonly associated with terrorism.
Bibliography	Stepanova Ekaterina, Institute for Economics & Peace, 2012 Global Terrorism Index – Capturing the Impact of Terrorism of the Last Decade. 2012.

Energy Indexes

Energy Development Index (EDI)

Developed by	International Energy Agency (IEA), in 2011.
Abstract	The IEA has devised an Energy Development Index (EDI) in order to better understand the role that energy plays in human development. It is an indicator that tracks progress in a country or region's transition to the use of modern fuels. Helping to measure energy poverty, the EDI provides a rigorous analytical basis for policy-making. It is calculated in such a way as to mirror the UNDP's Human Development Index and is composed of four indicators, each of which captures a specific aspect of potential energy poverty, combined through an arithmetic average: per capita commercial energy consumption; per capita electricity consumption in the residential sector; share of modern fuels in total residential sector energy use; share of population with access to electricity.
Advantages	• The few number of indicators makes the model simple • It does not use any weights, it just computes the normalization among the maximum and the minimum value (no subjectivity)
Disadvantages	• It is used only in the less developed and developing countries
Bibliography	International Energy Agency, World Energy Outlook – Methodology for Energy Access Analysis. 2011.

Energy Sustainability Index (ESI)

Developed by	World Energy Council (WEC), in 2012.
Abstract	It ranks World Energy Council member countries in terms of their likely ability to provide a stable, affordable, and environmentally-sensitive energy system through the three dimensions of the energy trilemma: energy security, social equity and environmental impact mitigation. For the first time, countries are also awarded a 'balance score'. While the Index rank measures overall performance, the balance score highlights how well a country manages the trade-offs between the three competing dimensions: energy security, energy equity, and environmental-sustainability. The best score 'A' is given for a very high performance. Countries with good results are awarded with the score 'B'. High performers receive the score 'AAA' while countries that do not yet perform well receive a 'DDD' score. It is composed by a weighted average of 22 indicators divided in six categories: Energy security; Social equity; Environmental Impact Mitigation; Political strength; Societal strength; Economic strength. These categories are collected in two main sectors differently weighted: Energy Performance and Contextual Performance.
Advantages	• The contextual indicators consider also the broader circumstances of energy performance including societal, political and economic strength and stability • It is useful to design coherent and predictable energy policies, support market conditions that attract long-term investments and encourage initiatives that foster research and development in all areas of energy technology
Disadvantages	• The high number of indicators makes the model complex • Recent world events that could affect the Index's outcomes are not completely captured (for example, turbulence in global nuclear power industry due to Fukushima, or the political unrest in the Middle East)
Bibliography	Wyman Oliver, World Energy Council (WEC), World Energy Trilemma - 2012 Energy Sustainability Index. 2012.

Other Indexes

Millennium Development Goals

Developed by	United Nations (UN), in 2000.
Abstract	The Millennium Development Goals (MDGs) are eight international development goals that were established following the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration. All the 193 United Nations member states and at least 23 international organizations committed to help achieve the Millennium Development Goals by 2015. The goals follow: 1) to eradicate extreme poverty and hunger; 2) to achieve universal primary education; 3) to promote gender equality and empowering women; 4) to reduce child mortality rates; 5) to improve maternal health; 6) to combat HIV/AIDS, malaria, and other diseases; 7) to ensure environmental sustainability; 8) to develop a global partnership for development. Each goal has specific targets and related dates for achieving them and a series of measurable health and economic indicators have been assigned to each target.
Bibliography	United Nations, The Millennium Development Goals Report 2013. 2013.

Technology Achievement Index (TAI)

Developed by	United Nations Development Programme (UNDP), in 2002.
Abstract	It is used to measure how well a country is creating and diffusing technology and building a human skill base, reflecting capacity to participate in the technological innovations of the network age. The TAI is composed by eight indicators and it focuses on four arithmetically weighted dimensions of technological capacity: creation of technology, diffusion of recent innovations, diffusion of old innovations, human skills.
Advantages	• The few number of indicators makes the model simple • It focuses on outcomes and achievements rather than on effort or inputs such as numbers of scientists, R&D expenditures or policy environments
Disadvantages	• It uses equal weights • Difficulties in the data collection
Bibliography	Desai Meghnad, Fukuda-Parr Sakiko, Johansson Claes, Sagasti Francisco, Measuring the Technology Achievement of Nations and the Capacity to Participate in the Network Age. *Journal of Human Development, Vol. 3, No. 1*, 2002.

National Innovation Capacity Index

Developed by	Porter Michael E., Stern Scott, Institute for Strategy and Competitiveness, in 1999.
Abstract	It depends in part on the technological sophistication and the size of the scientific and technical labor force in a given economy, and it also reflects the array of investments and policy choices of the government and private sector that affect the incentives for and the productivity of a country research and development activities. The findings of this index reveal the striking degree to which the national environment matters for success in innovative activity, and they highlight sharp differences in the environment for innovation across both OECD and emerging economies. The analysis suggests that subtle aspects of a country institutional and microeconomic environment play an important role in determining the productivity of investments in innovation. Though the results are subject to caveats common to any quantitative study focusing on the causes and consequences of innovation, the findings provide a consistent set of implications for policymakers attempting to enhance the locational foundations of innovation, and with it, international competitiveness. It is a combination of the eight indicators, weighted by their contribution to building up the capacity calculated by the multiple regression model. This analysis provides a consistent and comparable way to assign relative weights to the different influences on national innovation capacity.
Advantages	• The few number of indicators makes the model simple • It is shaped by the accumulated outcome of the interaction between many public and private choices • It computes the weights through a regression model
Disadvantages	• Difficulties in the data collection • It is applied to only 17 OECD countries
Bibliography	Porter Michael E., Stern Scott, Furman Jeffrey L., National Bureau of Economic Research, The Determinants of National Innovative Capacity. *Working Paper 7876*, September 2000.

City Development Index (CDI)

Developed by	Urban Indicators Programme of the United Nations Human Settlements Programme (UN-Habitat), in 1996.
Abstract	It measures the level of development in cities and it could also be taken as a measure of average well-being and access to urban facilities by individuals. The Urban Indicators Programme of the United Nations Human Settlements Programme (UN-Habitat) developed the indicator so that they could rank cities of the world according to their level of development and as a display of indicators depicting development. The CDI cuts across the different clusters identified in the Urban Indicator Framework as it is based on a weighted average of five sub-indices namely: infrastructure, waste, health, education and city product. It is useful as it provides a snapshot view of how cities are doing with respect to the different indices.
Advantages	• The few number of indicators makes the model simple • It provides a better measure of real city conditions than the national-level HDI, because there is considerable variation between cities in any particular country
Disadvantages	• The methodology to assign the weights to the indicators could be sometimes arbitrary • It does not take into account the environmental aspect of the city development, for example, if the number of industries grows, this is lead to a greater City Development Index, at the expense of a possible worse quality of air/water/land
Bibliography	Global Urban Osservatory, United Nations Human Settlements Programme (UN-Habitat), Global Urban Indicators Database. *United Nations Publication HS/637/01E – ISBN 92-1-131627-8.*

Networked Readiness Index (NRI)

Developed by	INSEAD – business school for the world, World Bank and World Economic Forum, in 2003-2004.
Abstract	It measures the propensity for countries to exploit the opportunities offered by information and communications technology (ICT). The NRI seeks to better comprehend the impact of ICT on the competitiveness of nations. The NRI is composed by 48 indicators, equally weighted, classified in three components: the environment for ICT offered by a given country or community (market environment; political and regulatory environment; infrastructure environment), the readiness of the community's key stakeholders (individuals readiness; businesses readiness; governments readiness) to use ICT, and finally the usage of ICT amongst these stakeholders.
Bibliography	Dutta Soumitra, Bilbao-Osorio Insead Benat, Geiger Thierry, The Global Information Technology Report 2012 - The Networked Readiness Index 2012: Benchmarking ICT Progress and Impacts for the Next Decade. 2012.

Market Potential Index (MPI)

Developed by	Michigan State University, in 1996.
Abstract	The focus of this index is ranking the market potential of countries identified as "Emerging Markets" by The Economist magazine. These emerging economies comprise more than half of the world's population, account for a large share of world output, and have very high growth rates. This indexing study is conducted to help companies compare the Emerging Markets with each other on several dimensions. Eight dimensions are chosen to represent the market potential of a country over a scale of 1 to 100. Each dimension is measured using various indicators, and are weighted in determining their contribution to the overall Market Potential Index. The eight dimensions are: 1) market size; 2) market growth rate; 3) market intensity; 4) market consumption capacity; 5) commercial infrastructure; 6) economic freedom; 7) market receptivity; 8) country risk.
Bibliography	S.Tamer Cavusgil, Measuring The Potential of Emerging Markets: An Indexing Approach. *Business Horizons, Vol. 40 Number 1, 87-91,* January-February 1997.

Quality of Life Index

Developed by	The Economist Intelligence Unit, in 2005.
Abstract	It is based on a method that links the results of subjective life-satisfaction surveys to the objective determinants of quality of life across countries. The survey uses nine quality of life factors to determine a nation score: 1) health; 2) family life; 3) community life; 4) material well being; 5) political stability and security; 6) climate and geography; 7) job security; 8) political freedom; 9) gender equality. The survey results have been used as a starting point and a means for deriving weights for the various determinants of quality of life across countries, in order to calculate an objective index. The average scores from comparable life-satisfaction surveys (on a scale of one to 10) have been assembled for 1999 or 2000 for 74 countries. These scores have then been related in a multivariate regression to various factors that have been shown to be associated with life satisfaction in many studies. Together these variables explain more than 80% of the inter-country variation in life-satisfaction scores. Using so called *beta* coefficients from the regression to derive the weights of the various factors, the most important were health, material well-being, and political stability and security. These were followed by family relations and community life. Next in order of importance were climate, job security, political freedom and finally gender equality. The values of the life-satisfaction scores that have been predicted by the nine indicators represent a country quality-of-life index, or the "corrected" life-satisfaction scores, based on objective cross-country determinants.
Bibliography	The Economist Intelligence Unit. The Economist Intelligence Unit's Quality Of Life Index. *The World in 2005*. 2005.

Millennium Challenge Account Country Rankings

Developed by	US Government Millennium Challenge Corporation (MCC), in 2005.
Abstract	Millennium Challenge Account ("MCA") is based on the assistance to countries that enter into compacts with the United States to support policies and programs that advance the progress of such countries in achieving lasting economic growth and poverty reduction. The Millennium Challenge Corporation ("MCC") determines the countries that will be eligible to receive MCA assistance during the fiscal year, based on their demonstrated commitment to just and democratic governance, economic freedom, and investing in their people, as well as on the opportunity to reduce poverty and generate economic growth in the country. The Board uses 17 indicators grouped under the three policy categories (ruling justly, encouraging economic freedom, investing in people) to assess the policy performance of individual countries.
Bibliography	Millennium Challenge Corporation - United States of America, Report on the Criteria and Methodology for Determining the Eligibility of Candidate Countries for Millennium Challenge Account Assistance in Fiscal Year 2013. September 2012.

APPENDIX C

International Organizations for Data Sourcing

In this appendix international and globally recognized organizations, used both to identify the indicators for the Sustainability Evaluation Model and consequently as data source, are listed.

Central Intelligence Agency (CIA)

The Central Intelligence Agency was created in 1947 with the signing of the National Security Act by President Harry S. Truman. The act also created a Director of Central Intelligence (DCI): to serve as head of the United States intelligence community, act as the principal adviser to the President for intelligence matters related to the national security, and serve as head of the Central Intelligence Agency. As a separate agency, CIA serves as an independent source of analysis on topics of concern and also works closely with the other organizations in the Intelligence Community to ensure that the intelligence consumer—whether Washington policymaker or battlefield commander—receives the best intelligence possible. [1]

Economist Intelligence Unit (EIU)

It is an independent business within The Economist Group. It is headquartered in London, United Kingdom.
Through research and analysis, the EIU offers forecasting and advisory services to its clients. It provides country, industry and management analysis worldwide and incorporates the former Business International Corporation, a U.K. company acquired by the parent organization in 1986.
The Economist intelligence Unit prepares business leaders for opportunity. It accomplishes this by delivering accurate and impartial forecasts and analysis which empower its clients to act with confidence when making strategic decisions.
The core principles are: uncompromising integrity, relentless rigour and precise communication. [2]

European Environment Agency (EEA)

The European Environment Agency (EEA) is an agency of the European Union. Its task is to provide sound, independent information on the environment. They are a major information source for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public. Currently, the EEA has 33 member countries. [3]

Food and Agriculture Organization of the United Nations (FAO)

FAO is an intergovernmental organization, with 194 member nations. It is headquartered in Rome, Italy.
Its employees come from various cultural backgrounds and are experts in the multiple fields of activity FAO engages in. FAO's staff capacity allows it to support improved governance inter alia, generate, develop and adapt existing tools and guidelines and provide targeted governance support as a resource to country and regional level FAO offices.

Achieving food security for all is at the heart of FAO's efforts – to make sure people have regular access to enough high-quality food to lead active, healthy lives.

Its three main goals are: the eradication of hunger, food insecurity and malnutrition; the elimination of poverty and the driving forward of economic and social progress for all; and, the sustainable management and utilization of natural resources, including land, water, air, climate and genetic resources for the benefit of present and future generations. [4]

Freedom House

Freedom House is an independent watchdog organization dedicated to the expansion of freedom around the world.
Freedom House speaks out against the main threats to democracy and empowers citizens to exercise their fundamental rights. It analyzes the challenges to freedom; advocate for greater political and civil liberties; and support frontline activists to defend human rights and promote democratic change. Founded in 1941, Freedom House was the first American organization to champion the advancement of freedom globally. [5]

Global Footprint Network

In 2003, Global Footprint Network, a no profit organization, was established to enable a sustainable future where all people have the opportunity to live satisfying lives within the means of one planet. An essential step in creating a one-planet future is measuring human impact on the Earth so it is possible to make more informed choices. Together with hundreds of individuals, 200 cities, 23 nations, leading business, scientists, NGO's, academics and 90-plus global Partners, spanning six continents, it is advancing the impact of the Footprint in the world, applying it to practical projects and sparking a global dialogue about a one-planet future and how we can facilitate change.[6]

International Energy Agency (IEA)

The IEA is an autonomous organization which works to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA's four main areas of focus are: energy security, economic development, environmental awareness, and engagement worldwide.
Founded in response to the 1973/4 oil crisis, the IEA's initial role was to help countries co-ordinate a collective response to major disruptions in oil supply through the release of emergency oil stocks. [7]

Organisation for Economic Co-operation and Development (OECD)

The mission of the Organisation for Economic Co-operation and Development (OECD) is to promote policies that will improve the economic and social well-being of people around the world. The OECD provides a forum in which governments can work together to share experiences and seek solutions to common problems. It works with governments to understand what drives economic, social and environmental change. It measures productivity and global flows of trade and investment. It analyse and compare data to predict future trends. It set international standards on a wide range of things, from agriculture and tax to the safety of chemicals.
Today, its 34 member countries span the globe, from North and South America to Europe and the Asia-Pacific region. [8]

Transparency International

It is a non-governmental organization that monitors and publicizes corporate and political corruption in international development.
Originally founded in Germany, in May 1993, as a not-for-profit organization, Transparency International is now an international non-governmental organization. The headquarters is located in Berlin, Germany.
Transparency International consists of chapters that address corruption in their respective countries. From small bribes to large-scale looting, corruption differs from country to country. As chapters are staffed with local experts they are ideally placed to determine the priorities and approaches best suited to tackling corruption in their countries. [9]

Joint United Nations Programme on HIV/AIDS (UNAIDS)

The Joint United Nations Programme on HIV and AIDS, or UNAIDS, is the main advocate for accelerated, comprehensive and coordinated global action on the HIV/AIDS epidemic.
The mission of UNAIDS is to lead, strengthen and support an expanded response to HIV and AIDS that includes preventing transmission of HIV, providing care and support to those already living with the virus, reducing the vulnerability of individuals and communities to HIV and alleviating the impact of the epidemic. UNAIDS seeks to prevent the HIV/AIDS epidemic from becoming a severe pandemic.
UNAIDS is headquartered in Geneva, Switzerland, where it shares some site facilities with the World Health Organization (WHO). It is a member of the United Nations Development Group. [10]

United Nations Development Programme (UNDP)

Since 1966, UNDP partners with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves the quality of life for everyone.
On the ground in more than 170 countries and territories, it offers global perspective and local insight to help empower lives and build resilient nations.
World leaders have pledged to achieve the Millennium Development Goals, including the overarching goal of cutting poverty in half by 2015. UNDP's network links and coordinates global and national efforts to reach these Goals. It focuses on helping countries build and share solutions in four main areas: Poverty Reduction and Achievement of the MDGs, Democratic Governance, Crisis Prevention and Recovery, Environment and Energy for Sustainable Development. In all its activities, it encourages the protection of human rights and the empowerment of women, minorities and the poorest and most vulnerable. [11]

United Nations Educational, Scientific and Cultural Organization (UNESCO)

UNESCO was founded on 16 November 1945. It has 195 Members and eight Associate Members and it is governed by the General Conference and the Executive Board.
The Organization has more than 50 field offices around the world. Its headquarters are located at Place de Fontenoy in Paris, France.
UNESCO works to create the conditions for dialogue among civilizations, cultures and peoples, based upon respect for commonly shared values. It is through this dialogue that the world can achieve global

visions of sustainable development encompassing observance of human rights, mutual respect and the alleviation of poverty, all of which are at the heart of UNESCO'S mission and activities.
The broad goals and concrete objectives of the international community – as set out in the internationally agreed development goals, including the Millennium Development Goals (MDGs) – underpin all UNESCO's strategies and activities. Thus UNESCO's unique competencies in education, the sciences, culture and communication and information contribute towards the realization of those goals. [12]

United Nations Children's Fund (UNICEF) - formerly United Nations International Children's Emergency Fund

It is an agency, created by the United Nations General Assembly in 1946, concerned with improving the health and nutrition of children and mothers throughout the world, Nobel peace Prize 1965.
Its headquarter is in New York City and it is one of the members of the United Nations Development Group and its Executive Committee. [13]

Water Footprint Network

The Water Footprint Network is a non-profit foundation under Dutch law, composed by a dynamic and international learning community.
It is a platform for connecting diverse communities interested in sustainability, equitability and efficiency of water use.
It believes in openness and sharing, for this reason data, methods and tools are available for free. Moreover it believes in inclusiveness, in fact it incorporates diverse perspectives from a broad range of stakeholders from different social, cultural, economic and environmental backgrounds.
The mission of the Water Footprint Network is to promote the transition towards sustainable, fair and efficient use of fresh water resources worldwide by: advancing the concept of the 'water footprint', a spatially and temporally explicit indicator of direct and indirect water use of consumers and producers; increasing the water footprint awareness of communities, government bodies and businesses and their understanding of how consumption of goods and services and production chains relate to water use and impacts on fresh-water systems; and encouraging forms of water governance that reduce the negative ecological and social impacts of the water footprints of communities, countries and businesses. [14]

World Health Organization (WHO)

WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.
More than 7000 people from more than 150 countries work for the Organization in 150 WHO offices in countries, territories and areas, six regional offices and at the headquarters in Geneva, Switzerland. [15]

World Bank (WB)

The World Bank is a vital source of financial and technical assistance to developing countries around the world. It is not a bank in the ordinary sense but a unique partnership to reduce poverty and support development. The World Bank Group comprises five institutions managed by their member countries:

- The International Bank for Reconstruction and Development (IBRD) lends to governments of middle-income and creditworthy low-income countries.
- The International Development Association (IDA) provides interest-free loans—called credits— and grants to governments of the poorest countries.
- The International Finance Corporation (IFC), a member of the World Bank Group, is the largest global development institution focused exclusively on the private sector. They help developing countries achieve sustainable growth by financing investment, mobilizing capital in international financial markets, and providing advisory services to businesses and governments.
- The Multilateral Investment Guarantee Agency (MIGA) was created in 1988 as a member of the World Bank Group to promote foreign direct investment into developing countries to support economic growth, reduce poverty, and improve people's lives. MIGA fulfills this mandate by offering political risk insurance (guarantees) to investors and lenders.
- The International Centre for Settlement of Investment Disputes (ICSID) provides international facilities for conciliation and arbitration of investment disputes. [16]

World Resource Institute (WRI)

It is an independent, non-partisan and non-profit organization founded in 1982.
WRI is a global research organization that spans more than 50 countries, with offices in the United States, China, India, Brazil, and more.
More than 300 experts and staff work closely with leaders to turn big ideas into action to sustain natural resources - the foundation of economic opportunity and human well-being. The work focuses on six critical issues at the intersection of environment and development: climate, energy, food, forests, water, and cities and transport. [17]

Bibliography:

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APPENDIX D

Discarded indicators

The final framework of the Sustainability Evaluation Model is the result of numerous changes made during the elaboration process regarding the indicators.
In fact, for different reasons, they have been progressively discarded. This choice derives from the goal of describing the sustainable development concept through a limited number of indicators, that were as representative as possible.
Below the excluded indicators and the relative removal reasons are listed:

Economic Dimension

- **Primary Energy Supply from Renewable Sources / Total Primary Energy Supply**
  Primary energy is the energy form found in nature that has not been subjected to any conversion or transformation process and therefore it does not refer to the energy effectively consumed. The use of *Electricity Production from Renewable Sources / Total Electricity Production* has been preferred because it provides a more representative picture of the renewable energy use in a country.

- **Renewable Energy Consumption / Total Final Consumption**
  Total Final Consumption (TFC) is the sum of consumption by the different end-use sectors. This indicator was not used because the International Energy Agency – IEA (data source) does not include the whole rate of electricity produced by renewable sources in the computation of the TFC.

Social Dimension

- **Total Population Density**
  A high level of urban population density could be a reason for a low degree of liveability and well being in the cities. In this sense the total population density does not give any useful information and it could be distorted by the presence of uninhabited areas. For this reason the indicator *Urban Population Density* has been used.

- **Share of Young People**
  A high rate of young people could represent the human potential for a country, but in those nations where this share is great, it does not necessarily correspond to an optimistic perspective for the future. A clarifying example of this phenomenon are the poor countries.

- **Tertiary School Enrolment**
  Secondary School Enrolment have been preferred over Tertiary because the value of this latter is low for the developing countries, and it could lead to an excessive penalization in the computation of the final index.

- **Air Transport**
  Two different indicators have been taken into account:
  -Number of Airports in a Country, which is not representative of the accessibility to the transport.

-Registered Carrier Departures Worldwide, which could be distorted by the location or the presence of attractions (touristic, political, business destinations) in a country.
Furthermore both refer to an expensive form of transport, not accessible to the whole population.
For these reasons the *Rail Route-km per 1'000 People* indicator has been used.

- **Paved Roads among Urban Areas**
  This could have been an interesting indicator, but due to the lack of data and to the fact that in many countries unpaved roads are still prevalent, it was discarded.

- **Number of Vehicles per Capita**
  This indicator has not been representative of the real transport access because it depends on the personal richness, on cultural factors (as the diffusion of bicycles) and on the accessibility of the public transportation.

Environmental Dimension

- **NO_x and SO_x Emissions**
  The inclusion of these two indicators would have led to an excessive number of indicators regarding the air sector. Therefore the *CO_2* and *Green House Gases Emissions* indicators have been selected to represent the global air pollution and the *PM_{10} Concentration* for the local air pollution.

- **Annual Freshwater Withdrawals**
  This indicator is strictly related to the presence of freshwater reservoirs in the country, so it is not able to properly describe the water management.

- **Water Footprint**
  It is a quantitative index which represents the amount of water used, not providing any qualitative information. Since any International Organization has defined maximum and minimum thresholds regarding the water footprint, the *Rate of Grey Water Footprint,* a qualitative indicator that represent the human impact on water, has been selected.

- **Recycling Waste / Total Waste Produced**
  This would have been a very representative and useful indicator to understand the waste policy of a country, but data were available only for a local level or they were totally missing. If data were available in a context different from the considered one, it would be appropriate to add this indicator in the proposed framework.

- **Electricity Production from Waste / Total Electricity Production**
  Initially this indicator has been included in the proposed index to represent the policy regarding the waste issue and the presence of incinerators in a country. Then it was noted that it could be affected by several external factors like governmental incentives or population pressures. Moreover sometimes the electricity production from waste is efficient only when connected to an heat generation.

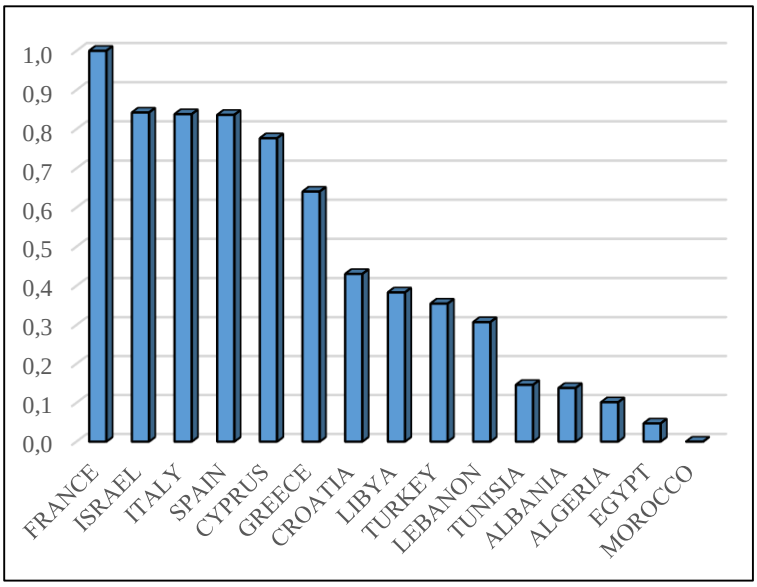
APPENDIX E

Countries' ranking for each indicator of the Sustainable Evaluation Model.

GNI (PPP) per Capita

Table A.1. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2012
2	ISRAEL	0,842	2011
3	ITALY	0,838	2012
4	SPAIN	0,836	2012
5	CYPRUS	0,777	2010
6	GREECE	0,641	2012
7	CROATIA	0,430	2012
8	LIBYA	0,383	2005
9	TURKEY	0,355	2012
10	LEBANON	0,307	2012
11	TUNISIA	0,146	2012
12	ALBANIA	0,138	2012
13	ALGERIA	0,101	2009
14	EGYPT	0,047	2012
15	MOROCCO	0,000	2012

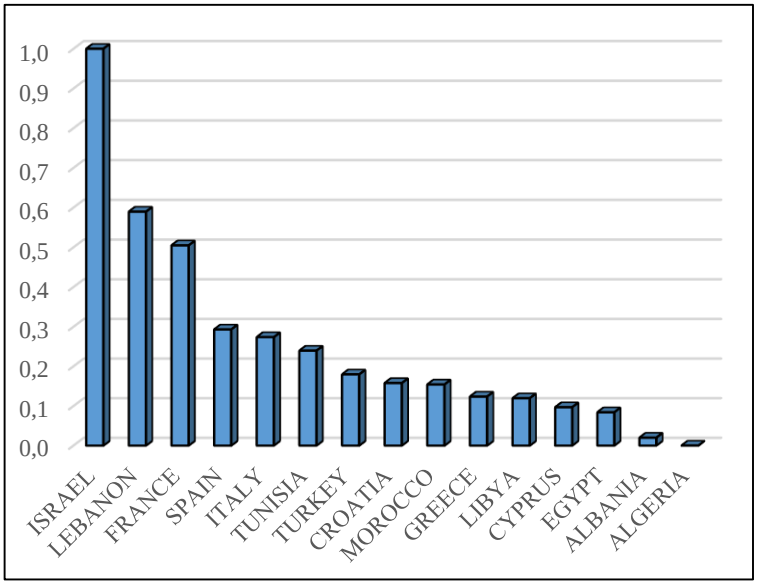


Graph A.1. Plot of the normalized data by country

Research & Development Expenditure (% of GDP)

Table A.2. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ISRAEL	1,000	2011
2	LEBANON	0,590	2010
3	FRANCE	0,505	2011
4	SPAIN	0,293	2011
5	ITALY	0,274	2011
6	TUNISIA	0,240	2009
7	TURKEY	0,180	2010
8	CROATIA	0,158	2011
9	MOROCCO	0,154	2010
10	GREECE	0,124	2007
11	LIBYA	0,119	2005
12	CYPRUS	0,097	2011
13	EGYPT	0,084	2011
14	ALBANIA	0,020	2008
15	ALGERIA	0,000	2005

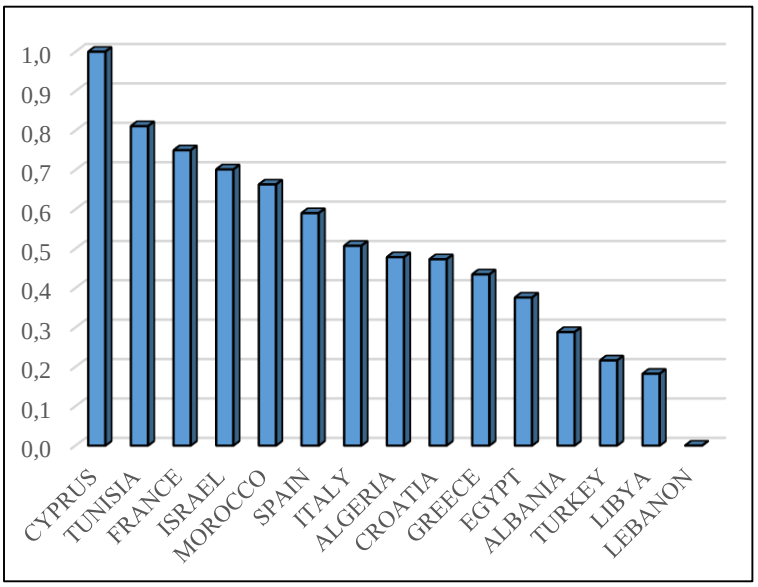


Graph A.2. Plot of the normalized data by country

Public Spending on Education (% of GDP)

Table A.3. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	CYPRUS	1,000	2010
2	TUNISIA	0,811	2010
3	FRANCE	0,750	2010
4	ISRAEL	0,701	2010
5	MOROCCO	0,663	2009
6	SPAIN	0,590	2010
7	ITALY	0,507	2010
8	ALGERIA	0,478	2008
9	CROATIA	0,473	2010
10	GREECE	0,435	2005
11	EGYPT	0,376	2008
12	ALBANIA	0,288	2007
13	TURKEY	0,216	2006
14	LIBYA	0,182	1999
15	LEBANON	0,000	2011

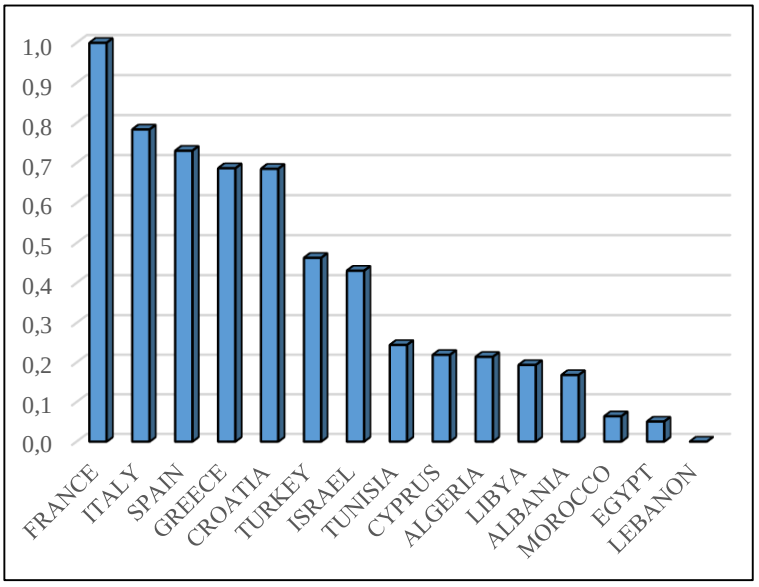


Graph A.3. Plot of the normalized data by country

Public Health Expenditure (% of GDP)

Table A.4. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2011
2	ITALY	0,784	2011
3	SPAIN	0,730	2011
4	GREECE	0,687	2011
5	CROATIA	0,685	2011
6	TURKEY	0,463	2011
7	ISRAEL	0,431	2011
8	TUNISIA	0,244	2011
9	CYPRUS	0,219	2011
10	ALGERIA	0,214	2011
11	LIBYA	0,194	2011
12	ALBANIA	0,168	2011
13	MOROCCO	0,064	2011
14	EGYPT	0,051	2011
15	LEBANON	0,000	2011

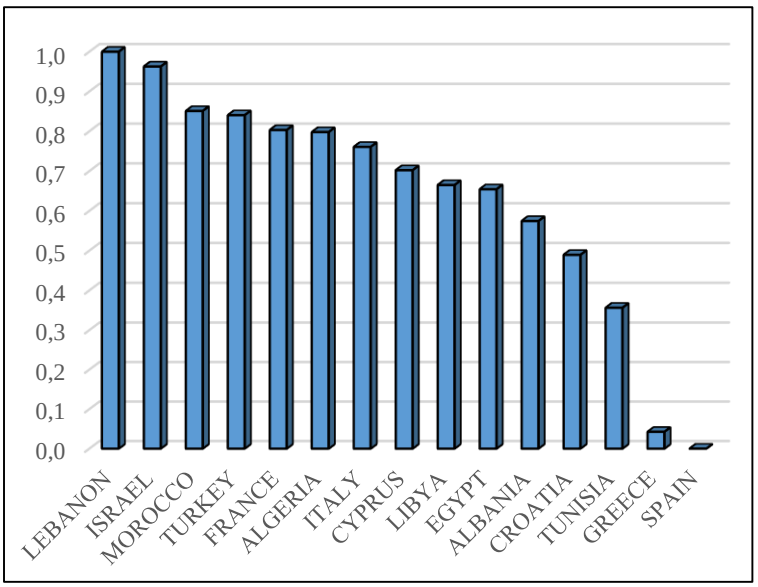


Graph A.4. Plot of the normalized data by country

Unemployment, Total (% of Total Labor Force)

Table A.5. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	LEBANON	1,000	2009
2	ISRAEL	0,963	2012
3	MOROCCO	0,851	2012
4	TURKEY	0,840	2012
5	FRANCE	0,803	2012
6	ALGERIA	0,798	2011
7	ITALY	0,761	2012
8	CYPRUS	0,702	2012
9	LIBYA	0,665	2011
10	EGYPT	0,654	2012
11	ALBANIA	0,574	2010
12	CROATIA	0,489	2012
13	TUNISIA	0,356	2011
14	GREECE	0,043	2012
15	SPAIN	0,000	2012

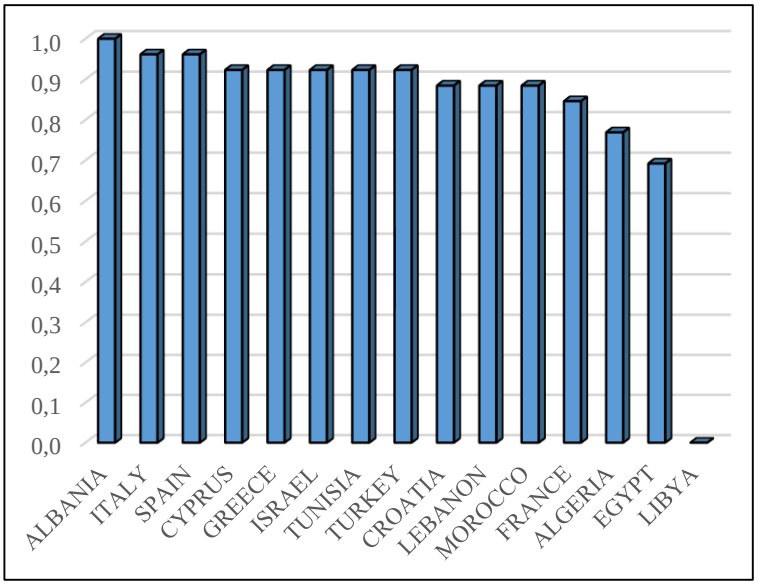


Graph A.5. Plot of the normalized data by country

Total Primary Energy Supply / GDP

Table A.6. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ALBANIA	1,000	2011
2	ITALY	0,962	2011
2	SPAIN	0,962	2011
3	CYPRUS	0,923	2011
3	GREECE	0,923	2011
3	ISRAEL	0,923	2011
3	TUNISIA	0,923	2011
3	TURKEY	0,923	2011
4	CROATIA	0,885	2011
4	LEBANON	0,885	2011
4	MOROCCO	0,885	2011
5	FRANCE	0,846	2011
6	ALGERIA	0,769	2011
7	EGYPT	0,692	2011
8	LIBYA	0,000	2009

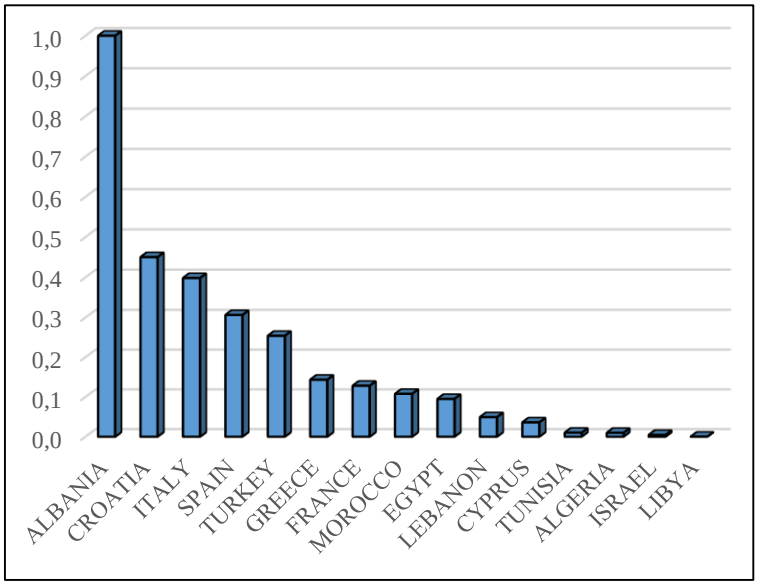


Graph A.6. Plot of the normalized data by country

Electricity Production from Renewables / Total Electricity Production

Table A.7. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ALBANIA	1,000	2011
2	CROATIA	0,450	2011
3	ITALY	0,398	2011
4	SPAIN	0,306	2011
5	TURKEY	0,254	2011
6	GREECE	0,143	2011
7	FRANCE	0,128	2011
8	MOROCCO	0,108	2011
9	EGYPT	0,095	2011
10	LEBANON	0,049	2011
11	CYPRUS	0,036	2011
12	TUNISIA	0,010	2011
13	ALGERIA	0,010	2011
14	ISRAEL	0,004	2011
15	LIBYA	0,000	2011

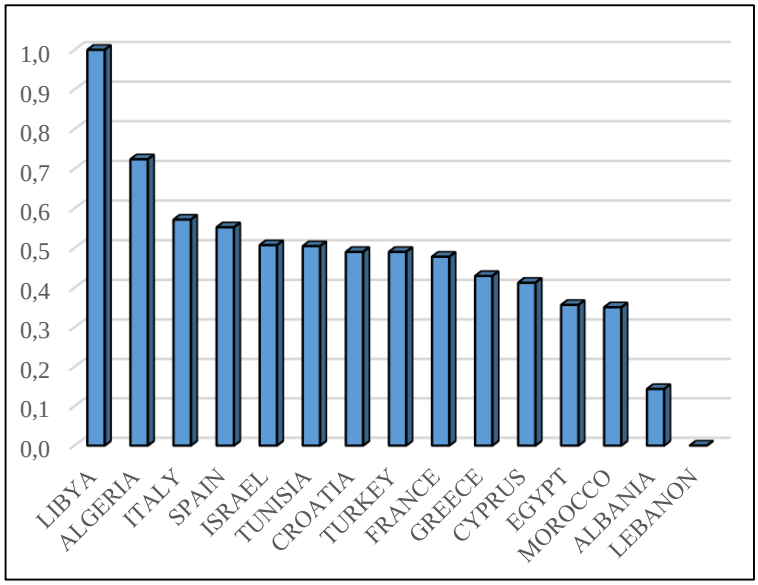


Graph A.7. Plot of the normalized data by country

Net Exports / (Exports + Imports of Goods and Services)

Table A.8. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	LIBYA	1,000	2005
2	ALGERIA	0,724	2009
3	ITALY	0,572	2012
4	SPAIN	0,552	2012
5	ISRAEL	0,507	2012
6	TUNISIA	0,505	2012
7	CROATIA	0,490	2012
8	TURKEY	0,490	2012
9	FRANCE	0,478	2012
10	GREECE	0,429	2012
11	CYPRUS	0,412	2010
12	EGYPT	0,356	2012
13	MOROCCO	0,350	2012
14	ALBANIA	0,144	2012
15	LEBANON	0,000	2012

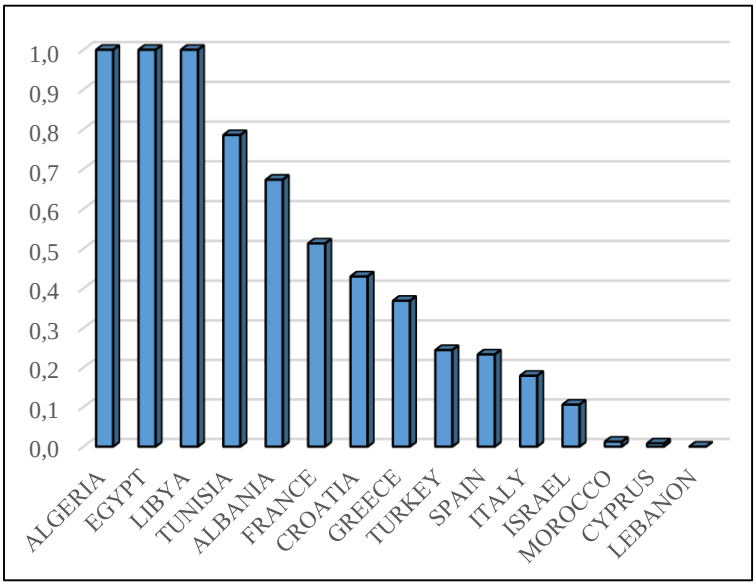


Graph A.8. Plot of the normalized data by country

Energy Imports, Net (% of Energy Use)

Table A.9. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ALGERIA	1,000	2011
1	EGYPT	1,000	2011
1	LIBYA	1,000	2011
2	TUNISIA	0,786	2011
3	ALBANIA	0,673	2011
4	FRANCE	0,513	2012
5	CROATIA	0,430	2011
6	GREECE	0,369	2012
7	TURKEY	0,244	2012
8	SPAIN	0,233	2012
9	ITALY	0,179	2012
10	ISRAEL	0,106	2012
11	MOROCCO	0,013	2011
12	CYPRUS	0,008	2011
13	LEBANON	0,000	2011

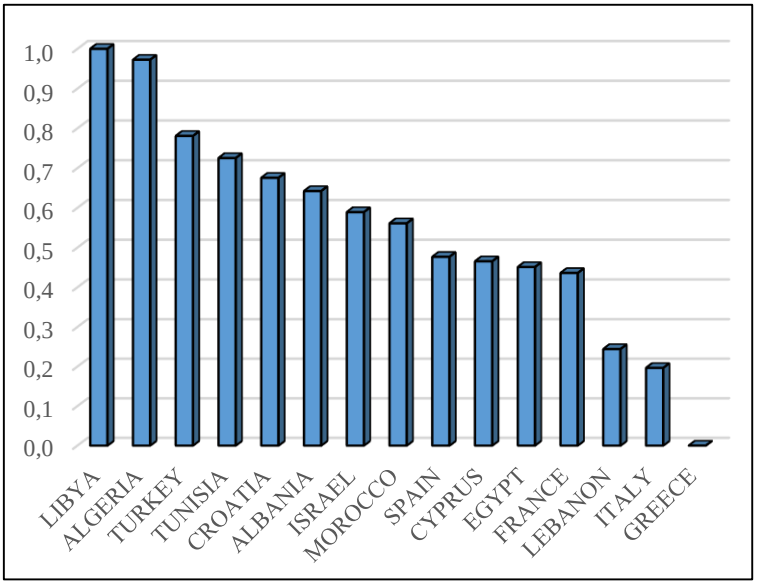


Graph A.9. Plot of the normalized data by country

Public Debt (% of GDP)

Table A.10. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	LIBYA	1,000	2012
2	ALGERIA	0,973	2012
3	TURKEY	0,781	2012
4	TUNISIA	0,725	2012
5	CROATIA	0,675	2012
6	ALBANIA	0,642	2012
7	ISRAEL	0,589	2012
8	MOROCCO	0,561	2012
9	SPAIN	0,476	2012
10	CYPRUS	0,465	2012
11	EGYPT	0,451	2012
12	FRANCE	0,436	2012
13	LEBANON	0,244	2012
14	ITALY	0,196	2012
15	GREECE	0,000	2012

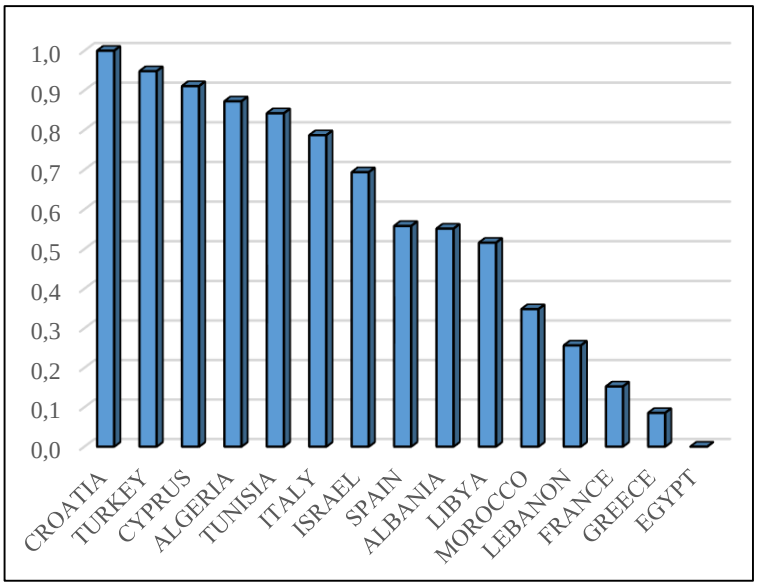


Graph A.10. Plot of the normalized data by country

Urban Population / Urban Areas

Table A.11. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	CROATIA	1,000	2011
2	TURKEY	0,948	2010
3	CYPRUS	0,911	2007
4	ALGERIA	0,872	2008
5	TUNISIA	0,842	2004
6	ITALY	0,787	2012
7	ISRAEL	0,694	2012
8	SPAIN	0,558	2013
9	ALBANIA	0,551	2011
10	LIBYA	0,516	2004
11	MOROCCO	0,348	2004
12	LEBANON	0,256	2008
13	FRANCE	0,153	2011
14	GREECE	0,085	2011
15	EGYPT	0,000	2006

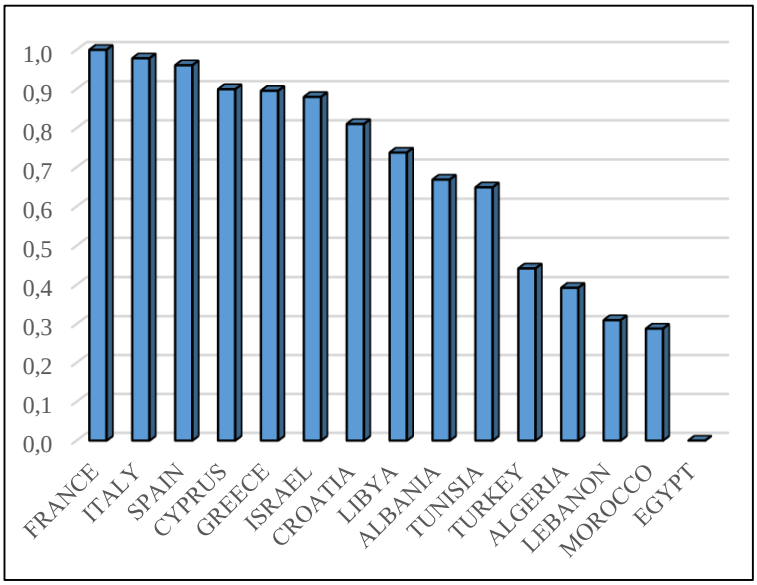


Graph A.11. Plot of the normalized data by country

Gender Inequality Index

Table A.12. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2012
2	ITALY	0,978	2012
3	SPAIN	0,961	2012
4	CYPRUS	0,899	2012
5	GREECE	0,895	2012
6	ISRAEL	0,880	2012
7	CROATIA	0,811	2012
8	LIBYA	0,738	2012
9	ALBANIA	0,669	2012
10	TUNISIA	0,649	2012
11	TURKEY	0,442	2012
12	ALGERIA	0,393	2012
13	LEBANON	0,310	2012
14	MOROCCO	0,288	2012
15	EGYPT	0,000	2012

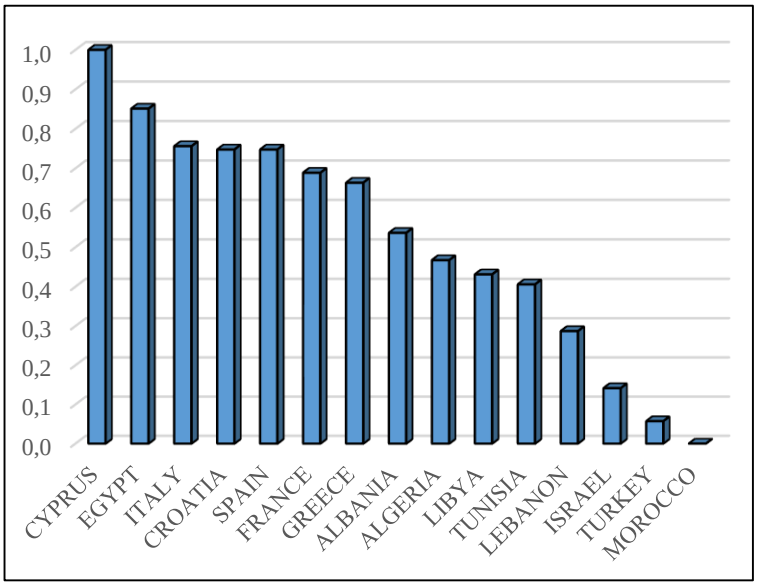


Graph A.12. Plot of the normalized data by country

GINI Richness Distribution

Table A.13. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	CYPRUS	1,000	2005
2	EGYPT	0,851	2008
3	ITALY	0,756	2011
4	CROATIA	0,747	2010
5	SPAIN	0,747	2005
6	FRANCE	0,689	2008
7	GREECE	0,663	2005
8	ALBANIA	0,536	2008
9	ALGERIA	0,467	1995
10	LIBYA	0,431	1995
11	TUNISIA	0,406	2010
12	LEBANON	0,287	2005
13	ISRAEL	0,141	2008
14	TURKEY	0,057	2010
15	MOROCCO	0,000	2007

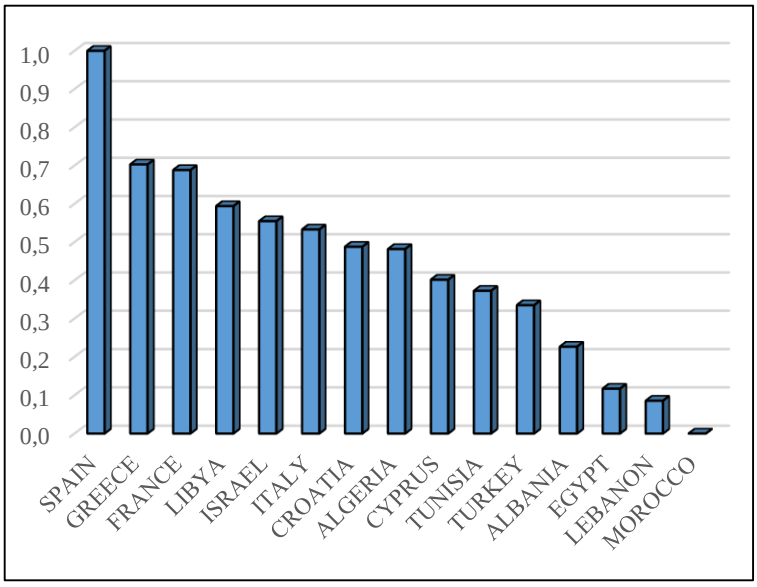


Graph A.13. Plot of the normalized data by country

School Enrolment, Secondary (% Respect to the Official Secondary School Age)

Table A.14. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	SPAIN	1,000	2011
2	GREECE	0,703	2010
3	FRANCE	0,688	2011
4	LIBYA	0,594	2006
5	ISRAEL	0,555	2010
6	ITALY	0,533	2011
7	CROATIA	0,488	2011
8	ALGERIA	0,482	2011
9	CYPRUS	0,402	2011
10	TUNISIA	0,372	2011
11	TURKEY	0,335	2011
12	ALBANIA	0,227	2008
13	EGYPT	0,117	2010
14	LEBANON	0,086	2012
15	MOROCCO	0,000	2012

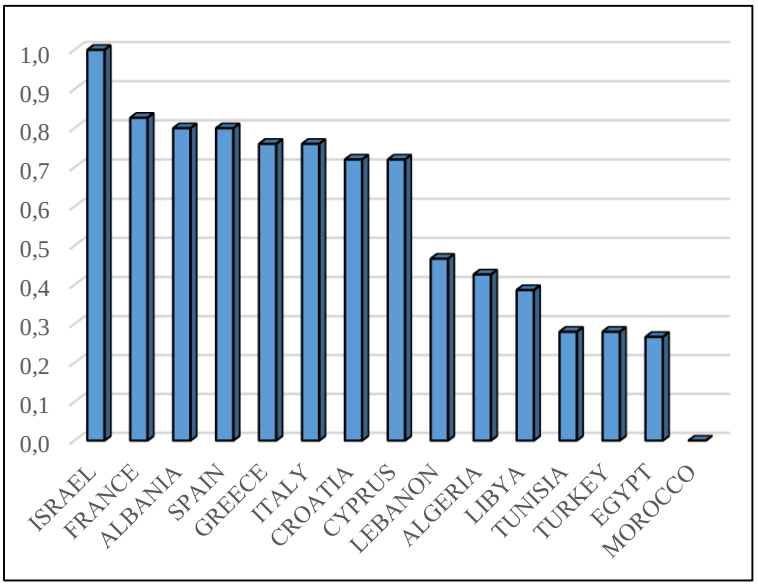


Graph A.14. Plot of the normalized data by country

Mean Years of Schooling

Table A.15. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ISRAEL	1,000	2012
2	FRANCE	0,827	2012
3	ALBANIA	0,800	2012
4	SPAIN	0,800	2012
5	GREECE	0,760	2012
6	ITALY	0,760	2012
7	CROATIA	0,720	2012
8	CYPRUS	0,720	2012
9	LEBANON	0,467	2012
10	ALGERIA	0,427	2012
11	LIBYA	0,387	2012
12	TUNISIA	0,280	2012
13	TURKEY	0,280	2012
14	EGYPT	0,267	2012
15	MOROCCO	0,000	2012

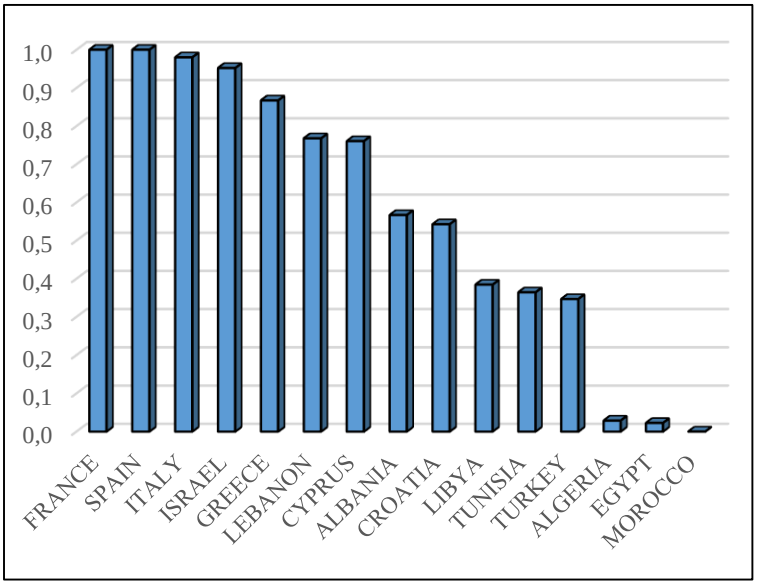


Graph A.15. Plot of the normalized data by country

Life Expectancy at Birth

Table A.16. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2011
1	SPAIN	1,000	2011
2	ITALY	0,980	2011
3	ISRAEL	0,952	2011
4	GREECE	0,867	2011
5	LEBANON	0,768	2011
6	CYPRUS	0,760	2011
7	ALBANIA	0,567	2011
8	CROATIA	0,543	2011
9	LIBYA	0,384	2011
10	TUNISIA	0,364	2011
11	TURKEY	0,347	2011
12	ALGERIA	0,029	2011
13	EGYPT	0,023	2011
14	MOROCCO	0,000	2011

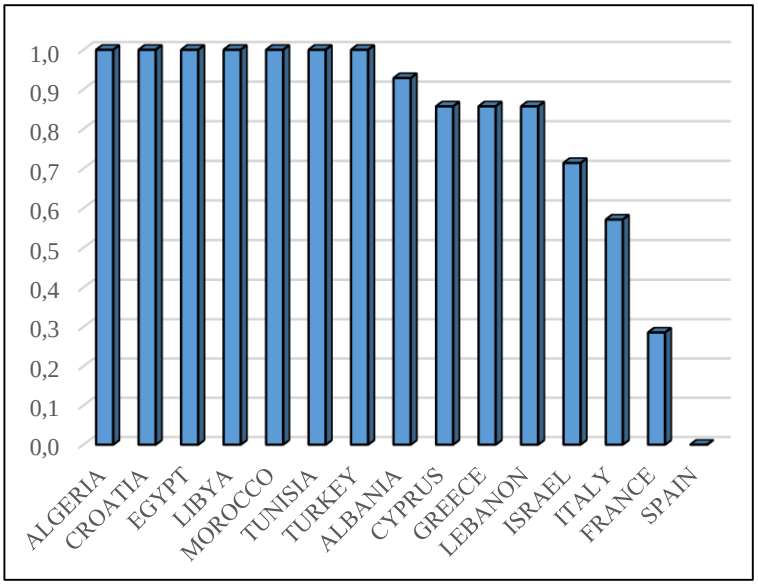


Graph A.16. Plot of the normalized data by country

% of HIV Cases

Table A.17. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ALGERIA	1,000	2012
1	CROATIA	1,000	2012
1	EGYPT	1,000	2012
1	LIBYA	1,000	2012
1	MOROCCO	1,000	2012
1	TUNISIA	1,000	2012
1	TURKEY	1,000	2012
2	ALBANIA	0,929	2012
3	CYPRUS	0,857	2012
4	GREECE	0,857	2012
5	LEBANON	0,857	2012
6	ISRAEL	0,714	2012
7	ITALY	0,571	2012
8	FRANCE	0,286	2012
9	SPAIN	0,000	2012

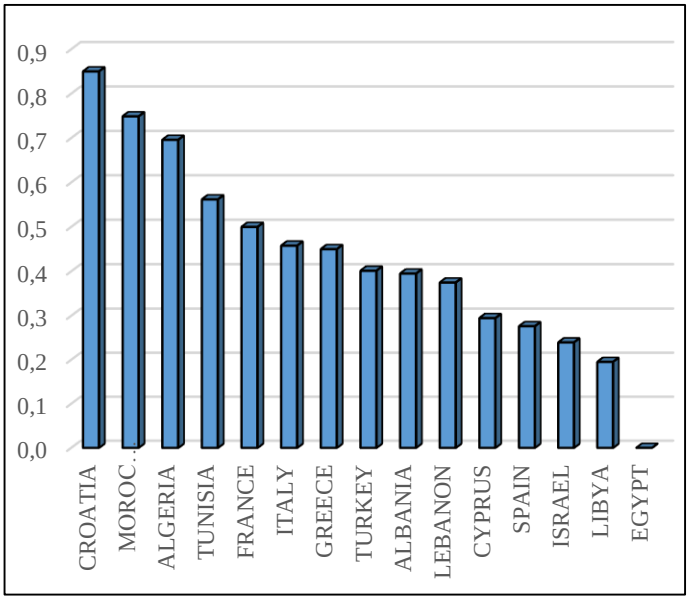


Graph A.17. Plot of the normalized data by country

Obesity Prevalence, Body Mass Index > 30 (% 20+ Years Old); Malnutrition Prevalence, (% < 5 Years Old)

Table A.18. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	CROATIA	0,850	2008 - 1996
2	MOROCCO	0,749	2008 - 2011
3	ALGERIA	0,696	2008 - 2005
4	TUNISIA	0,562	2008 - 2006
5	FRANCE	0,500	2008
6	ITALY	0,458	2008
7	GREECE	0,450	2008
8	TURKEY	0,401	2008 - 2004
9	ALBANIA	0,395	2008 - 2009
10	LEBANON	0,375	2008 - 2004
11	CYPRUS	0,295	2008
12	SPAIN	0,276	2011
13	ISRAEL	0,239	2008
14	LIBYA	0,195	2008 - 2007
15	EGYPT	0,000	2008 - 2008

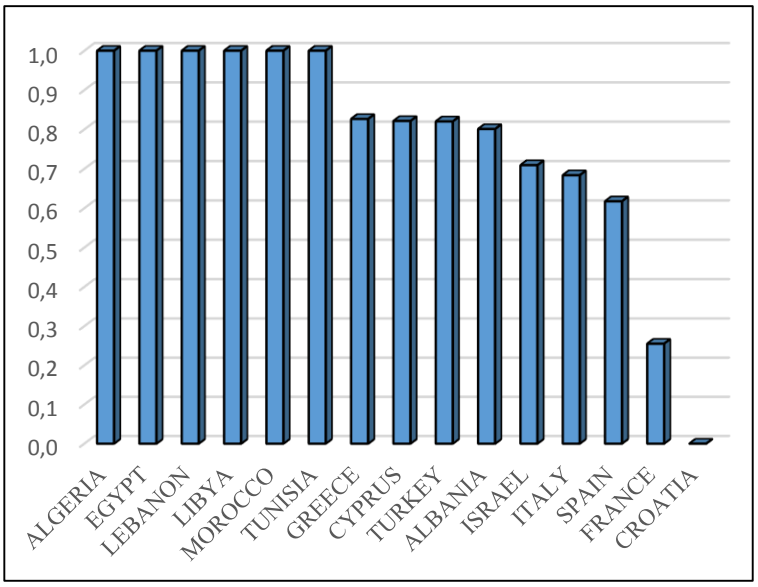


Graph A.18. Plot of the normalized data by country

Suicide Rate per 100'000 People

Table A.19. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ALGERIA	1,000	2009
1	EGYPT	1,000	2009
1	LEBANON	1,000	2009
1	LIBYA	1,000	2009
1	MOROCCO	1,000	2009
1	TUNISIA	1,000	2009
2	GREECE	0,827	2009
3	CYPRUS	0,821	2009
4	TURKEY	0,820	2011
5	ALBANIA	0,801	2003
6	ISRAEL	0,709	2007
7	ITALY	0,684	2007
8	SPAIN	0,617	2008
9	FRANCE	0,255	2010
10	CROATIA	0,000	2002

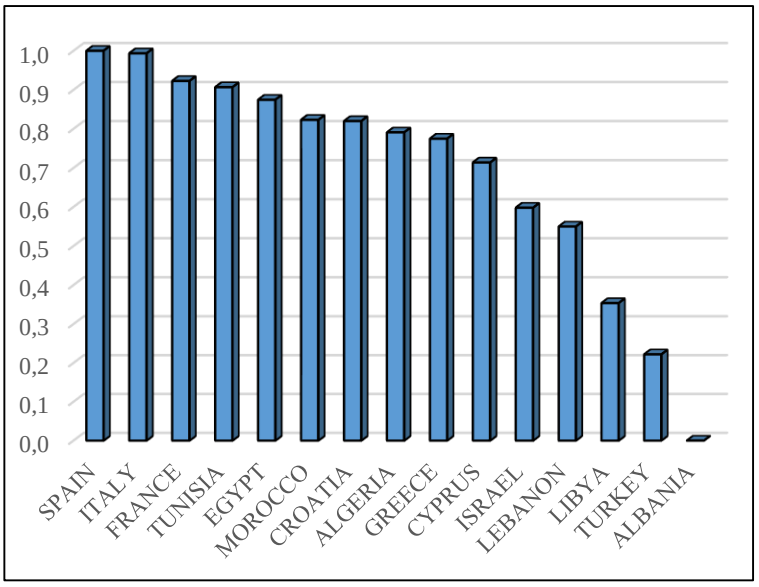


Graph A.19. Plot of the normalized data by country

Homicide Rate per 100'000 People

Table A.20. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	SPAIN	1,000	2010
2	ITALY	0,994	2010
3	FRANCE	0,923	2009
4	TUNISIA	0,907	2008
5	EGYPT	0,875	2010
6	MOROCCO	0,823	2010
7	CROATIA	0,820	2010
8	ALGERIA	0,791	2008
9	GREECE	0,775	2010
10	CYPRUS	0,714	2009
11	ISRAEL	0,598	2011
12	LEBANON	0,550	2010
13	LIBYA	0,354	2009
14	TURKEY	0,222	2008
15	ALBANIA	0,000	2010

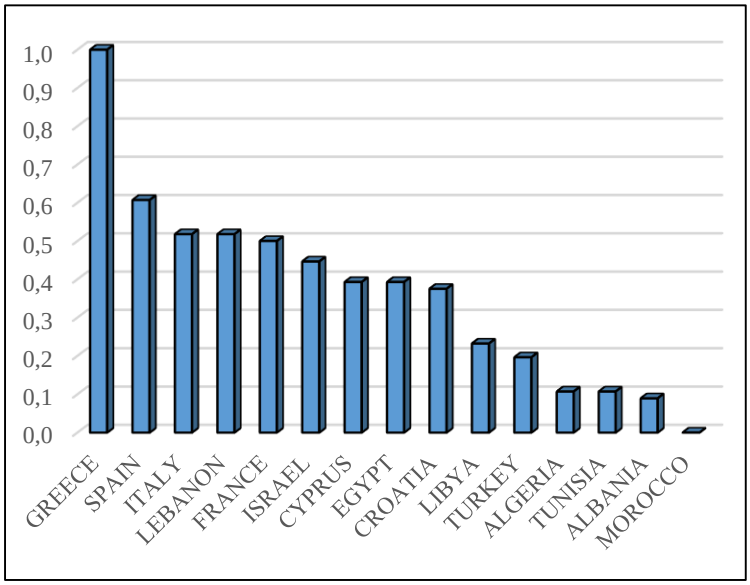


Graph A.20. Plot of the normalized data by country

Physicians per 1'000 People

Table A.21. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	GREECE	1,000	2010
2	SPAIN	0,607	2011
3	ITALY	0,518	2010
4	LEBANON	0,518	2010
5	FRANCE	0,500	2011
6	ISRAEL	0,446	2011
7	CYPRUS	0,393	2010
8	EGYPT	0,393	2010
9	CROATIA	0,375	2010
10	LIBYA	0,232	2010
11	TURKEY	0,196	2011
12	ALGERIA	0,107	2010
13	TUNISIA	0,107	2010
14	ALBANIA	0,089	2011
15	MOROCCO	0,000	2010

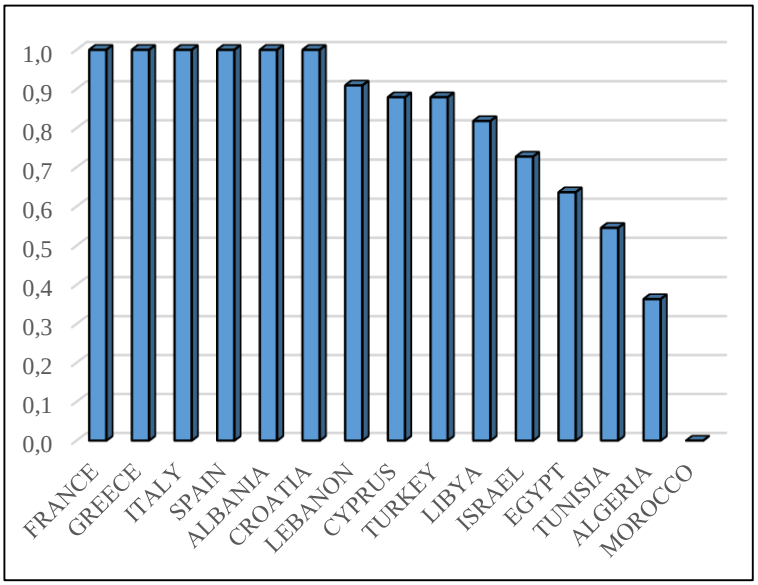


Graph A.21. Plot of the normalized data by country

Access to Electricity (% of Population)

Table A.22. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2010
1	GREECE	1,000	2010
1	ITALY	1,000	2010
1	SPAIN	1,000	2010
1	ALBANIA	1,000	2010
1	CROATIA	1,000	2010
2	LEBANON	0,909	2010
3	CYPRUS	0,879	2010
3	TURKEY	0,879	2010
4	LIBYA	0,818	2010
5	ISRAEL	0,727	2010
6	EGYPT	0,636	2010
7	TUNISIA	0,545	2010
8	ALGERIA	0,364	2010
9	MOROCCO	0,000	2010

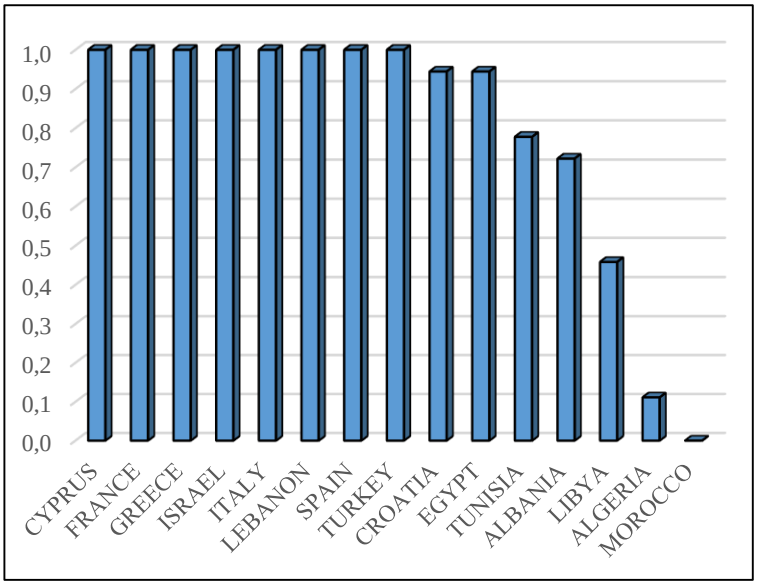


Graph A.22. Plot of the normalized data by country

Improved Water Source (% of Population with Access)

Table A.23. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	CYPRUS	1,000	2011
1	FRANCE	1,000	2011
1	GREECE	1,000	2011
1	ISRAEL	1,000	2011
1	ITALY	1,000	2011
1	LEBANON	1,000	2011
1	SPAIN	1,000	2011
1	TURKEY	1,000	2011
2	CROATIA	0,944	2011
3	EGYPT	0,944	2011
4	TUNISIA	0,778	2011
5	ALBANIA	0,722	2011
6	LIBYA	0,458	2011
7	ALGERIA	0,111	2011
8	MOROCCO	0,000	2011

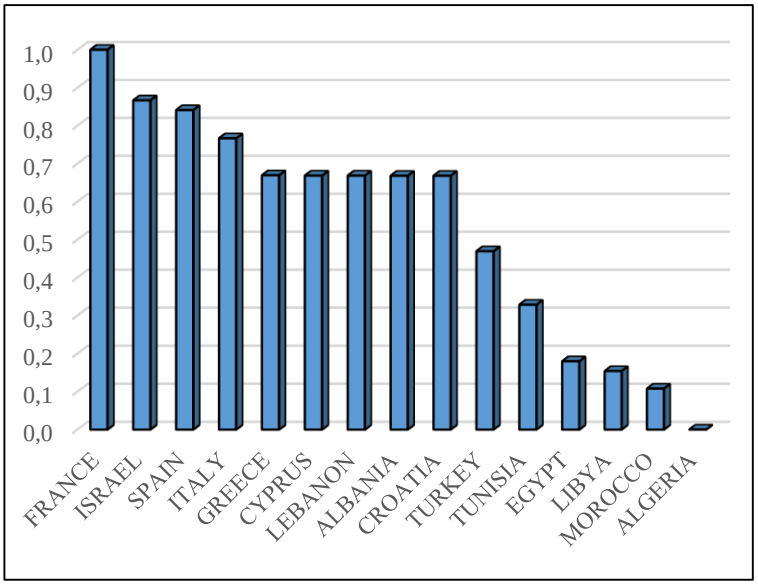


Graph A.23. Plot of the normalized data by country

Food Security Index

Table A.24. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2013
2	ISRAEL	0,867	2013
3	SPAIN	0,841	2013
4	ITALY	0,767	2013
5	GREECE	0,669	2013
6	CYPRUS	0,668	2013
6	LEBANON	0,668	2013
6	ALBANIA	0,668	2013
6	CROATIA	0,668	2013
7	TURKEY	0,469	2013
8	TUNISIA	0,328	2013
9	EGYPT	0,179	2013
10	LIBYA	0,154	2013
11	MOROCCO	0,108	2013
12	ALGERIA	0,000	2013

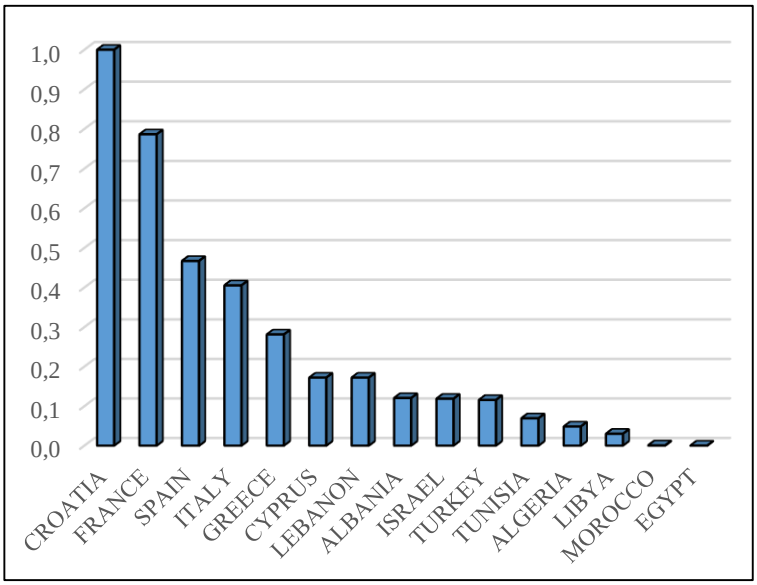


Graph A.24. Plot of the normalized data by country

Rail Route-km per 1'000 People

Table A.25. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	CROATIA	1,000	2011
2	FRANCE	0,787	2011
3	SPAIN	0,467	2011
4	ITALY	0,405	2011
5	GREECE	0,281	2011
6	CYPRUS	0,172	2011
6	LEBANON	0,172	2011
7	ALBANIA	0,120	2011
8	ISRAEL	0,119	2011
9	TURKEY	0,115	2011
10	TUNISIA	0,069	2011
11	ALGERIA	0,048	2011
12	LIBYA	0,030	2011
13	MOROCCO	0,001	2011
14	EGYPT	0,000	2011

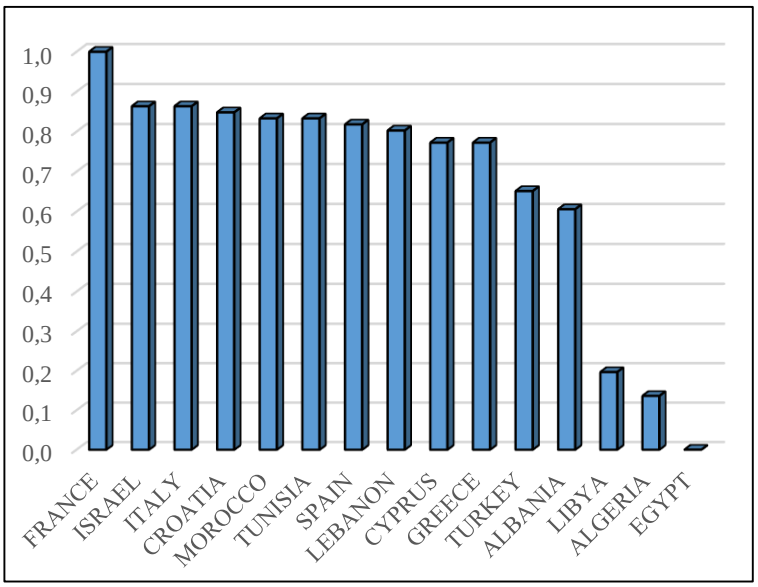


Graph A.25. Plot of the normalized data by country

PM_{10} Emissions, µg/m^3

Table A.26. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2010
2	ISRAEL	0,864	2010
3	ITALY	0,864	2010
4	CROATIA	0,848	2010
5	MOROCCO	0,833	2010
6	TUNISIA	0,833	2010
7	SPAIN	0,818	2010
8	LEBANON	0,803	2010
9	CYPRUS	0,773	2010
10	GREECE	0,773	2010
11	TURKEY	0,652	2010
12	ALBANIA	0,606	2010
13	LIBYA	0,197	2010
14	ALGERIA	0,136	2010
15	EGYPT	0,000	2010

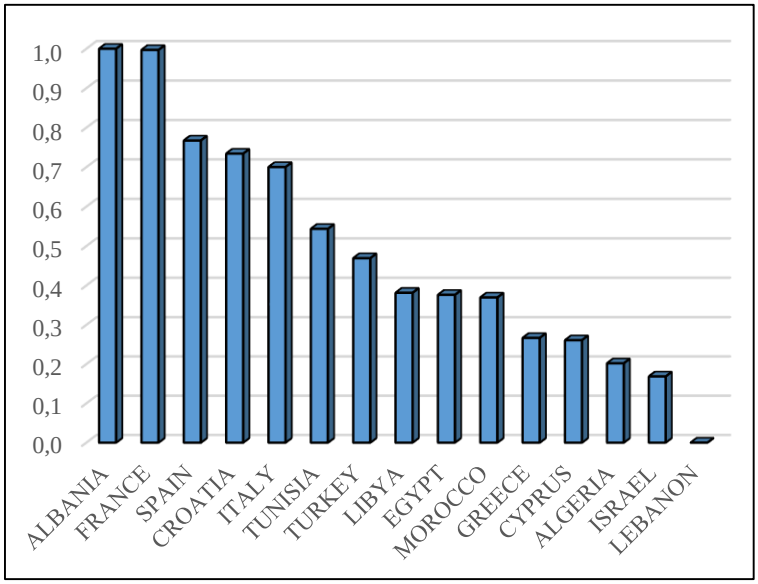


Graph A.26. Plot of the normalized data by country

Total CO_2 Emissions / Total Final Consumption [t CO_2/toe]

Table A.27. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	ALBANIA	1,000	2010
2	FRANCE	0,997	2010
3	SPAIN	0,767	2010
4	CROATIA	0,734	2010
5	ITALY	0,700	2010
6	TUNISIA	0,543	2010
7	TURKEY	0,469	2010
8	LIBYA	0,381	2010
9	EGYPT	0,376	2010
10	MOROCCO	0,369	2010
11	GREECE	0,267	2010
12	CYPRUS	0,261	2010
13	ALGERIA	0,202	2010
14	ISRAEL	0,168	2010
15	LEBANON	0,000	2010

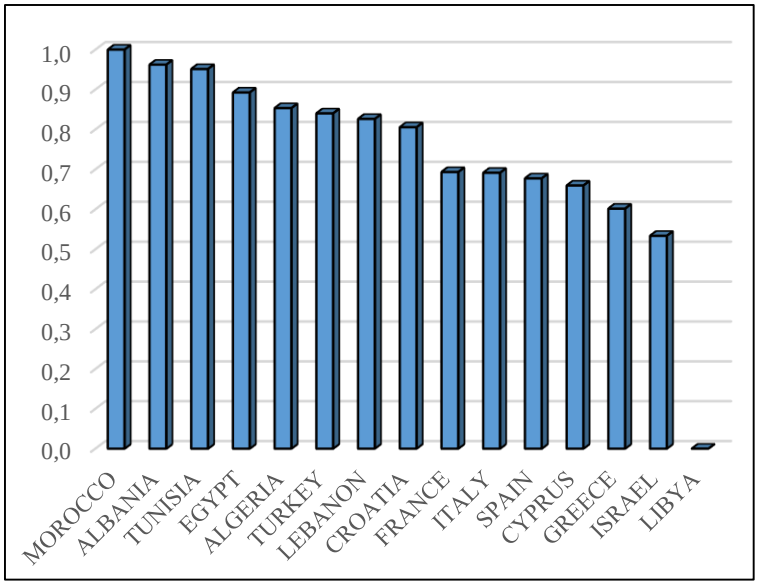


Graph A.27. Plot of the normalized data by country

GHG Emissions, Tons of CO_2 Equivalent per Capita

Table A.28. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	MOROCCO	1,000	2010
2	ALBANIA	0,962	2010
3	TUNISIA	0,951	2010
4	EGYPT	0,893	2010
5	ALGERIA	0,854	2010
6	TURKEY	0,840	2010
7	LEBANON	0,826	2010
8	CROATIA	0,806	2010
9	FRANCE	0,694	2010
10	ITALY	0,692	2010
11	SPAIN	0,678	2010
12	CYPRUS	0,660	2010
13	GREECE	0,602	2010
14	ISRAEL	0,534	2010
15	LIBYA	0,000	2010

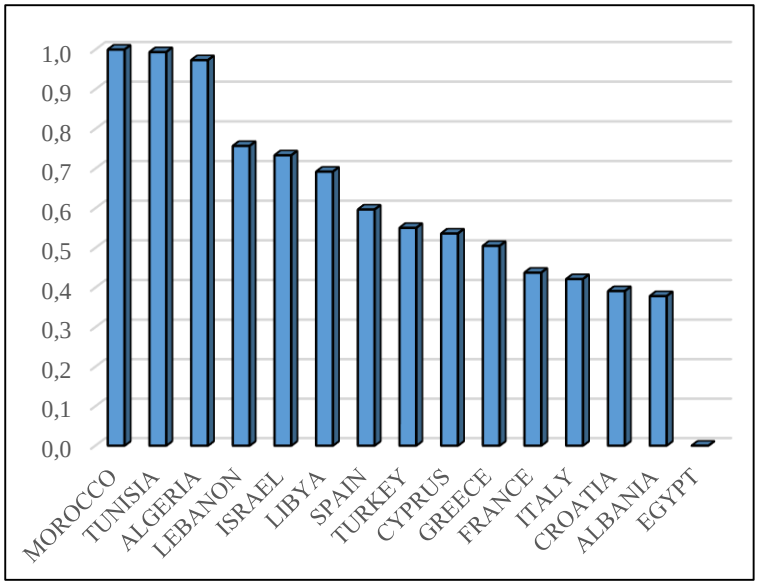


Graph A.28. Plot of the normalized data by country

Human Impact on Water

Table A.29. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	MOROCCO	1,000	2005
2	TUNISIA	0,994	2005
3	ALGERIA	0,973	2005
4	LEBANON	0,757	2005
5	ISRAEL	0,734	2005
6	LIBYA	0,692	2005
7	SPAIN	0,597	2005
8	TURKEY	0,551	2005
9	CYPRUS	0,536	2005
10	GREECE	0,505	2005
11	FRANCE	0,438	2005
12	ITALY	0,421	2005
13	CROATIA	0,391	2005
14	ALBANIA	0,379	2005
15	EGYPT	0,000	2005

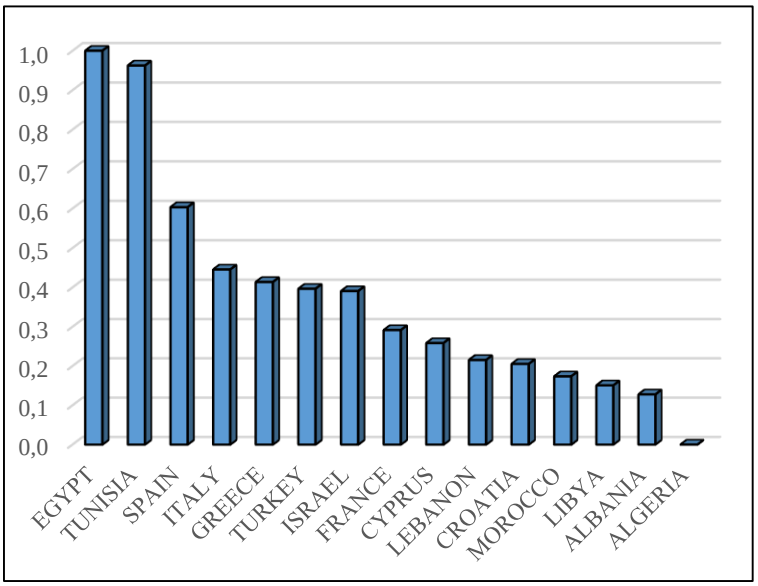


Graph A.29. Plot of the normalized data by country

Change in Forest Area, 1990/2010 (%)

Table A.30. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	EGYPT	1,000	2010
2	TUNISIA	0,963	2010
3	SPAIN	0,603	2010
4	ITALY	0,445	2010
5	GREECE	0,414	2010
6	TURKEY	0,397	2010
7	ISRAEL	0,391	2010
8	FRANCE	0,292	2010
9	CYPRUS	0,259	2010
10	LEBANON	0,216	2010
11	CROATIA	0,205	2010
12	MOROCCO	0,174	2010
13	LIBYA	0,151	2010
14	ALBANIA	0,128	2010
15	ALGERIA	0,000	2010

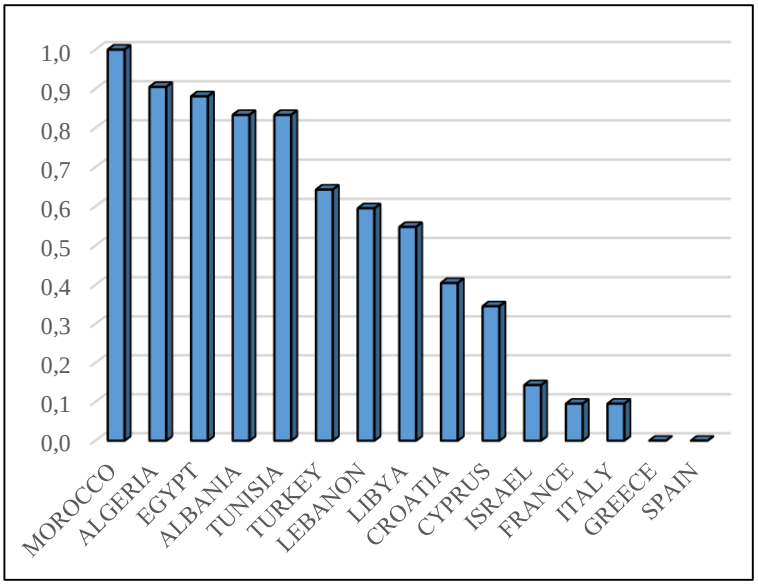


Graph A.30. Plot of the normalized data by country

Ecological Footprint Index

Table A.31. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	MOROCCO	1,000	2007
2	ALGERIA	0,905	2007
3	EGYPT	0,881	2007
4	ALBANIA	0,833	2007
5	TUNISIA	0,833	2007
6	TURKEY	0,643	2007
7	LEBANON	0,595	2007
8	LIBYA	0,548	2007
9	CROATIA	0,405	2007
10	CYPRUS	0,345	2007
11	ISRAEL	0,143	2007
12	FRANCE	0,095	2007
13	ITALY	0,095	2007
14	GREECE	0,000	2007
14	SPAIN	0,000	2007

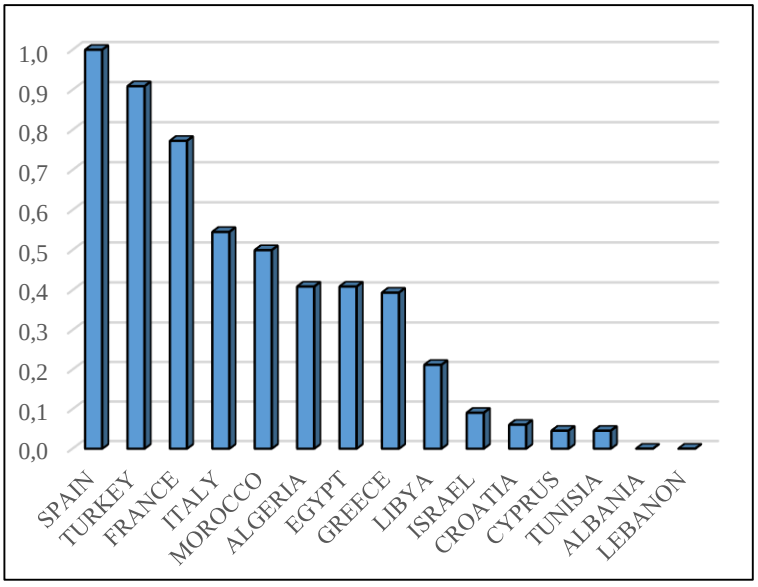


Graph A.31. Plot of the normalized data by country

GEF Benefits Index for Biodiversity

Table A.32. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	SPAIN	1,000	2008
2	TURKEY	0,909	2008
3	FRANCE	0,773	2008
4	ITALY	0,545	2008
5	MOROCCO	0,500	2008
6	ALGERIA	0,409	2008
7	EGYPT	0,409	2008
8	GREECE	0,394	2008
9	LIBYA	0,212	2008
10	ISRAEL	0,091	2008
11	CROATIA	0,061	2008
12	CYPRUS	0,045	2008
13	TUNISIA	0,045	2008
14	ALBANIA	0,000	2008
14	LEBANON	0,000	2008

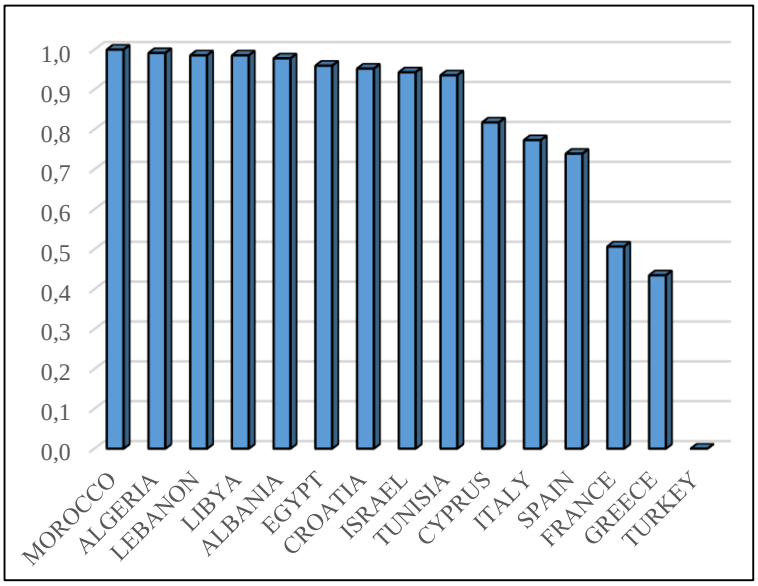


Graph A.32. Plot of the normalized data by country

Amount of Total Waste Produced / Population (tonnes/inh/year)

Table A.33. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	MOROCCO	1,000	2010
2	ALGERIA	0,992	2010
3	LEBANON	0,986	2010
4	LIBYA	0,986	2010
5	ALBANIA	0,978	2010
6	EGYPT	0,960	2009
7	CROATIA	0,952	2010
8	ISRAEL	0,943	2010
9	TUNISIA	0,936	2010
10	CYPRUS	0,818	2010
11	ITALY	0,773	2010
12	SPAIN	0,739	2010
13	FRANCE	0,507	2010
14	GREECE	0,435	2010
15	TURKEY	0,000	2010

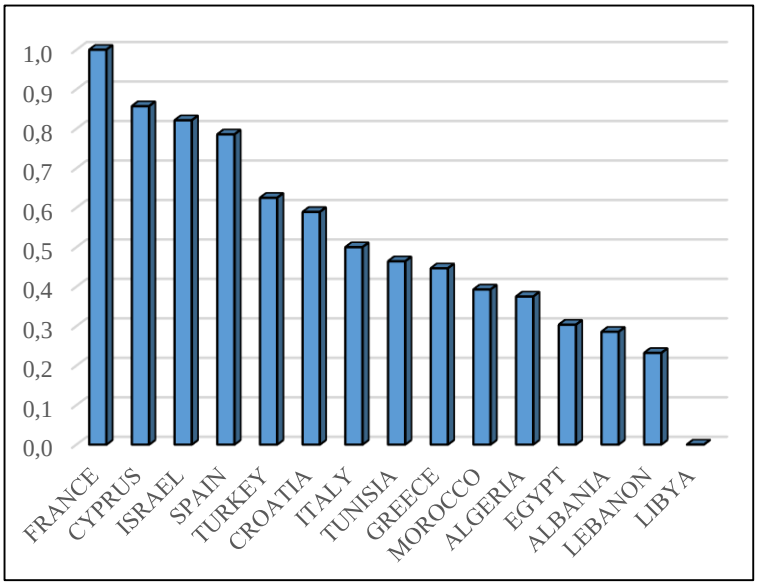


Graph A.33. Plot of the normalized data by country

Corruption Perception Index

Table A.34. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2013
2	CYPRUS	0,857	2013
3	ISRAEL	0,821	2013
4	SPAIN	0,786	2013
5	TURKEY	0,625	2013
6	CROATIA	0,589	2013
7	ITALY	0,500	2013
8	TUNISIA	0,464	2013
9	GREECE	0,446	2013
10	MOROCCO	0,393	2013
11	ALGERIA	0,375	2013
12	EGYPT	0,304	2013
13	ALBANIA	0,286	2013
14	LEBANON	0,232	2013
15	LIBYA	0,000	2013

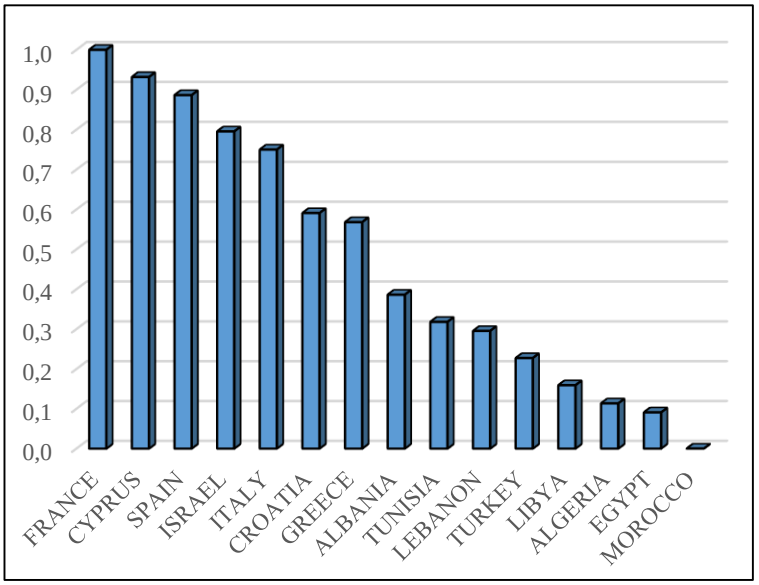


Graph A.34. Plot of the normalized data by country

Press Freedom Index

Table A.35. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	FRANCE	1,000	2013
2	CYPRUS	0,932	2013
3	SPAIN	0,886	2013
4	ISRAEL	0,795	2013
5	ITALY	0,750	2013
6	CROATIA	0,591	2013
7	GREECE	0,568	2013
8	ALBANIA	0,386	2013
9	TUNISIA	0,318	2013
10	LEBANON	0,295	2013
11	TURKEY	0,227	2013
12	LIBYA	0,159	2013
13	ALGERIA	0,114	2013
14	EGYPT	0,091	2013
15	MOROCCO	0,000	2013

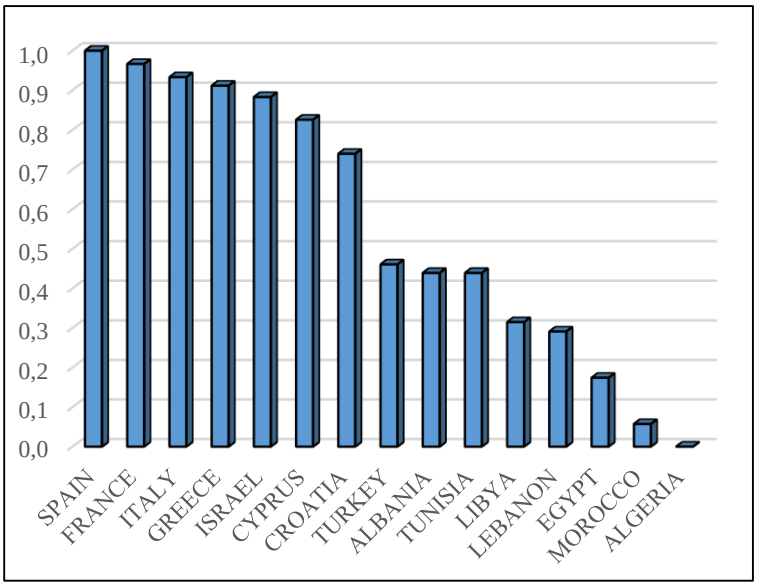


Graph A.35. Plot of the normalized data by country

Democracy Index

Table A.36. Rank by country, normalized data and year of the data

Rank	Country	Normalized Data	Year
1	SPAIN	1,000	2012
2	FRANCE	0,967	2012
3	ITALY	0,933	2012
4	GREECE	0,912	2012
5	ISRAEL	0,883	2012
6	CYPRUS	0,826	2012
7	CROATIA	0,740	2012
8	TURKEY	0,461	2012
9	ALBANIA	0,439	2012
10	TUNISIA	0,439	2012
11	LIBYA	0,315	2012
12	LEBANON	0,291	2012
13	EGYPT	0,174	2012
14	MOROCCO	0,057	2012
15	ALGERIA	0,000	2012



Graph A.36. Plot of the normalized data by country

APPENDIX F

Questionnaire proposed in order to obtain the experts' weights.

It is important to answer referring to your home country.

1) In which Country do you currently live?

2) Choose the ranking among the four dimensions of sustainability, basing on the needs of your Country.

	1	2	3	4
Economic Dimension	○	○	○	○
Social Dimension	○	○	○	○
Environmental Dimension	○	○	○	○
Institutional Dimension	○	○	○	○

ECONOMIC DIMENSION

3) Choose the ranking among these "Economic" aspects - GNI per capita, Long Term Drivers, Vulnerability - for a sustainable development of your Country.

GROSS NATIONAL INCOME (PPP) per capita. LONG TERM DRIVERS: Investment in Research & Development; Public Education Expenditure; Public Health Expenditure; Unemployment Rate; Energy Efficiency. VULNERABILITY: Electricity Share from Renewable Sources; Relative Trade Balance; Energy Imported; Public Debt.

	1	2	3
GNI per capita	○	○	○
Long Term Drivers	○	○	○
Vulnerability	○	○	○

Long Term Drivers

4) Which factor between "Research and Development Expenditure" and "Public Education Expenditure" affects more the sustainable development of your Country?

Very strong importance of Research and Development Expenditure	Strong importance of Research and Development Expenditure	Moderate importance of Research and Development	Equal importance	Moderate importance of Public Education Expenditure	Strong importance of Public Education Expenditure	Very strong importance of Public Education Expenditure
○	○	○	○	○	○	○

5) Which factor between "Research and Development Expenditure" and "Public Health Expenditure" affects more the sustainable development of your Country?

Very strong importance of Research and Development Expenditure	Strong importance of Research and Development Expenditure	Moderate importance of Research and Development Expenditure	Equal importance	Moderate importance of Public Health Expenditure	Strong importance of Public Health Expenditure	Very strong importance of Public Health Expenditure
○	○	○	○	○	○	○

6) Which factor between "Research and Development Expenditure" and "Unemployment Rate" affects more the sustainable development of your Country?

Very strong importance of Research and Development Expenditure	Strong importance of Research and Development Expenditure	Moderate importance of Research and Development Expenditure	Equal importance	Moderate importance of Unemployment Rate	Strong importance of Unemployment Rate	Very strong importance of Unemployment Rate
○	○	○	○	○	○	○

7) Which factor between "Research and Development Expenditure" and "Energy Intensity" affects more the sustainable development of your Country?

*Energy Intensity: is a measure of the energy efficiency of a nation's economy. It is calculated as units of energy per unit of GDP.

Very strong importance of Research and Development Expenditure	Strong importance of Research and Development Expenditure	Moderate importance of Research and Development Expenditure	Equal importance	Moderate importance of Energy Intensity	Strong importance of Energy Intensity	Very strong importance of Energy Intensity
○	○	○	○	○	○	○

8) Which factor between "Public Education Expenditure" and "Public Health Expenditure" affects more the sustainable development of your Country?

Very strong importance of Public Education Expenditure	Strong importance of Public Education Expenditure	Moderate importance of Public Education Expenditure	Equal importance	Moderate importance of Public Health Expenditure	Strong importance of Public Health Expenditure	Very strong importance of Public Health Expenditure
○	○	○	○	○	○	○

9) Which factor between "Public Education Expenditure" and "Unemployment Rate" affects more the sustainable development of your Country?

Very strong importance of Public Education Expenditure	Strong importance of Public Education Expenditure	Moderate importance of Public Education Expenditure	Equal importance	Moderate importance of Unemployment Rate	Strong importance of Unemployment Rate	Very strong importance of Unemployment Rate
○	○	○	○	○	○	○

10) Which factor between "Unemployment Rate" and "Public Health Expenditure" affects more the sustainable development of your Country?

Very strong importance of Unemployment Rate	Strong importance of Unemployment Rate	Moderate importance of Unemployment Rate	Equal importance	Moderate importance of Public Health Expenditure	Strong importance of Public Health Expenditure	Very strong importance of Public Health Expenditure
○	○	○	○	○	○	○

11) Which factor between "Relative Trade Balance" and "Energy Imported" affects more the vulnerability of your Country?

*Relative Trade Balance: difference between Exports and Imports of Goods and Services divided by the sum of Exports and Imports of Goods and Services.

Very strong importance of Relative Trade Balance	Strong importance of Relative Trade Balance	Moderate importance of Relative Trade Balance	Equal importance	Moderate importance of Energy Imported	Strong importance of Energy Imported	Very strong importance of Energy Imported
○	○	○	○	○	○	○

12) Which factor between "Electricity Share from Renewables" and "Energy Imported" affects more the vulnerability of your Country?

Very strong importance of Electricity Share from Renewables	Strong importance of Electricity Share from Renewables	Moderate importance of Electricity Share from Renewables	Equal importance	Moderate importance of Energy Imported	Strong importance of Energy Imported	Very strong importance of Energy Imported
○	○	○	○	○	○	○

13) Which factor between "Relative Trade Balance" and "Public Debt" affects more the vulnerability of your Country?

*Relative Trade Balance: difference between Exports and Imports of Goods and Services divided by the sum of Exports and Imports of Goods and Services.

Very strong importance of Relative Trade Balance	Strong importance of Relative Trade Balance	Moderate importance of Relative Trade Balance	Equal importance	Moderate importance of Public Debt	Strong importance of Public Debt	Very strong importance of Public Debt
○	○	○	○	○	○	○

14) Which factor between "Energy Imported" and "Public Debt" affects more the vulnerability of your Country?

Very strong importance of Energy Imported	Strong importance of Energy Imported	Moderate importance of Energy Imported	Equal importance	Moderate importance of Public Debt	Strong importance of Public Debt	Very strong importance of Public Debt
○	○	○	○	○	○	○

SOCIAL DIMENSION

15) Choose the ranking among these "Social" aspects - Population, Well Being, Accessibility - for a better quality of life in your Country?

POPULATION: Density in the Urban Areas; Gender Inequalities; Richness Distribution. WELL BEING: Education Level; Health; Deaths due to Suicide and Homicide. ACCESSIBILITY: Number of Physicians; Electricity Access; Water Access; Food Security; Coverage of Rail Lines.

	1	2	3
Population	○	○	○
Well Being	○	○	○
Accessibility	○	○	○

Population

16) Which factor between "Urban Population Density" and "Richness Inequality Distribution" affects more the society in your Country?

	Very strong importance of Urban Population Density	Strong importance of Urban Population Density	Moderate importance of Urban Population Density	Equal importance	Moderate importance of Richness Inequality Distribution	Strong importance of Richness Inequality Distribution	Very strong importance of Richness Inequality Distribution
	○	○	○	○	○	○	○

17) Which factor between "Gender Inequalities" and "Richness Inequality Distribution" affects more the social disparity in your Country?

	Very strong importance of Gender Inequalities	Strong importance of Gender Inequalities	Moderate importance of Gender Inequalities	Equal importance	Moderate importance of Richness Inequality Distribution	Strong importance of Richness Inequality Distribution	Very strong importance of Richness Inequality Distribution
	○	○	○	○	○	○	○

Well Being

18) Choose the ranking among these aspects in order to identify the major needs concernig the "Well Being" in your Country.

HEALTH: Life Expectancy; HIV Cases; Obesity & Malnutrition Share.

	1	2	3
Education Level	○	○	○
Health	○	○	○
Deaths due to Suicide, Homicide	○	○	○

19) Which problem between "Suicide Rate" and "Homicide Rate" affects more the people living in your Country?

Very strong importance of Suicide Rate	Strong importance of Suicide Rate	Moderate importance of Suicide Rate	Equal importance	Moderate importance of Homicide Rate	Strong importance of Homicide Rate	Very strong importance of Homicide Rate
○	○	○	○	○	○	○

20) Which issue between "Life Expectancy" and "HIV Cases" affects more the people living in your Country?

Very strong importance of Life Expectancy	Strong importance of Life Expectancy	Moderate importance of Life Expectancy	Equal importance	Moderate importance of HIV Cases	Strong importance of HIV Cases	Very strong importance of HIV Cases
○	○	○	○	○	○	○

21) Which issue between "Life Expectancy" and "Obesity & Malnutrition Share" affects more the people living in your Country?

Very strong importance of Life Expectancy	Strong importance of Life Expectancy	Moderate importance of Life Expectancy	Equal importance	Moderate importance of Obesity & Malnutrition Share	Strong importance of Obesity & Malnutrition Share	Very strong importance of Obesity & Malnutrition Share
○	○	○	○	○	○	○

Accessibility

22) Choose the ranking among these "Accessibility" aspects which your Country should improve to guarantee the main needs of the population.

	1	2	3	4	5
Number of Physicians	○	○	○	○	○
Electricity Access	○	○	○	○	○
Water Source Access	○	○	○	○	○
Food Security	○	○	○	○	○
Coverage of Rail Lines	○	○	○	○	○

ENVIRONMENTAL DIMENSION

23) Choose the ranking among these aspects in order to identify the issues that mainly affect the "Environmental" quality in your Country?

	1	2	3	4	5
Air Pollution	○	○	○	○	○
Water Use	○	○	○	○	○
Land Use	○	○	○	○	○
Biodiversity	○	○	○	○	○
Waste Management	○	○	○	○	○

INSTITUTIONAL DIMENSION

24) Choose the ranking among these "Insitutional" aspects that mainly affect the public sector in your Country.

	1	2	3
Corruption Perception	○	○	○
Press Freedom	○	○	○
Level of Democracy	○	○	○