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Supporting the UN SDGs transition: methodology for sustainability assessment and current worldwide ranking

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Abstract
This analysis lies in the stream of research related to the quantitative assessment of the Sustainable Development Goals (SDGs), adopted by the United Nations at the end of September 2015. We assemble a composite multi-dimensional index and a worldwide ranking of current sustainability. This makes it possible to assess the strengths and weaknesses of today's socio-economic development, as well as environmental criticalities worldwide. The methodology goes through the following steps: screening of indicators capable of addressing the UN's SDGs; data collection from relevant sources; organization into three pillars of sustainability (economy, society, and environment); normalization to a common metrics; aggregation of the 26 indicators into composite indices by pillars as well as in a multi-dimensional index. The final ranking includes 139 countries. Sweden, Norway and Switzerland are at the top of the ranking.

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1 Introduction

In September 2015, the United Nations (UN) adopted the 2030 Agenda for Sustainable Development (UN, 2015), setting 17 Sustainable Development Goals (SDGs). These are aspirational goals to be achieved worldwide by 2030, by means of a global strategy. SDGs, by building upon the Millennium Development Goals[1] (MDGs), aim at meeting the unreached MDG targets and setting broader objectives towards sustainable development. The SDGs, specified in 169 targets, are overarching and go from poverty reduction in all its forms to sustainable economic growth, environmental preservation, and climate mitigation commitments. Unlike MDGs, which guided and monitored the progress of developing countries, SDGs address all countries and are defined to inspire Governments to set their own national targets according to their specific circumstances and capacities. Achieving SDGs implies differentiated challenges for developed and developing countries: the former must stem environmental degradation, while the latter must intensify their socioeconomic development without harming the environment.

The UN defines a multi-level process of "follow-up and review…of progress made in implementing the Goals and targets over the coming 15 years" (UN, 2015), with Governments fulfilling a primary role and a high level political forum overseeing the global picture. Indicators are at the core of this process at all levels: local, national, regional, and global. The Inter-Agency and Expert Group on Sustainable Development Goal Indicators (IEAG), formed in March 2016, supervises the creation of the global indicator framework, by "taking into account existing efforts by different groups of countries and organizations, including regional and international agencies, regional commissions, academia, civil society and other relevant international organizations" (UN IEAG, 2017), while Member States are in charge of developing indicators at local and regional levels.

The current list of indicators[2],adopted in July 2017 by the UN General Assembly, considers 232 indicators (UN, 2017). Despite the complexity of this indicator framework and the issue of data availability worldwide,[3] it is important not to underestimate the importance of an indicator framework as a management tool for helping countries and the global community to measure gaps, highlight criticality, monitor progress, prioritize interventions and allocate resources where they are most needed to converge towards a sustainable development path.

The idea for this paper was inspired by the UN's long-lasting effort to measure and promote Wellbeing and Sustainable Development, and by the more recent debate on SDGs. We analyse current country performances on SDGs by collecting and computing a set of sustainable development indicators for 139 countries. The 26 indicators selected, representative of 15

[1] The Millennium Development Goals (MDGs), included in the United Nations Millennium Declaration adopted in September 2000, are 8 goals to be achieved by 2015; they range from halving extreme poverty to reversing the spread of HIV/AIDS, ensuring universal primary education and eliminating gender disparities in education.

[2] The current list of indicators may still be refined; a plan of revisions is already set and includes "possible annual minor refinements and two comprehensive reviews of the indicator framework" (UN IEAG, 2017).

[3] Following the UN IEAG classification, only 42% of indicators are Tier I, i.e. have "conceptually clear, established methodology and standards available and data regularly produced by countries" (UN IEAG, 2017). The others are not regularly measured by countries (Tier 2) or still at the testing stage (Tier 3). According to Dunning and Kalow (2016), currently only 62% of Tier 1 indicators are publicly accessible.

SDGs, are then grouped according to their pertinence to sustainability pillars (society, environment and economy). Composite measurements of pillar-specific and overall sustainability are thereafter derived, on the assumption that the narrower the gap is from meeting each SDG, the higher are the level of wellbeing achieved by the country and its likelihood of maintaining a sustainable path.

Producing synthetic indices can be very useful for summarizing complex and multi-dimensional data into a single and intuitive value to communicate to policymakers and the general public. Many examples can be found in the literature, despite the scepticism on aggregate indicators:[4] the HDI–Human Development Index (UNDP, 1990); the Wellbeing Index (Prescott-Allen, 2001); GS−Genuine Savings (Hamilton, 2000); GPI − the Genuine Progress Indicator (Cobb et al., 1995); the FEEM SI−FEEM Sustainability Index (Carraro et al. 2016); and the EPI–Environmental Performance Index (Yale and Columbia Universities, 2010). The move from aggregate or pillar-specific measurements of Sustainable Development to the more recent SDG benchmark has, to our knowledge, only one example: the SDG Index (SDSN-Bertelsmann Stiftung, 2017), which is an aggregate measurement of the gap for achieving SDGs, comparable to our methodology. The SDG Index, on its last release, considers 83 indicators and covers 157 countries.[5]

The focus of our SDG monitoring is at the national level. This is a common characteristic of all the cross-country analyses cited above. Data availability and statistical measurements of consistency are important constraints for indicator selection. Global databases (e.g., UN and World Bank sources) guarantee broad country coverage and common guidelines on indicator construction that statistical offices must fulfill. The homogeneity between the indicator definition and computation across countries is at the core of this type of analysis and makes it possible to compare country performances with target achievement. Therefore, our approach is limited to the global perspective of Agenda 2030, and cannot account for countries’ role in defining the national and local SDG indicators that are best suited to track their own progress towards sustainable development. The heterogeneity of country characteristics and priorities will certainly imply huge differences in indicator selection that could enrich a country-specific analysis, but invalidate a cross-country comparison.

This paper produces a snapshot of current country wellbeing and a worldwide ranking by highlighting the degree of effort and progress each country must make to achieve SDGs. The purpose of a ranking is to identify the absolute or topic-specific or area-specific benchmark countries whose example, in terms of topic prioritisation and implemented policies, can help similar lagging countries to improve their wellbeing. A low score in the aggregate wellbeing index should be seen as a wake-up call whose causes can be identified by examining their lesser aggregate indices and specific indicators.

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[4] Aggregating a heterogeneous set of indicators has been questioned by the Commission on the Measurement of Economic Performance and Social Progress (2009) because it implies loss of information and implicit subjectivity in the weighting procedure.

[5] With respect to our analysis the wider country and indicator coverage of SDG Index can be motivated by their decision to compute the SDG Index for countries with missing data on one or more indicators. We adopted a more stringent strategy, dropping from our analysis countries even with a single missing data.

This assessment of current country wellbeing is the first step toward a broader project that aims at envisioning future dynamics of SDG indicators under some reference scenarios and considering different policy interventions for sustainable development (ex-ante sustainability assessment). The ex-ante assessment, which will integrate empirical methods into a macroeconomic model, will be explored in a further paper, but implies some constraints on the present analysis (e.g. the indicator selection).

The structure of the paper is as follows. Section two describes the methodology for data collection. Section three provides a concise overview of the technical aspects of benchmarking and normalization procedures, as well as the aggregation methodology of indicators. Section four presents the main results of the analysis. The concluding section summarizes results and outlines the scope of our future research.

2 Indicator selection, collection and organization

The starting point of our analysis is the set of SDG indicators recommended by the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (UN IEAG, 2017). The indicator selection process has been guided by three main criteria.

The main objective was to cover all the 17 SDGs that will be the aspirational guidance in the 2016–2030 period. Namely, 8 SDGs are represented by a single indicator and 6 (3, 7, 8, 9, 11, 13, 15) by more than one indicator. 2 SDGs cannot be accounted for in our analysis. SDG 5, on gender equality, has only recently started to be monitored by UN Women, and so far data on physical violence inflicted on women have only been available for 100 countries[6] and would affect the results of the analysis by pillar. SDG 17 has also been excluded, as it refers to means of implementation and as such cuts across all three dimensions of sustainability.

Second, the indicators with a limited coverage in terms of cross-country data availability have been excluded from our dashboard. Also countries with few observations for the selected indicators have been dropped. We decided, instead, to include in our analysis countries with a small number of missing indicator values by filling them in with average geographical-area figures when available and reliable (e.g., the WDI database provides mean values for regional aggregates, such as Latin America & the Caribbean and East Asia and the Pacific, which are used to replace the missing data of countries that are part of that specific regional aggregate).

Third, a further screening procedure has been motivated by the wider scope of the project that aims at projecting future indicator trends under a number of scenarios by using a mixed empirical and modelling approach. Thus, we have to exclude indicators that, according to the literature, lack empirical correlation with macro-economic variables output of our model and used as explanatory variables for projecting indicators. At this stage, we also opted for the Palma ratio[7] as a measurement of inequality, instead of the more widely used Gini index (the

[6] UN Women (2013).

[7] The Palma Ratio is "the ratio of the top 10% of population's share of Gross National Income (GNI), divided by the poorest 40% of the population's share of GNI" (Cobham and Sumner 2013).

Palma ratio focusing only on two quantiles of the distribution instead of on the entire distribution and therefore easier to project).

A final consideration refers to the selected panel of indicators. The panel is strongly unbalanced because the frequency of measurement is different across indicators and countries (e.g., developing countries can have detailed data on poverty issues and lack data on environmental matters). We decided not to interpolate the missing data and therefore we focus on the last available years (generally 2013–2014) to get a snapshot of the current level of wellbeing and sustainability.

The final list of 26 indicators considered in the present analysis are reported in Table 1 (column 2), classified by sustainability dimension. The first column reports the code name used in the result section (Section 4). The third column shows the source of the data collection. The last column connects each indicator to its UN SDG.

Table 1. Indicators list, data sources and corresponding SDGs

SDG Indicator	***Definition***	***Source***	***UN GOAL***
SOCIETY			
SDG 1	Population below $1.25 (PPP) per day, percentage	WDI / MDGs	1. End poverty in all its forms everywhere
SDG 2	Undernourished population, percentage	MDGs	2. End hunger, achieve food security and improve nutrition, and promote sustainable agriculture
SDG 3a	Physician density (per 1000 population)	WDI	3. Ensure healthy lives and promote well-being for all at all ages
SDG 3b	Healthy Life Expectancy (HALE) at birth (years)	WHO	
SDG 4	Literacy rate of 15–24 year olds, both sexes, percentage	UNESCO / MDGs	4. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all
SDG 7	Access to electricity (% of total population)	WDI	7. Ensure access to affordable, reliable, sustainable, and modern energy for all
SDG 10	Palma ratio	PovcalNet (WB)	10. Reduce inequality within and among countries
SDG 16	Corruption Perception Index	TI	16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels
ENVIRONMENT			
SDG 6	Proportion of total water resources used	MDGs	6. Ensure availability and sustainable management of water and sanitation for all
SDG 7a	Share of electricity from renewables	WDI	7. Ensure access to affordable, reliable, sustainable, and modern energy for all
SDG 7b	Rate of primary energy intensity	IEA	
SDG 9	Total energy and industry-related GHG emissions over value added	IMF / CAIT	9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG 11a	Mean urban air pollution of particulate matter (PM2.5)	WDI	11. Make cities and human settlements inclusive, safe, resilient and sustainable
SDG 11b	CO_2 intensity of residential sector over energy volumes	IEA	

SDG Indicator	*Definition*	*Source*	*UN GOAL*
ENVIRONMENT			
SDG 13a	Net GHG emissions in the agriculture, forestry and other land use (AFOLU) sectors (weighted by total land)	FAO / WDI	13. Take urgent action to combat climate change and its impacts
SDG 13b	CO_2 intensity of power and transport over energy volumes	IEA	
SDG 14	Proportion of terrestrial and marine protected areas	MDGs	14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
			15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG 15a	Forest area (% of land area)	WDI	
SDG 15b	Share of endangered and vulnerable (animals and plants) species (% of total species)	IUCN	
ECONOMY			
SDG 8a	GDP per capita growth	IMF & WDI	8. Promote Sustained, Inclusive and Sustainable Economic Growth, Full and Productive Employment and Decent Work for All
SDG 8b	GDP per person employed (PPP)	IMF & WDI	
SDG 8c	Public debt as share of GDP	IMF	
SDG 8d	Employment-to-population ratio, percentage	MDGs / ILO	
SDG 9a	Manufacturing value added (MVA) as percent of GDP	WDI	9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG 9b	Gross domestic expenditure on R&D as share of GDP	WDI	
SDG12	Direct Material Consumption over GDP	IMF + GMWD	12. Ensure sustainable consumption and production patterns

Source Acronyms => WDI: World Development Indicators; MDGs: Millennium Development Goals; WHO: World Health Organization; WB: World Bank; TI: Transparency International; IEA: International Energy Agency; IMF: International Monetary Fund; CAIT: WRI Climate Data Explorer; FAO: UN Food and Agriculture Organization; IUCN: International Union for Conservation of Nature; ILO: International Labor Organization; GMWD: SERI/WU Global Material Flows Database.

3 Benchmarking, normalization and aggregation

The main purpose of this paper is to go beyond the single indicators, in order to provide a comprehensive snapshot of country positioning with respect to the achievement of SDGs in 2030. In order to derive synthetic measurements of sustainability, two main steps must be undertaken: benchmarking and a normalization procedure that brings all the selected indicators (Table 1) to the same measurement unit and aggregation that convert the normalized indicators into synthetic figures.

3.1 Benchmarking and normalization

In this work we do not use common techniques to normalize data (such as min-max, z-score, quantile, etc.), but, instead, we build an indicator-specific stepwise benchmarking function whose values are established according to either policy targets or observed trends. The upper and lower bounds (or benchmarks) of this function correspond, depending on the polarity of the indicator, to *fully sustainable* and *unsustainable* conditions. This approach gives us a way not only to compare countries, but, also and more importantly, to assess the level of sustainability of each elementary indicator, of each pillar and of the composite one; moreover, it provides a way to monitor over time the countries' progress towards sustainability.

Defining the benchmarks for all indicators is a hard task and possibly the most critical of the present analysis; however, whenever possible, the quantitative targets outlined in the 2030 Agenda for Sustainable Development (UN, 2015) are used to define the fully sustainable condition. When SDGs do not provide a quantifiable target, EU policies are used as benchmark: e.g. 3% of Gross Domestic Expenditure on R&D over GDP from the Europe 2020 strategy (EC, 2010). In all other cases, the average indicator score of the 5% top (or bottom) performers is used as a fully sustainable (or unsustainable) benchmark.

Apart from upper and lower benchmarks, indicators can be split into two main categories according to their: a) positive polarity/direction (*i.e.* the higher the score of a country, the higher the country's performance); b) negative polarity/direction (*i.e.* the higher the score of a country, the lower the country's performance). As a consequence, the normalization procedure required for transforming the raw data into a common [0,1] scale is different and specific for the two cases.

For indicators belonging to the a) category, a country is defined as fully *unsustainable* whenever its score is below a critical threshold value $\underline{x}$, whereas it is defined as fully *sustainable* whenever its score is above the threshold value $\overline{x}$. Indicators belonging to the b) category have the opposite normalization process. In both cases, the linear interpolation between these two threshold values represents all the non-polar cases.

Equations below depict the normalization method used for indicators belonging to the a) and b) category, respectively.

$$a) \quad f_a(x) = \begin{cases} 1 & x \geq \overline{x} \\ 0 & x \leq \underline{x} \\ \dfrac{(x-\underline{x})}{(\overline{x}-\underline{x})} & \underline{x} \leq x \leq \overline{x} \end{cases}$$

$$b) \quad f_b(x) = \begin{cases} 1 & x \leq \overline{x} \\ 0 & x \geq \underline{x} \\ \dfrac{(x-\underline{x})}{(\overline{x}-\underline{x})} & \overline{x} \leq x \leq \underline{x} \end{cases}$$

Table 2 reports the threshold values used for each indicator in the social, environmental and economic dimension.

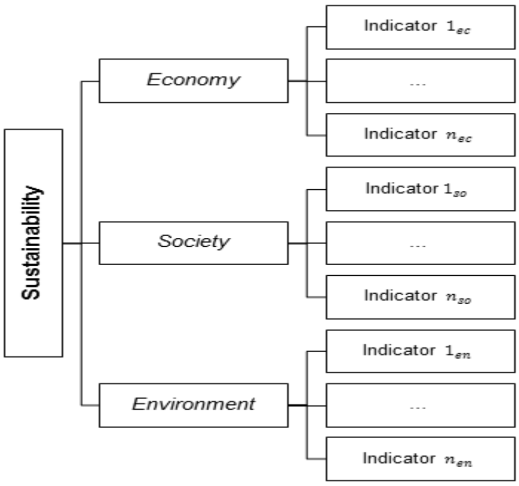
Table 2. Benchmarking category and values by indicator

SDG Indicator	***Type***	$\underline{x}$	$\overline{x}$
SOCIETY			
Population below $1.25 (PPP) per day, percentage	*b*	40	0.5
Population undernourished, percentage	*b*	*20*	5
Physician density (per 1000 population)	*a*	2	3
Healthy Life Expectancy (HALE) at birth (years)	*a*	55	70
Literacy rate of 15–24 years old, both sexes, percentage	*a*	85	99
Access to electricity (% of total population)	*a*	5	99
Palma ratio	*b*	2	1.2
Corruption Perception Index	*a*	3	6
ENVIRONMENT			
Proportion of total water resources used	*b*	30	5
Share of electricity from renewables	*a*	5	60
Rate of primary energy intensity	*b*	*10*	*3*
Total energy and industry-related GHG emissions over value added	*b*	*2*	*1*
Mean urban air pollution of particulate matter (PM2.5)	*b*	*25*	*5*
CO_2 intensity of residential sector over energy volumes	*b*	*3*	*0*
Net GHG emissions in the AFOLU sector over total surface	*b*	*3*	*2*
CO_2 intensity of power and transport over energy volumes	*b*	*3*	*0*
Proportion of terrestrial and marine protected areas	*a*	*5*	*20*
Forest area (% of land area)	*a*	*10*	*50*
Share of endangered and vulnerable (animals & plants) species (% of total species)	*b*	10	5
ECONOMY			
GDP per capita growth	*a*	0	7
GDP per person employed (PPP)	*a*	5	50
Public debt as share of GDP	*b*	70	20
Employment-to-population ratio, percentage	*a*	40	80
Manufacturing value added (MVA) as percent of GDP	*a*	5	15
Gross domestic expenditure on R&D as share of GDP	*a*	0.5	3
Direct Material Consumption over GDP	*a*	0.5	2

3.2 Aggregation

In order to derive a multi-dimensional composite index of sustainability, we adopt a two-level nested approach (Figure 1). In the first level (right) the elementary indicators have been

Figure 1. Overall Composite Index structure



aggregated additively by means of an arithmetic mean. In the second level, hence among sustainability dimensions (Economy, Society and Environment), the composite index has been computed non additively by means of *Fuzzy measures* and the *Choquet* integral (Ishii and Sugeno (1985), Grabisch et al. (1995), Grabisch (1996), Grabisch and Roubens (2000), Marichal (2000a, b, 2004, 2007), Marichal and Roubens (2000), Meyer and Roubens (2005). This is a brilliant approach, able to relax the preferential independence among indicators assumption (common to many composite indices) and hence to model potential interactions (ranging from redundancies to synergies) that may exist among indicators. This paper relies on some of the results of Farnia and Giove (2015) and Carraro et al. (2016). More specifically, we use the elicited preferences of 23 international experts for weighting the main node of the decision tree, where the three dimensions of sustainability (*Economy*, *Society*, and *Environment*) are taken into account.

Given that fuzzy measures are difficult to be interpreted, several behavioral indices have been proposed to summarize and describe them. The indices reported in this paper are the two most popular ones: the Shapley value and the Interaction index (Murofushi and Soneda 1993; Grabisch 1997; Marichal 2000a, 2000b). The Shapley value is a measurement (on the [0, 1] scale) of the relative importance of a dimension but taking into account all the marginal gains that may exist and considering jointly other criteria too. The interaction index of two dimensions (represented on the [–1, +1] scale) is the degree of substitutability (–1) or complementarity (+1) between them. Table 3 reports the relative importance (after the fusion of experts' opinions) of the three pillars of sustainability in terms of the Shapley index. The result is that *Society* is the most relevant pillar (38.60%) followed by *Environment* (35.70%). *Economy* accounts for only 25.70%, showing lower relative importance. This outcome may reflect a predisposition of the panel to give greater importance to other challenges besides economic ones, hence contrasting with the still predominant idea that a good performance in economic indicators, such GDP, is sufficient to guarantee high levels of wellbeing and future sustainability. Table 4 shows the interaction index for each coalition that can be formed by the

Table 3 – Shapley Value for each pillar of sustainability

Pillar	***Shapley Value***
Society	38.60%
Environment	35.70%
Economy	25.70%

Table 4 – Interaction index for each coalition of pillars

Coalition	**Interaction Index**
Environment – Society	0.29
Environment – Economy	0.03
Society – Economy	0.14

three pillars; the result is closer to the concept of strong sustainability than weak sustainability (Solow (1993), Pearce and Atkinson (1993)), especially for the coalition formed by the environmental and social pillars.

Table 5 reports the Möbius representations of fuzzy measures that describe the previous results.[8] Given the set $N = \{Env, Soc, Eco\}$ and the Möbius representation of fuzzy measures $m\{T\}$ attached to the set $T \subseteq N$, the Choquet Integral of country j, given its performance in pillars $X_j = (x_{Env}, x_{Soc}, x_{Eco})$, is computed as:

$$C_j(x_{Env}, x_{Soc}, x_{Eco}) = \sum_{T \subseteq N} m\{T\} \bigwedge_{i \in T} x_{ji}$$

where $\wedge$ is the minimum operator.

Table 5 – Möbius representation of fuzzy measures elicited

Möbius	***Value***
$m\{Env\}$	0.196
$m\{Soc\}$	0.168
$m\{Eco\}$	0.172
$m\{Env, Soc\}$	0.294
$m\{Env, Eco\}$	0.027
$m\{Soc, Eco\}$	0.142

8 A 2-additive model has been considered (Grabish, 1997).

4 Assessing SDGs

In this section, we make a snapshot of the current level of sustainability worldwide by dimension. An in-depth analysis is made for several countries to highlight the contribution of the different indicators to the performance for each dimension of sustainability. Then, we move on to assess the overall sustainability level from a global perspective and with some country examples.

4.1 The economic dimension

The economic map (Figure 2) shows that South Korea[9], Central and Northern Europe (Sweden, Switzerland, Denmark and Germany), the United States and Japan perform well economically. The worst performers are to be found in Africa and in Latin America. The unexpected green spot in Central Africa is the Democratic Republic of the Congo (ranking 11th in the economic pillar), which is characterized by a high per capita GDP growth, a low share of public debt over GDP, a high material productivity and a share of value added in the manufacturing sector.

In Figure 3, we compare the performance of the three highest and lowest performers by looking at the normalized value of the indicators in the economic pillar (described in Table 2). The top performers in economic sustainability are South Korea (1st), Sweden (2nd) and Switzerland (3rd). South Korea outperforms the other two countries because of its higher per capita economic growth (2.9% compared to Sweden's 1.3% and Switzerland's 0.8%) and because of its lower public debt/GDP share (35.7% compared to Sweden's 41.5% and Switzerland's 46.1%). Switzerland's higher employment-to-population ratio (65.2% compared to Korea's 59.1% and Sweden's 58.9%) is insufficient to compensate for its lower performance in per capita economic growth (Figure 3, left).

Figure 3 (right) shows a much different result for the lowest performers: Guinea-Bissau, Gambia and Sudan. The normalized indicator values are all close to zero in these three countries, with the exception of Gambia's employment-to-population ratio (72%) and Guinea-Bissau's (68.1%). Interestingly, with respect to this indicator the two countries perform better than the three top ones on the left-hand graph; this may be explained by the lower healthy life expectancy at birth, which enables fewer people to "enjoy" retirement age. Sudan is the worst performer, with low scores in per capita economic growth (1%), GDP per those employed (8.5 1000$PPP), employment-to-population ratio (45.4%), share of value added in the manufacturing sector (7.8%), share of R&D expenditure over GDP (0.5%) and material productivity (0.5 ml$PPP/tonnes), as well as high public debt share over GDP (74.2%).

9 Since not all of the social indicators were available for South Korea, it is not part of the final ranking of the overall composite index, but only of the economic and environmental pillar rankings.

Figure 2. Country performance in the Economic pillar (0 fully unsustainable, 1 fully sustainable)

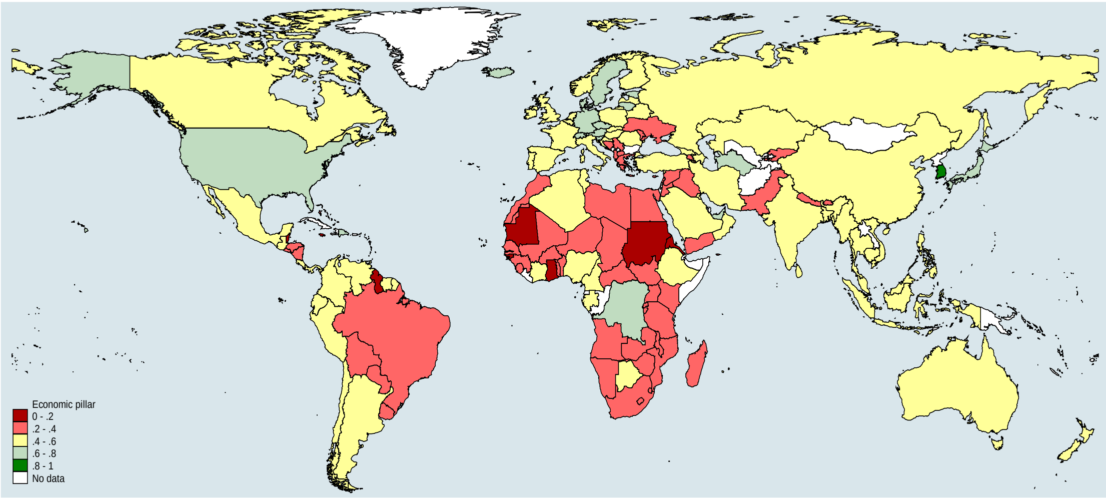


Figure 3. Performance in the economic pillar by normalized indicator, top(a) and bottom (b) performers

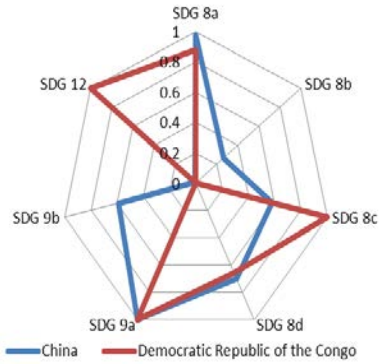
a) b)

The economic pillar ranking shows some surprising results, such as the above-mentioned good performance of the Democratic Republic of the Congo (ranking 11th), which outperforms rapidly growing China (ranking 22nd). Figure 4 helps clarify the reasons behind this result. Both China and the Democratic Republic of the Congo have a rapid growth rate (6.8% and 6.1%, respectively), have a good score on employment-to-population ratio (68% and 66%, respectively) and a high share of their value added comes from the manufacturing sector (30% and 20%, respectively); China surpasses the Democratic Republic of the Congo in terms of GDP per employed (17 versus 1.1 1000$PPP, respectively) and largely on R&D expenditure share (2% versus 0.13%), but the latter is completely sustainable in terms of public debt/GDP share (20% compared to China's 41%) and material productivity (4.57 versus China's 0.52 ml$PPP/tonnes).

The indicator of material productivity, whose results show such a large divergence between China and the Democratic Republic of the Congo, is commonly used to summarize the intensive use of resources and the value added they are generating; but it has to be taken with caution in the case of the Democratic Republic of the Congo and other developing countries, whose low material productivity is due to an underdeveloped sector for raw materials transformation (i.e.

low domestic consumption of these materials) and a high reliance on revenues from raw materials exports.

Figure 4. Performance in the economic pillar by normalized indicator, China vs. the Democratic Republic of the Kongo



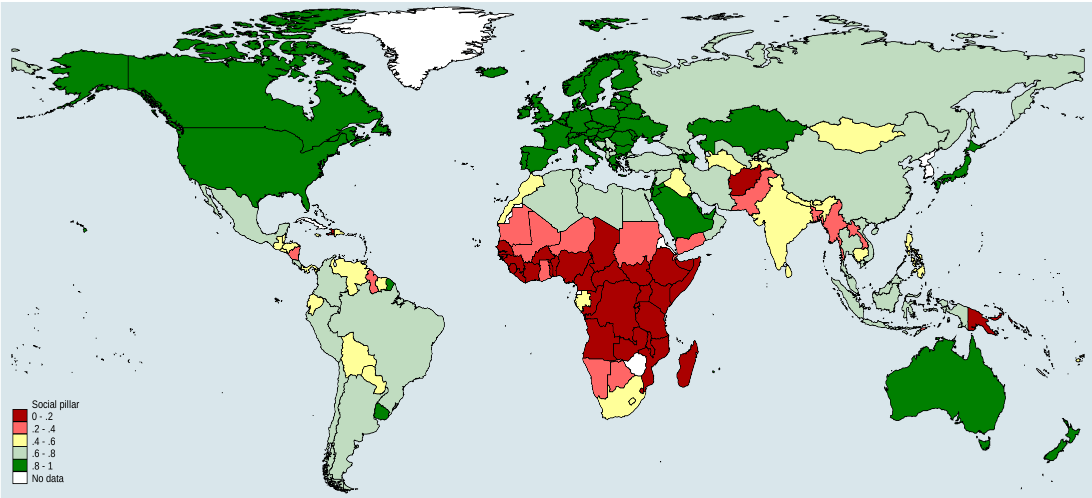
4.2 The social dimension

The feature for catalyzing attention and facilitating the comparison that is appropriate for to aggregating indexes is particularly evident when we consider social sustainability. Figure 5 highlights the high vulnerability of the Sub-Saharan African area and, to a lesser extent, Southern Asia, with reference to the social pillar, and a good sustainability level in Europe, the United States and Oceania. Interestingly, some areas that in Figure 2 are characterized by a good level of economic sustainability are highlighted on this map as high risk in the social pillar, e.g. the Democratic Republic of the Congo, which ranks 163rd (out of 165 countries) in terms of social sustainability.

The three best performers in the social pillar are France, Iceland and Germany, which reach the highest sustainability level in all the social indicators. At the bottom positions of the social pillar we find the Democratic Republic of the Congo, Chad and the Central African Republic, which are close to the total unsustainable levels across all indicators. Rather than focusing on the highest and lowest performers, it is more interesting to make a graph analysis that compares two Middle Eastern countries, such as Qatar and Saudi Arabia, to European and North American countries.

Looking at Figure 6 (a), we see that Qatar, the UK and Greece have similar performances with regard to the prevalence of poverty (1.7%, 1.1% and 1.4%, respectively), healthy life expectancy at birth (68, 71 and 71, respectively), literacy rate (99%) and access to reliable electricity (slightly lower in Qatar, 94%, while 100% for the others). The higher ranking of Qatar as compared to the UK is determined by a higher physician density (respectively. 7.7 versus 2.8 doctors per every 1000 persons) and a lower Palma ratio (1.5 in Qatar and 1.7 in the UK). Overall, this result has to be judged carefully. On the one hand, it is worth noting that the

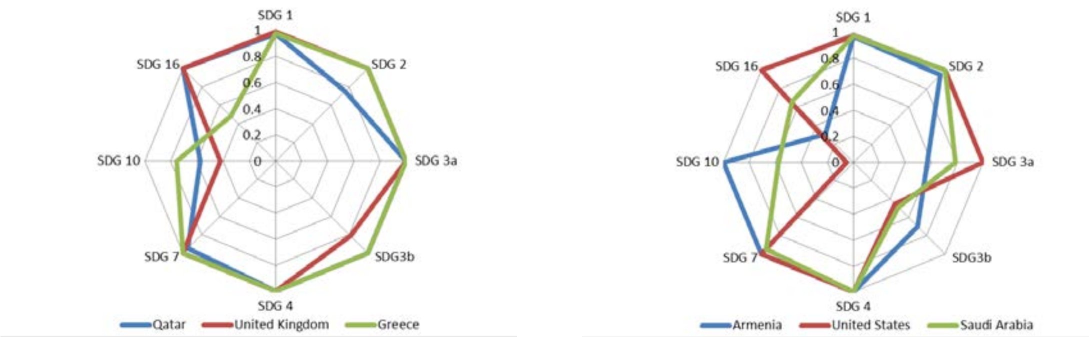
Figure 5. Country performance in the social pillar (0 fully unsustainable, 1 fully sustainable)



indicator chosen to represent the quality of the health system does not account directly for the access of a population to health services, and may reveal inefficiencies. On the other hand, in regard to the Palma ratio, the missing data for Qatar has been replaced with the average Palma ratio in the Arab world (UNDP, 2015). The ranking of Greece after the UK in the social pillar is certainly a more reliable result, and it is due to its low performance in the CPI (4.3 in Greece and 7.8 in the UK). Its better performance for the Palma ratio (1.4 versus 1.7 in UK) is insufficient to compensate for this.

Figure 6 (b) compares a group of countries – Armenia, the United States and Saudi Arabia – that, while very different from each other, are close in ranking in our social pillar, with similar results in the prevalence of poverty and malnutrition, literacy rate and access to electricity. However, the indicator determining the drop of the United States to 47th place in social sustainability is its high Palma ratio (2 versus 1.1 in Armenia) and lower physician density (2.5 compared to 2.7 doctors per every 1000 persons).

Figure 6. Performance in the social pillar by normalized indicator: from the 25th to 27th rank (b) and from the 46th to 48th rank (a)



a) b)

4.3 The environmental dimension

Mapping performance in environmental sustainability (Figure 7) helps us to ascertain that environmental degradation and exploitation is more heterogeneous within each continent. In fact, it is more linked to the development level as well as the degree of awareness of and concern for environmental risks. Overall, Northern European, Sub-Saharan African and Latin American countries are among the top performers, while South Asian, North African and Middle Eastern countries are at the bottom of the ranking.

Figure 8 enables us to compare the performance of the top three and lowest three countries for each environmental indicator considered. Latvia, the first country in the ranking, is completely sustainable in regard to water use (1.1%), has a very low level of CO_2 intensity in the residential sector (0.3 ktonsCO_2/ktoe) and in the power and transport sector (2 ktonsCO_2/ktoe), negative GHG emissions from AFOLU (–0.2 ktonsCO_2e/Km^2), a high share of forest area (54%) and a low percentage of endangered species (3%). Sweden slightly outperforms Latvia in terms of GHG emissions over value added in the industrial sector (respectively 0.46 versus 1.13 MtCO2e / billion$2011PPP) and a lower PM2.5 concentration (respectively 6 versus 9 mg/m^3), but shows a lower share of protected areas as compared to Latvia (respectively 13% versus 17%). The Congo’s third-place ranking is mainly due to higher CO_2 intensity in the power and transport sector (2.6 ktonsCO_2/ktoe) and PM2.5 concentration (14 mg/m^3).

Figure 8 (b) explains the reasons behind the low performance of the three lowest-ranking countries. The score in most of the environmental indicators is close to zero for South Africa, Uzbekistan and Syria. The three countries perform equally well only in SDG13a, having an insignificant amount of GHGs emissions from AFOLU. Furthermore, Uzbekistan and Syria have an average CO_2 intensity level in the power and transport sector (respectively 2.4 and 2.6 ktonsCO_2/ktoe) and South Africa has an above average performance in the indicator of PM2.5 concentration (7.8 mg/m^3).

Figure 7. Country performance in the Environmental Pillar (0 fully unsustainable, 1 fully sustainable)

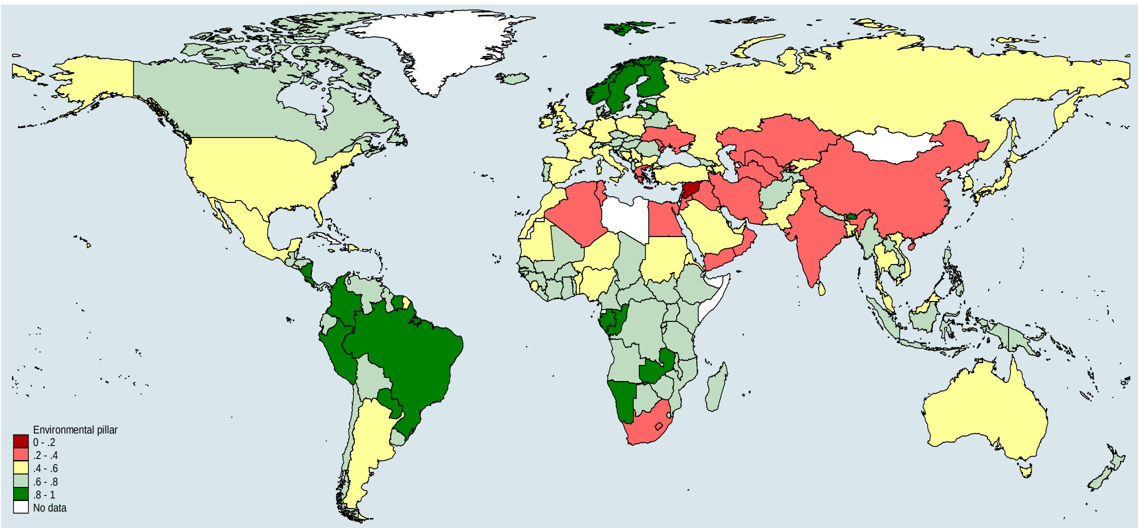
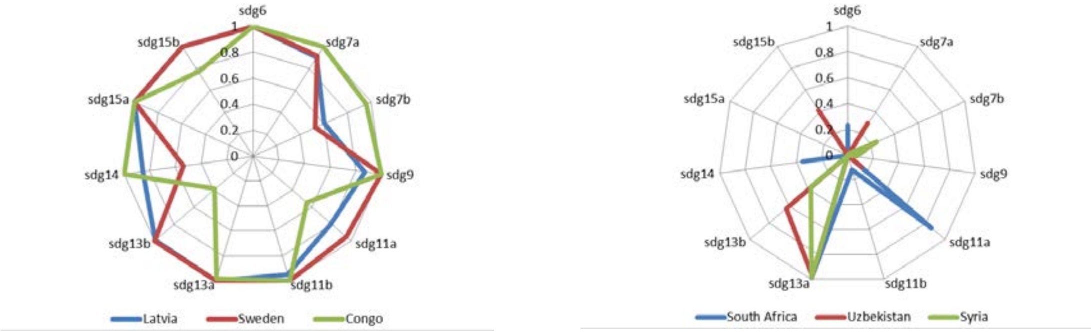


Figure 8. Performance by environmental indicators (normalized), high (a) and low (b) performers



a) b)

4.4 The multi-dimensional composite index of sustainability

The final step of our analysis leads to a multi-dimensional composite index of sustainability. As opposed to the pillar-specific indices described above, there is, in this case, a further aggregation step with the application of the *Choquet* Integral differentiating weights for the various dimensions based on experts' elicitation.

The map below (Figure 9) reports the aggregate sustainability covering 139 countries across the world. The only country in the world that is close to a fully sustainable performance is Sweden. 9 out of 10 top scorers are from Europe, with Norway and Switzerland respectively in 2nd and 3rd place. Slovenia is the only Mediterranean country (10th), while it is worth mentioning the good situation in the Baltic region, with Latvia (4th) and Lithuania (8th). The only non-European country in the top 10 is New Zealand, ranked 9th and lagging behind somewhat, especially in the environmental and economic pillars. The most industrialized countries in Europe rank between 15th and 35th, highlighting the linkages to environmental drawbacks. Other countries worth mentioning are Japan (44th), Russia (45th), the USA (52nd), China (80th) and India (102nd).

The bottom ten counties in the ranking belong to Sub-Saharan Africa: the Comoros, the Central African Republic and Chad, ranking, respectively 137th, 138th and 139th, show huge gaps, especially in the social pillar, balanced out only partially by their performance in the environmental pillar (lower levels of industrialization are linked to less damage for the environment). The first non-Sub Saharan country near the bottom is Syria, ranking 122nd. The Annex I (Table AI 1) reports the overall ranking and the score by pillar for the 139 countries considered in our analysis.[10] The sensitivity analysis for the composite index and the ranking robustness can be found in Annex II (Table AII 1).

[10] For some countries, we were able to compute the pillar-specific score, but not the multi-dimensional index score because one or more sustainability dimensions were missing (e.g. in case of Mongolia, we can compute the score for the social pillar, but not for the economic and the environmental ones, and therefore the multi-dimensional composite index of Sustainability) .

Figure 9. Country performance in the multi-dimensional composite index of sustainability (0 fully unsustainable, 1 fully sustainable)

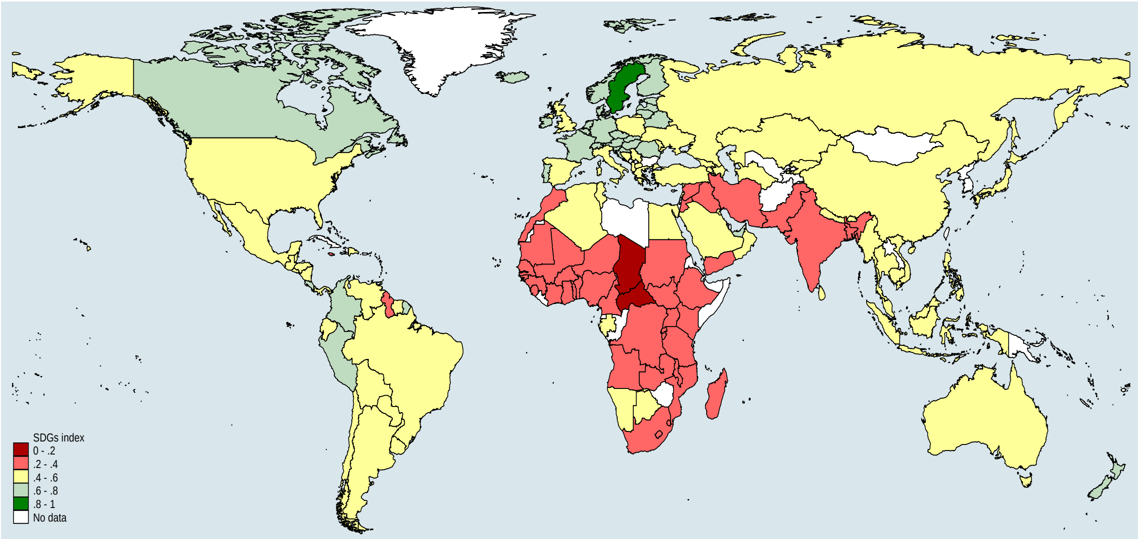
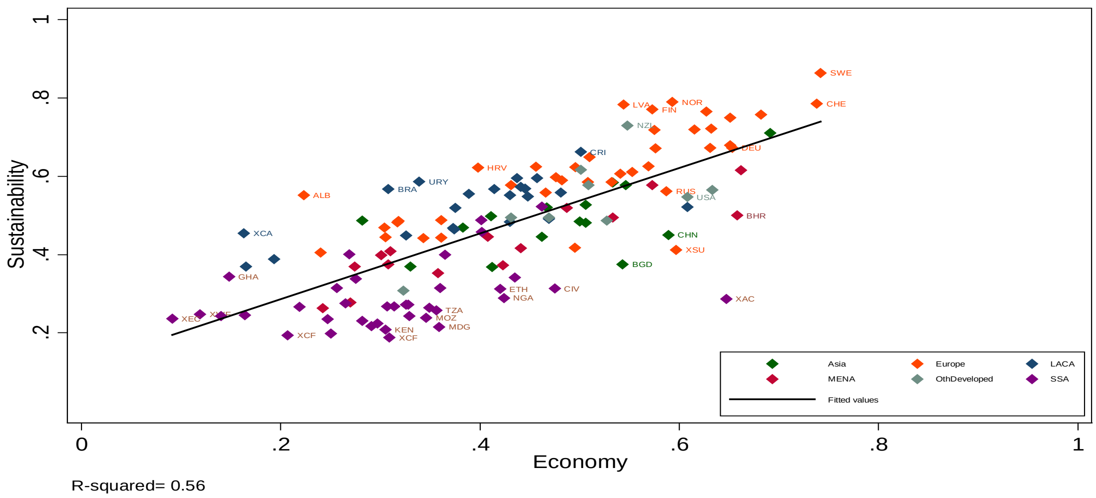


Figure 10 provides another graph illustration of sustainability, connecting overall sustainability (vertical axis) with the economic pillar (horizontal axis).[11] There emerges a positive correlation between the two, but, in line with SDG ambitions, the performance in the economic pillar explains only 56% of the overall level of sustainability. Social and economic indicators boost the sustainability score (countries above the regression line) or depress it (countries below the regression line).

Figure 10. Economic pillar and sustainability

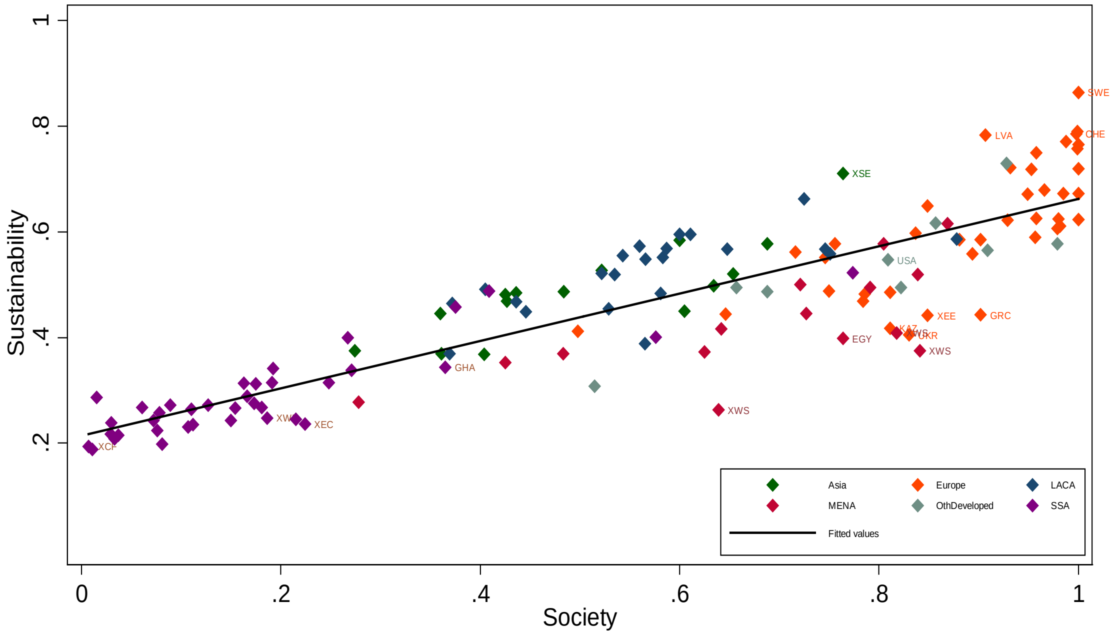


11 To enable a clear reading of the graph, country codes are provided for few countries that have the highest distance from the regression line or that are specifically mentioned in the text.

Other interesting information emerges from Figure 10 and the regional clustering. Sub-Saharan Africa (SSA) is located at the bottom-left, which denotes a lag in both the economic and the sustainability dimensions, with the exception of the Democratic Republic of the Congo for the former, and Mauritius and Cape Verde for the latter (thanks to their environmental integrity). The Middle East and North Africa (MENA) are slightly better in terms of sustainability, while sharing a similar economic pattern. Asia improves upon MENA in both respects. Latin America (LACA) is on the same level of sustainability as Asia, with a reduced economic performance but benefiting from lower environmental deterioration. Non-European developed countries (OthDeveloped) share similar economic scores but differentiated levels of sustainability. Finally, Europe occupies the top-right part of the picture, which shows that there is still much to do before becoming fully sustainable, even if we look only at the economic dimension.

Figure 11 highlights the positive correlation between sustainability and the social pillar, with the latter explaining 76% of sustainability performance[12]. Here the regional clustering is even more evident: SSA is lagging behind, Asia and LACA occupy the central part of the distribution, MENA, despite the above-average score in the social pillar, is strongly conditioned in its sustainability performance by the other pillars, and the developed countries (non-EU and EU) obtain the highest level of social sustainability.

Figure 11. Social pillar and sustainability

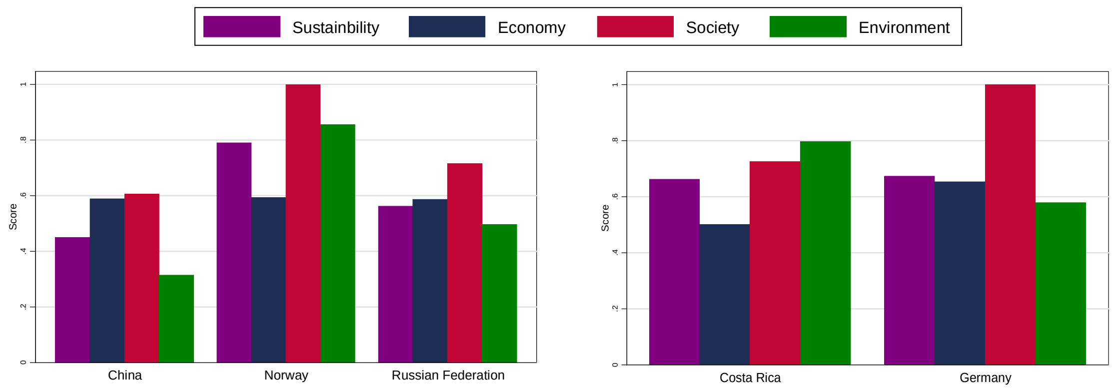


R-squared= 0.76

12 The environmental dimension has a close to zero explanatory power on the overall sustainability performance; therefore we decided not to report the graph.

Furthermore, it is important to highlight similarities and divergences between countries in different parts of the world by looking at the different components of sustainability. For example, it can be interesting to take a more in-depth look at what produces differences in sustainability for countries having the same level of economic performance in Figure 10. This is the case, for instance, for Norway (NOR), Russia (RUS) and China (CHN), which occupy the same column in the above picture, but on different rows. Figure 12 (left) helps explain the reason for this. There is a marked difference of ranking between the three countries in the other dimensions, with Norway outperforming Russia and, in turn, Russia surpassing China in both the social and environmental dimensions. Our analysis can go the other way around to explain the different compositions for an equal level of sustainability, as for Costa Rica (CRI) and Germany (DEU), with the former having a higher score in the environmental dimension and the latter having a higher score in the social and economic component (Figure 12, right).

Figure 12. Selected country performance in the index of sustainability and by pillar for similar economic (left) and sustainability (right) scores



5 Conclusions

This paper describes the methodological steps and reports the main results of a new assessment of worldwide sustainability. The novelty of this work lies in its effort to organize the data collected for 26 indicators and 139 countries covering almost all the 17 UN SDGs, in order to provide a comprehensive measurement of sustainability for its three dimensions, as well as a multi-dimensional index internalizing the global aspirations of SDGs. This latter index, which has enabled us to compute a world sustainability ranking, applies a non-linear aggregation method based on the Choquet Integral.

According to our analysis, best performances in terms of sustainability occur in Europe, due to its economic and social development. Some industrialized countries, however, are penalized by environmental degradation, which negatively affects their sustainability. The environmental pillar is the only dimension in which poor countries outperform rich ones, given their early stage of industrialization, especially in Sub-Saharan Africa. Our analysis allows for both a graph and an in-depth numerical assessment of similarities/divergences between countries in a specific geographical-area or at different stages of development.

The multi-dimensional composite index of Sustainability aims at effectively informing policymakers and the general public about country-specific performances in SDGs, which can be rephrased as their current wellbeing and future sustainability perspectives. Despite the effort to cover as many dimensions and indicators as possible, the current data availability worldwide restricted our analyses to 26 indicators. The UN's SDG process of goal and measurement definition follow-up and review, will hopefully extend the coverage of the UN's IEAG indicators. This will enable us to produce more informative future assessments. The UN's IEAG will also play a key role in helping countries to set and measure the national and local goals that will define country-specific sustainability. Regarding this point, our framework can certainly be applied to more detailed analysis at the country level.

Despite the controversies about using multidimensional aggregate indicators, we think that a synthetic measurement of sustainability can be a useful tool for making a rough assessment of a country's wellbeing, especially over time, and in particular, when an SDG-specific policy is implemented and it becomes necessary to understand the overall effect of the policy on other SDGs. Nevertheless, an aggregate result is a pretext for investigating the reasons that have determined it. Therefore, interesting insights and policy recommendations arise by looking at lesser aggregate indices (pillars) and to single indicators. Similar reasoning characterizes the practice of ranking countries according to their sustainability score. The ranking proximity and the motives for this result can inspire countries that lag behind to implement policies similar to those applied in countries with analogous characteristics and higher sustainability scores.

This paper constitutes the first part of a broader project. Current wellbeing, analyzed in this paper, is the starting point for producing a future sustainability assessment based on empirical analyses of historical data and a macro-economic model integrated with social and environmental dimensions. The ultimate purpose is to evaluate the extent to which the world will be able to move towards sustainability by 2030, greening the economy in developed countries, and guiding developing countries towards highly-inclusive economic growth with low pollution. In addition, the model-based analysis will deliver information on the costs and the effectiveness of policies necessary to follow a sustainable development path.

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Annex I

Table AI 1– Countries' performance in the sustainable, economic, social and environmental dimension.

Rank	Country	Multi-dimensional Sustainability	Economy	Society	Environment
1	Sweden	0.86	0.74	1.00	0.90
2	Norway	0.79	0.59	1.00	0.86
3	Switzerland	0.79	0.74	1.00	0.75
4	Latvia	0.78	0.54	0.91	0.91
5	Finland	0.77	0.57	0.99	0.83
6	Austria	0.77	0.63	1.00	0.78
7	Denmark	0.76	0.68	1.00	0.73
8	Lithuania	0.75	0.65	0.96	0.75
9	New Zealand	0.73	0.55	0.93	0.79
10	Slovenia	0.72	0.63	0.93	0.71
11	Iceland	0.72	0.62	1.00	0.70
12	Slovakia	0.72	0.58	0.95	0.74
13	Brunei	0.71	0.69	0.76	0.71
14	Czech Rep.	0.68	0.65	0.97	0.60
15	Estonia	0.67	0.63	0.99	0.60
16	Germany	0.67	0.65	1.00	0.58
17	Hungary	0.67	0.58	0.95	0.64
18	Costa Rica	0.66	0.50	0.73	0.80
19	Romania	0.65	0.51	0.85	0.68
20	Ireland	0.63	0.57	0.96	0.55
21	Portugal	0.62	0.46	0.98	0.62
22	France	0.62	0.50	1.00	0.58
23	Croatia	0.62	0.40	0.93	0.67
24	Canada	0.62	0.50	0.86	0.62
25	United Arab Emirates	0.62	0.66	0.87	0.51

26	Netherlands	0.61	0.55	0.98	0.53
27	Belgium	0.61	0.54	0.98	0.53
28	Belarus	0.60	0.48	0.84	0.60
29	Peru	0.60	0.44	0.61	0.84
30	Colombia	0.60	0.46	0.60	0.82
31	Spain	0.59	0.48	0.96	0.54
32	Uruguay	0.59	0.34	0.88	0.66
33	Poland	0.59	0.53	0.88	0.52
34	United Kingdom	0.59	0.51	0.90	0.53
35	Indonesia	0.58	0.53	0.60	0.64
36	Saudi Arabia	0.58	0.57	0.81	0.51
37	Georgia	0.58	0.43	0.76	0.62
38	Australia	0.58	0.51	0.98	0.49
39	Malaysia	0.58	0.55	0.69	0.56
40	Suriname	0.57	0.44	0.56	0.83
41	Venezuela	0.57	0.45	0.59	0.75
42	Chile	0.57	0.41	0.75	0.61
43	Brazil	0.57	0.31	0.65	0.83
44	Japan	0.57	0.63	0.91	0.41
45	Russia	0.56	0.59	0.72	0.50
46	Italy	0.56	0.47	0.89	0.51
47	Argentina	0.56	0.48	0.75	0.55
48	Paraguay	0.56	0.39	0.54	0.87
49	Panama	0.55	0.43	0.58	0.69
50	Albania	0.55	0.22	0.75	0.72
51	Ecuador	0.55	0.45	0.57	0.68
52	United States	0.55	0.61	0.81	0.43
53	Sri Lanka	0.53	0.51	0.52	0.58
54	Mauritius	0.52	0.46	0.77	0.48
55	Dominican Rep.	0.52	0.61	0.52	0.49

56	Thailand	0.52	0.47	0.65	0.51
57	El Salvador	0.52	0.38	0.54	0.73
58	Kuwait	0.52	0.49	0.84	0.43
59	Bahrain	0.50	0.66	0.72	0.33
60	Vietnam	0.50	0.41	0.63	0.51
61	Oman	0.50	0.53	0.79	0.38
62	Azerbaijan	0.50	0.43	0.82	0.43
63	Mexico	0.50	0.47	0.66	0.46
64	Guatemala	0.49	0.47	0.41	0.78
65	Macedonia	0.49	0.36	0.75	0.49
66	Gabon	0.49	0.40	0.41	0.82
67	Turkey	0.49	0.53	0.69	0.40
68	Bhutan	0.49	0.28	0.48	0.85
69	Armenia	0.49	0.32	0.81	0.49
70	Philippines	0.49	0.50	0.44	0.62
71	Trinidad and Tobago	0.48	0.43	0.58	0.49
72	Serbia	0.48	0.32	0.79	0.49
73	Cambodia	0.48	0.51	0.43	0.63
74	Bosnia and Herzegovina	0.47	0.30	0.78	0.48
75	Nepal	0.47	0.38	0.43	0.72
76	Bolivia	0.47	0.37	0.44	0.71
77	Nicaragua	0.46	0.37	0.37	0.84
78	Botswana	0.46	0.40	0.38	0.77
79	Belize	0.46	0.16	0.53	0.79
80	China	0.45	0.59	0.61	0.32
81	Honduras	0.45	0.33	0.45	0.67
82	Myanmar	0.45	0.46	0.36	0.69
83	Tunisia	0.45	0.41	0.73	0.38
84	Kyrgyzstan	0.44	0.31	0.65	0.47

85	Greece	0.44	0.36	0.90	0.34
86	Moldova	0.44	0.34	0.85	0.37
87	Kazakhstan	0.42	0.50	0.81	0.24
88	Algeria	0.42	0.44	0.64	0.33
89	Turkmenistan	0.41	0.60	0.50	0.30
90	Lebanon	0.41	0.31	0.82	0.34
91	Ukraine	0.41	0.24	0.83	0.38
92	Cape Verde	0.40	0.27	0.58	0.43
93	Namibia	0.40	0.37	0.27	0.85
94	Egypt	0.40	0.30	0.76	0.34
95	Jamaica	0.39	0.19	0.57	0.46
96	Jordan	0.38	0.31	0.84	0.27
97	Bangladesh	0.38	0.54	0.27	0.52
98	Iran	0.37	0.42	0.63	0.26
99	Morocco	0.37	0.27	0.48	0.40
100	Guyana	0.37	0.17	0.37	0.73
101	Pakistan	0.37	0.33	0.36	0.46
102	India	0.37	0.41	0.40	0.33
103	Iraq	0.35	0.36	0.43	0.33
104	Ghana	0.34	0.15	0.37	0.64
105	Cameroon	0.34	0.44	0.19	0.70
106	Mali	0.34	0.28	0.27	0.61
107	Swaziland	0.32	0.36	0.19	0.65
108	Niger	0.32	0.26	0.25	0.58
109	Cote d'Ivoire	0.31	0.48	0.16	0.61
110	Ethiopia	0.31	0.42	0.18	0.62
111	South Africa	0.31	0.32	0.52	0.23
112	Nigeria	0.29	0.42	0.17	0.53
113	Dem. Rep. Congo	0.29	0.65	0.02	0.76
114	Yemen	0.28	0.27	0.28	0.29

115	Senegal	0.28	0.27	0.17	0.60
116	Angola	0.27	0.33	0.09	0.78
117	Burundi	0.27	0.33	0.13	0.66
118	Benin	0.27	0.31	0.18	0.49
119	Zambia	0.27	0.31	0.06	0.86
120	Guinea	0.27	0.22	0.15	0.66
121	Rwanda	0.26	0.35	0.11	0.65
122	Syria	0.26	0.24	0.64	0.15
123	Tanzania	0.26	0.36	0.08	0.71
124	Gambia	0.25	0.12	0.19	0.62
125	Mauritania	0.25	0.16	0.22	0.46
126	Uganda	0.24	0.33	0.07	0.68
127	Guinea-Bissau	0.24	0.14	0.15	0.64
128	Mozambique	0.24	0.35	0.03	0.77
129	Sudan	0.24	0.09	0.22	0.52
130	Togo	0.24	0.25	0.11	0.60
131	Sierra Leone	0.23	0.28	0.11	0.56
132	Burkina Faso	0.22	0.30	0.08	0.61
133	Malawi	0.22	0.29	0.03	0.72
134	Madagascar	0.22	0.36	0.04	0.61
135	Kenya	0.21	0.31	0.03	0.65
136	South Sudan	0.21	0.22	0.06	0.65
137	Comoros	0.20	0.25	0.08	0.51
138	Central African Republic	0.19	0.21	0.01	0.76
139	Chad	0.19	0.31	0.01	0.61

Annex II

The sensitivity analysis for the composite index and ranking robustness are obtained by simulating fuzzy measures of the three pillars of sustainability according to the variability of the experts' preferences obtained in the survey.

Table AII 1 reports the 2.5% and 97.5% centiles for both the composite score and the ranking position. We use the following definition for the sensitivity of i-th country:

$$sensitivity_i = \begin{cases} low, for\ \ \sigma_i < Mean(\sigma) - St.dev(\sigma) \\ medium, for\ \ |Mean(\sigma) - \sigma_i| \le St.dev(\sigma) \\ high, for\ \ \sigma_i > Mean(\sigma) + St.dev(\sigma) \end{cases}$$

where σ_i represents the standard deviation of the composite index score for i-th country.
Similarly, the ranking robustness of i-th country is defined as:

$$robustness_i = \begin{cases} low, for\ \ \sigma_i > Mean(\sigma) + St.dev(\sigma) \\ medium, for\ \ |Mean(\sigma) - \sigma_i| \le St.dev(\sigma) \\ high, for\ \ \sigma_i < Mean(\sigma) - St.dev(\sigma) \end{cases}$$

Table AII 1– Sensitivity and Ranking robustness

	Sensitivity Score			**Ranking Robustness**		
	Centile		*Sensitivity*	*Centile*		*Robustness*
Country	*2.5%*	*97.5%*		*2.5%*	*97.5%*	
Sweden	0.79	0.93	Medium	1	1	High
Norway	0.67	0.89	Medium	2	7	High
Switzerland	0.74	0.86	Medium	2	7	High
Latvia	0.65	0.89	Medium	2	20	Medium
Finland	0.65	0.87	Medium	4	11	High
Austria	0.67	0.85	Medium	4	7	High
Denmark	0.70	0.85	Medium	3	9	High
Lithuania	0.68	0.82	Medium	4	9	High
New Zealand	0.62	0.82	Medium	6	18	High
Slovenia	0.66	0.80	Medium	8	12	High
Iceland	0.64	0.82	Medium	6	14	High
Slovakia	0.63	0.81	Medium	10	14	High
Brunei	0.70	0.73	Low	4	23	Medium
Czech Rep.	0.62	0.79	Medium	10	23	High
Estonia	0.61	0.79	Medium	9	25	High
Germany	0.60	0.80	Medium	8	26	High
Hungary	0.60	0.77	Medium	13	22	High
Costa Rica	0.57	0.74	Medium	11	37	Medium
Romania	0.56	0.73	Medium	15	29	High

Ireland	0.56	0.75	Medium	16	42	Medium
Portugal	0.51	0.75	Medium	17	37	Medium
France	0.52	0.76	Medium	17	38	Medium
Croatia	0.48	0.75	Medium	13	47	Medium
Canada	0.54	0.70	Medium	21	36	High
United Arab Emirates	0.55	0.71	Medium	18	43	Medium
Netherlands	0.53	0.75	Medium	16	47	Medium
Belgium	0.53	0.75	Medium	18	49	Medium
Belarus	0.51	0.68	Medium	26	43	High
Peru	0.49	0.70	Medium	15	59	Medium
Colombia	0.50	0.70	Medium	16	57	Medium
Spain	0.50	0.72	Medium	24	53	Medium
Uruguay	0.44	0.72	High	21	63	Low
Poland	0.53	0.70	Medium	24	56	Medium
United Kingdom	0.52	0.70	Medium	26	54	Medium
Indonesia	0.55	0.61	Low	20	52	Medium
Saudi Arabia	0.53	0.66	Medium	26	55	Medium
Georgia	0.49	0.66	Medium	28	51	Medium
Australia	0.50	0.73	Medium	22	64	Medium
Malaysia	0.55	0.62	Low	23	54	Medium
Suriname	0.48	0.69	Medium	19	70	Low
Venezuela	0.49	0.65	Medium	25	64	Medium
Chile	0.47	0.65	Medium	32	55	Medium
Brazil	0.41	0.70	High	17	77	Low
Japan	0.48	0.69	Medium	25	66	Medium
Russia	0.53	0.62	Low	25	61	Medium
Italy	0.48	0.68	Medium	31	66	Medium
Argentina	0.50	0.63	Medium	36	60	Medium
Paraguay	0.44	0.69	Medium	17	78	Low
Panama	0.48	0.62	Medium	34	70	Medium
Albania	0.37	0.71	High	21	87	Low
Ecuador	0.48	0.61	Medium	37	70	Medium
United States	0.48	0.65	Medium	33	69	Medium
Sri Lanka	0.51	0.55	Low	33	73	Medium
Mauritius	0.47	0.61	Medium	41	74	Medium
Dominican Rep.	0.50	0.55	Low	34	78	Medium
Thailand	0.48	0.57	Low	46	73	Medium
El Salvador	0.42	0.62	Medium	37	81	Medium
Kuwait	0.45	0.64	Medium	36	77	Medium
Bahrain	0.43	0.60	Medium	36	86	Low

Vietnam	0.44	0.55	Low	56	78	Medium
Oman	0.43	0.61	Medium	44	84	Medium
Azerbaijan	0.43	0.62	Medium	40	88	Medium
Mexico	0.46	0.56	Low	50	84	Medium
Guatemala	0.41	0.62	Medium	37	87	Low
Macedonia	0.40	0.58	Medium	54	82	Medium
Gabon	0.40	0.64	Medium	27	91	Low
Turkey	0.44	0.56	Low	53	85	Medium
Bhutan	0.34	0.65	High	27	95	Low
Armenia	0.37	0.60	Medium	47	83	Medium
Philippines	0.44	0.54	Low	54	85	Medium
Trinidad and Tobago	0.45	0.52	Low	57	84	Medium
Serbia	0.37	0.59	Medium	50	84	Medium
Cambodia	0.43	0.55	Low	56	87	Medium
Bosnia and Herz.	0.36	0.58	Medium	54	87	Medium
Nepal	0.40	0.58	Medium	50	90	Medium
Bolivia	0.39	0.57	Medium	52	89	Medium
Nicaragua	0.37	0.63	Medium	30	98	Low
Botswana	0.38	0.59	Medium	45	95	Medium
Belize	0.27	0.62	High	39	108	Low
China	0.39	0.54	Medium	60	97	Medium
Honduras	0.36	0.55	Medium	63	95	Medium
Myanmar	0.37	0.55	Medium	62	95	Medium
Tunisia	0.39	0.55	Medium	59	104	Medium
Kyrgyzstan	0.36	0.53	Medium	68	94	Medium
Greece	0.35	0.61	High	42	112	Low
Moldova	0.35	0.59	Medium	48	108	Low
Kazakhstan	0.32	0.57	Medium	53	120	Low
Algeria	0.36	0.50	Medium	75	112	Medium
Turkmenistan	0.36	0.49	Medium	70	105	Medium
Lebanon	0.32	0.56	Medium	58	123	Low
Ukraine	0.28	0.56	High	64	117	Low
Cape Verde	0.32	0.47	Medium	78	111	Medium
Namibia	0.27	0.59	High	46	107	Low
Egypt	0.31	0.53	Medium	69	125	Low
Jamaica	0.28	0.49	Medium	75	115	Medium
Jordan	0.28	0.55	High	61	135	Low
Bangladesh	0.29	0.45	Medium	84	107	Medium
Iran	0.31	0.47	Medium	83	131	Medium
Morocco	0.31	0.42	Low	89	124	Medium

Guyana	0.23	0.53	High	70	115	Medium
Pakistan	0.34	0.41	Low	89	116	Medium
India	0.35	0.39	Low	83	128	Medium
Iraq	0.34	0.38	Low	91	133	Medium
Ghana	0.21	0.48	Medium	85	120	Medium
Cameroon	0.21	0.50	Medium	79	111	Medium
Mali	0.27	0.46	Medium	91	113	Medium
Swaziland	0.20	0.46	Medium	91	114	Medium
Niger	0.25	0.43	Medium	101	116	High
Cote d'Ivoire	0.18	0.45	Medium	95	118	Medium
Ethiopia	0.19	0.45	Medium	95	115	Medium
South Africa	0.26	0.39	Low	99	137	Medium
Nigeria	0.18	0.40	Medium	107	126	Medium
Dem. Rep. Congo	0.04	0.51	High	74	137	Low
Yemen	0.27	0.28	Low	103	139	Medium
Senegal	0.18	0.42	Medium	111	122	High
Angola	0.10	0.49	High	82	126	Medium
Burundi	0.14	0.44	Medium	98	122	Medium
Benin	0.19	0.37	Medium	113	132	Medium
Zambia	0.08	0.53	High	71	132	Low
Guinea	0.16	0.44	Medium	101	129	Medium
Rwanda	0.12	0.44	Medium	103	124	Medium
Syria	0.18	0.40	Medium	96	139	Medium
Tanzania	0.09	0.46	High	94	128	Medium
Gambia	0.14	0.41	Medium	112	137	Medium
Mauritania	0.18	0.34	Medium	111	136	Medium
Uganda	0.09	0.44	High	103	130	Medium
Guinea-Bissau	0.14	0.42	High	109	138	Medium
Mozambique	0.05	0.47	High	89	135	Medium
Sudan	0.13	0.36	Medium	111	138	Medium
Togo	0.12	0.40	Medium	120	130	High
Sierra Leone	0.12	0.38	Medium	122	132	High
Burkina Faso	0.09	0.39	Medium	122	134	High
Malawi	0.04	0.44	High	102	137	Medium
Madagascar	0.05	0.39	High	119	137	Medium
Kenya	0.05	0.40	High	117	137	Medium
S. Sudan	0.07	0.40	High	118	138	Medium
Comoros	0.09	0.33	Medium	128	139	High
Central African Rep.	0.02	0.44	High	103	139	Medium
Chad	0.03	0.38	High	128	139	High

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