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Summary

The FEEM project *APPS – Assessment, Projections and Policy of Sustainable Development Goals –* focuses on the quantitative assessment of the seventeen Sustainable Development Goals (SDGs), adopted by the United Nations at the end of September 2015. The project consists of two phases. The first, retrospective, computes indicators for all SDGs in 139 countries and then derives a composite multi-dimensional index and a worldwide ranking of current sustainability. This allows informing on strengths and weaknesses of today socio-economic development, as well as environmental criticalities, all around the world. The second phase, prospective, aims at evaluating the future trends of sustainability in the world by 2030. The assessment of the SDGs is carried out by means of an extended version of the recursive-dynamic computable general equilibrium ICES macro-economic model that includes social and environmental indicators. The final goal is to highlight future challenges left unsolved in the next 15 years of socio-economic development and to analyze costs and benefits of specific policies to support the achievement of proposed targets. This paper presents the methodology and the results of the retrospective assessment. Five main steps are described: i) screening of indicators eligible to address the UN SDGs; ii) data collection from relevant sources; iii) organization in the three pillars of sustainability (economy, society, environment); iv) normalization to a common metrics; v) aggregation of the 25 indicators in composite indices by pillars as well as in the multi-dimensional index. The final ranking summarizes countries' sustainability performance. As expected, Middle-North European countries are at top of the ranking (Sweden, Norway and Switzerland the first three), with the most industrialized European countries such as Germany and UK, however, penalized by insufficient environmental performance. Other highly developed countries are between 24th (Canada) and 52nd place (United States). The emerging nations are scattered in our sustainability ranking. Brazil (43rd) and Russia (45th) precede China (80th) and India (102nd), the latter two especially penalized because of their social complexity. The worst performances, in terms of overall sustainability, are in Sub-Saharan Africa (Comoros, the Central African Republic and Chad occupy the last places in the ranking).

Keywords: Sustainable Development Goals, Composite Index, Ranking, Indicators
JEL Classification: O44, O57, Q01

Paper presented at the UN Summit on Sustainable Development Goals, New York, September 25, 2015.

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Assessing SDGs: A new methodology to measure sustainability

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ABSTRACT

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1. Introduction

In September 2015, at the UN summit in New York City, the Sustainable Development Goals (SDGs) have been adopted by the head of governments of almost 200 countries. The goals identify a set of objectives designed to help the world to move towards sustainable development, by addressing its three dimensions: economic development, social inclusion, and environmental sustainability.

The sustainable developments goals will be measured by a set of indicators, a few per each goal. Indicators will be the essential tool to monitor progress towards the SDGs at the local, national, regional, and global levels. A sound indicator framework will turn the SDGs and their targets into a management tool to help countries and the global community to develop implementation strategies and allocate resources accordingly. They will also help ensure the accountability of all stakeholders for achieving the SDGs.

The focus of SDG monitoring must obviously be at the national level. Each country will choose the national SDG indicators that are best suited to track its own progress towards sustainable development. Given the diversity of countries, there will certainly be substantial variation in the number and type of national indicators that countries will adopt. Nevertheless, data availability and statistical consistency are important constraint for the choice of the statistical indicators that will be used to monitor and verify the SDGs. This will inevitably induce some homogeneity among the indicators selected by different countries.

In addition, statistical indicators must enable the UN and all parties to compare the efforts carried out in different countries, a comparison which is crucial to assess the effectiveness of domestic policies and the speed towards sustainable development (and possible free-riding behaviors as well).

Finally, indicators should not provide only a retrospective representation of the situation in each country. Indicators should enable policymakers to evaluate different domestic policies and their impacts on sustainable development. A prospective analysis of future dynamics of indicators is therefore essential.

The first objective – measuring, monitoring and verification – can be achieved only if indicators are sufficiently homogeneous – if not identical – across different countries. To achieve the second objective, indicators should be linked and integrated into a macroeconomic model of the world economy. This guarantees the consistency of the values of the indicators and the possibility to assess how different policy decisions affect future values of indicators representing the SDGs.

This paper provides a statistical and modeling framework to address these two objectives. First, it provides a retrospective analysis of SDGs, by computing a set of sustainable development statistical indicators for 139 countries. The selected indicators, chosen as the main ones relevant for the 17 SDGs adopted by the UN, are organized across pillars, to highlight a country's overall performance in all three dimensions (social, environmental and economic) of sustainable development. Moreover, a composite measure of sustainability is proposed by merging the three dimensions through a non-linear aggregation procedure. This will enable us to compute a sustainability ranking of all world countries.

Secondly, it outlines the macro-economic model, opportunely extended with social and environmental modules, which will be used to estimate future (endogenous) trends of the selected indicators in both reference and policy scenarios. The framework used makes it possible to obtain a global perspective of effects of socio-economic development over the next 15 years (until 2030), as well as that of policies which can highlight potential synergies and conflicts between indicators when attempting to achieve sustainability targets as defined by the UN Open Working Group[1]. Moreover, the use of the macro-economic model helps us to understand the magnitude of investments required to achieve the goals, and to highlight the role of international financial transfers.

The results shown in this paper relates mostly with the collection of indicators for most world countries and their analysis to identify which countries need to make more/less effort and progress towards sustainable development. The results derived from running the macro-economic model into which indicators are integrated will be presented in a companion paper.

The structure of the paper is as follows. Section two describes the methodology for data search, collection and organization. Section three provides a concise overview of the technical aspects of benchmarking and normalization procedures, as well as the aggregation methodology of indicators into the economic, social and environmental pillars. Section four presents the main results of the analysis, providing a global perspective through maps and comparisons of the indicators, in order to examine the most interesting examples of criticalities and similarities/divergences among countries. Section five introduces our model-based ex-ante assessment of future sustainability trends and policy impacts. The concluding section summarizes results and outlines the scope of our future research.

2. Data screening, collection and organization

Since 2012, a new process of selection of most relevant indicators has been proceeding along the same path traced by the MDGs experience. While the latter was mostly focused on the social dimensions of sustainable development, the new set of SDGs is much more comprehensive as it explores and considers all dimensions, granting greater space to the environmental and economic pillars.

Beyond the idea of delivering indicators and targets, as clearly recognized by the UN (2015) and the UN SDSN (2015), progress in sustainable development also relies upon an adequate monitoring of the suitable indicators used to measure its different dimensions.[2]

One main issue, once the necessary information has been gathered, is to organize the data to inform decision makers and stakeholders of where progress has been substantial and has more closely approached expected targets and, more importantly, where challenges still exist and require further efforts to fill gaps.

In this paper, we focus on a subset of indicators, partially considered by MDGs and the UN SDSN as the most representative of the new SDGs endorsed in September 2015 by the UN. A number of criteria guided the selection process.

First, as the analysis covers the whole world in large detail, down to the country level, indicators with a limited coverage in terms of data availability have not been considered eligible and therefore have been excluded by the dashboard. When available and reliable, missing data for countries have been replaced with the average of the geographical area. It is worth noting that available time series data are also unsatisfactory, especially concerning developing countries. And in several cases there is clear mismatching of data for different years. This has implied the infeasibility of a trend analysis.

Second, the screening procedure has been motivated by the specific requirement of introducing and defining all indicators in the research follow-up on a macro-economic model, so as to project possible future trends under a number of scenarios. Thus, we have excluded

[1] UN OWG, 2014.
[2] UN IEAG, 2015.

all those indicators lacking any connection with pre-existing macro-economic variables or, more extensively, any robust empirical evidence indicating why they get better or worse.

One main objective was to cover all the 17 SDGs proposed for the 2016-2030 period. This was fulfilled successfully. 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 have been excluded from the list. 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[3] 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.

A final consideration refers to the data format. While most of MDGs and SDGs targets are defined in terms of their progress over a predefined time horizon (15 years), missing time series do not provide concrete figures for this kind of assessment. For this reason, the indicators are expressed as the current situation since the last available record. The only notable exception is GDP per capita growth, for which we use available growth figures related to the last two subsequent years (generally 2013-2014). In contrast to other cases, the OWG made this benchmarking possible with its time series coverage and the presence of a quantitative target[4] for the 2016-2030 period (see Section 3).

Table 1 reports the final list of indicators considered in the present analysis (column 2), classified by sustainability dimension. The first column reports the code name used in the graph presentations in 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

[3] UN Women, 2013.
[4] Further clarifications on this point in the "benchmarking" section.

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 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
SDG 15a	Forest area (% of land area)	WDI	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 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.

Providing guidelines for actions by simultaneously viewing so many indicators can be very challenging. Once the data have been gathered, they are carefully assessed to improve the analysis. Benchmarking becomes essential for assessing the current level of sustainability of a specific indicator, as well as its distance from proposed targets[5]. Normalization allows comparability among indicators by building common metrics. Finally, the aggregation of indicators into a single composite measure helps achieve a comprehensive assessment of sustainability. The next section will describe those methodological steps.

3. Benchmarking, Normalization and Aggregation

Aggregating indicators in composing indices can be very useful for summarizing complex and multi-dimensional data into a single and easily interpretable value. Especially in the case of SDGs, where a large number of indicators structured into 17 Goals has been proposed and will be monitored over a range of years, this can be extremely helpful for policy makers at different governance levels.

The main purpose of this paper is to get beyond the single indicators, in order to provide a more comprehensive view of sustainable development. This is done in two steps. First, by considering the different dimensions of sustainability from the indicators listed in Table 1. Second, by building an overall composite index which summarizes the three dimensions. The sub-sections below illustrate the methodological steps adopted to compute the mono-dimensional and the overall composite index.

3.1 Benchmarking and Normalization

The main challenge when analyzing how countries behave across a range of indicators refers to the measurement metrics. Indicators are typically ratios. While the two components of such ratios can be expressed in any metrics, ratios themselves help as they provide in principle[6] a measurement between 0 and 1. Unfortunately, not all indicators have this feature. This requires a further effort to make the indicators first comparable and then, if desired, unified in a composite index. The procedure is defined as normalization and its aim is to bring all the indicators considered into the same measurement scale [0,1].

Generally speaking, indicators can be split into two main categories according to their: a) positive direction (*i.e.* the higher the score of a country, the higher the country's performance); b) negative 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.

[5] For a comparison of global and national targets see ODI (2015).

[6] This is not always the case. See, for instance, public debt, which can be higher than 100% or even negative.

Equations 1) and 2) below represent the normalization method used for indicators belonging to the a) and b) category, respectively. **Errore. L'origine riferimento non è stata trovata.** visualizes these definitions.

$$1)\quad f_a(x) = \begin{cases} 1 \;\; iff \; x \geq \overline{x} \\ 0 \;\; iff \;\; x \leq \underline{x} \\ \dfrac{(x-\underline{x})}{(\overline{x}-\underline{x})} \;\; iff \; \underline{x} \;\leq x \leq \overline{x} \end{cases} \qquad\qquad 2)\quad f_b(x) = \begin{cases} 1 \;\; iff \; x \leq \overline{x} \\ 0 \;\; iff \;\; x \geq \underline{x} \\ \dfrac{(x-\overline{x})}{(\overline{x}-\underline{x})} \;\; iff \;\; \overline{x} \leq x \leq \underline{x} \end{cases}$$

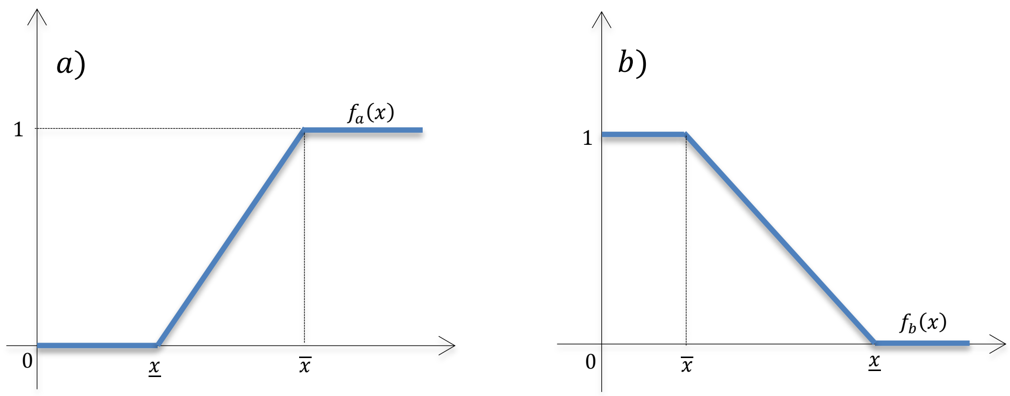

Figure 1 – Normalization Scheme

Defining $\underline{x}$ and $\overline{x}$ for all indicators is a hard task and possibly the most critical of the present analysis. As said in Section 2, almost all indicators are expressed as the current level in the latest available years rather than progress over a period. In fact, the latter option is also used to define OWG targets. Nevertheless, most targets are qualitative ("improve", "reduce", and so on) and only in a few cases provide quantitative levels that could have been used to specify benchmarks.

For this reason, benchmarks for sustainable/unsustainable levels have been defined by educated guesses for each indicator, based on an analysis of the scientific literature on each indicator, as well as the observed data. Table 2 shows the threshold values used, respectively, for the normalization process in the social, environmental and economic pillar.

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	*b*	60	5
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

Once the normalization procedure is completed, we use a routine script with "R" software to compute the four composite indices (one per each of the three dimensions, and the fourth for the overall composite sustainability index). Figure 2 shows the composite index structure; a country's sustainability level is determined by its overall performance in the three sustainability pillars, which in turn depend on the values of the single indicators pertaining to them.

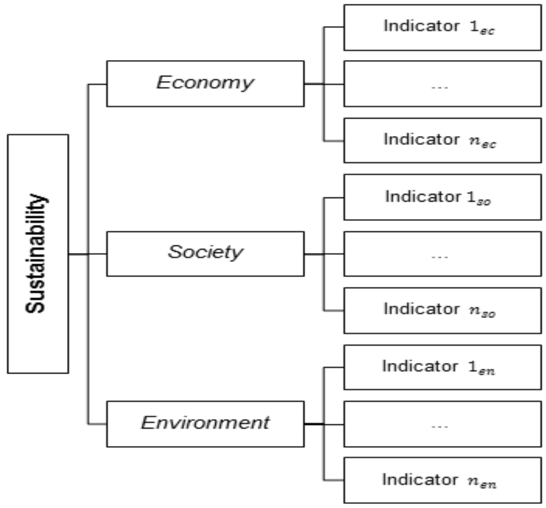

Figure 2 - Overall Composite Index structure

Two different aggregation procedures have been used. In the first step, concerning composite indices by dimensions, indicator scores belonging to the same pillar have been aggregated by their arithmetic means. Hence, defining X_j as the pillar score for country j, and x_{ji} as its normalized value in indicator $i = \{1,2, \dots, n\}$, the aggregated pillar score for country j is given by:

$$3) \quad X_j = \frac{1}{n}\sum_{i}^{n} x_{ji}$$

In the second step, which provides the overall measure of sustainability, the scores obtained for each dimension are aggregated for each country by means of *fuzzy measures* and the *Choquet Integral*, an advanced mathematical formulation making it possible to take into account potential interactions – from *synergy* to *redundancy* – that may exist among the selected indicators. For lack of space, we do not discuss here in detail the methodology behind *fuzzy measures*, the *Choquet* integral and *fuzzy measure* elicitation.[7]

The main concept of sustainability (and corresponding weights by dimension) in the current context derives from an ad hoc questionnaire submitted to an Experts' panel, and hence the resulting *fuzzy measures*. Such measures have been used for the overall computation of the composite index's main node.[8]

A country is defined as sustainable whenever, to a certain extent, both its environmental and social dimensions are jointly satisfied and, to a lesser extent, when both its social and economic dimensions are jointly fulfilled; no dimension can be substituted with another one.[9]

[7] The interested reader can refer to Grabisch (1997), Grabisch et al. (2008), Ishii and Sugeno (1985), Marichal (2000), Marichal and Roubens (2000).
[8] See Farnia and Giove (2015) for details and technical discussion.
[9] Going back to the sustainability theory, this implies "strong" rather than "weak" sustainability.

On average, considering all the interactions among the pillars, the social dimension is valued as the most important (38.6%), followed by the environmental (35.7%) and the economic (25.7%) dimensions.

The Möbius set in Table 3 models the above definition for all the subsets – limited to cardinality two at maximum – that can be formed from the set $N = \{Env, Soc, Eco\}$ containing the three pillars.

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_{ji} with $i = \{Env, Soc, Eco\}$, is computed as:

$$4) \quad C_j(X_{Env}, X_{Soc}, X_{Eco}) = \sum_{T \subseteq N} m\{T\} \bigwedge_{i \in T} X_{ji}$$

where ∧ is the minimum operator.

Table 3 - Möbius representation 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

4. Assessing SDGs

This section is organized as follows. First, we present the current level of sustainability in all countries, per each dimension, through worldwide maps, computed as explained in Section 3. 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 the overall sustainability representation, once again with a worldwide map, as well as with polar diagrams and a correlation analysis. Because of space limitations, only a few representations can be provided in this report. Interested readers can contact the authors for further infos and graphs/figures.

4.1 The Economic Dimension

The economic map (Figure 3) shows that South Korea[10], Central and Northern Europe

[10] 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.

(Sweden, Switzerland, Denmark and Germany), the United States and Japan perform well economically. Not surprisingly, 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.

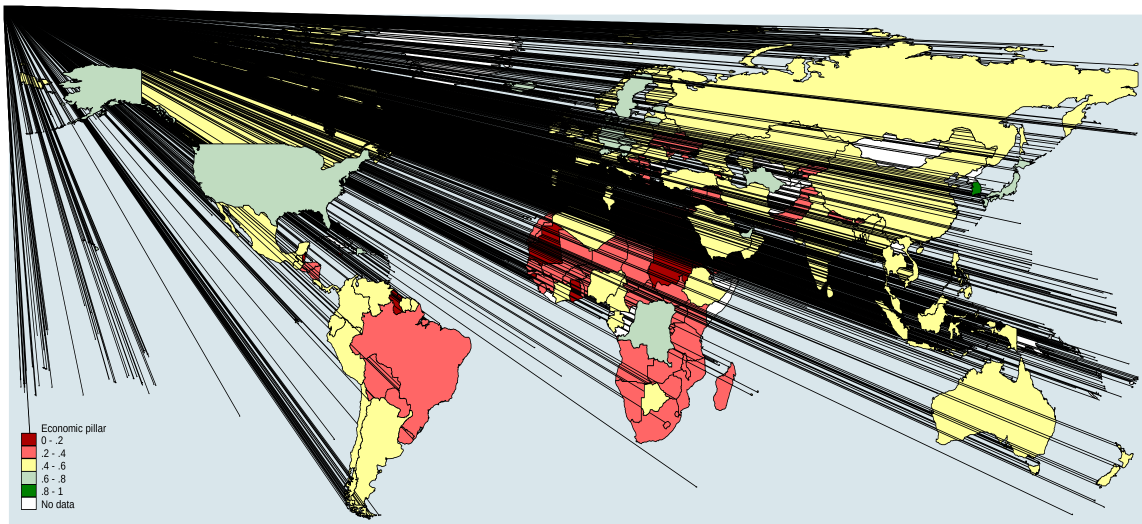

Figure 3 - Economic Pillar

In Figure 4, 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 not sufficient to compensate for its lower performance in per capita economic growth (Figure 4, left).

Figure 4 (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%),

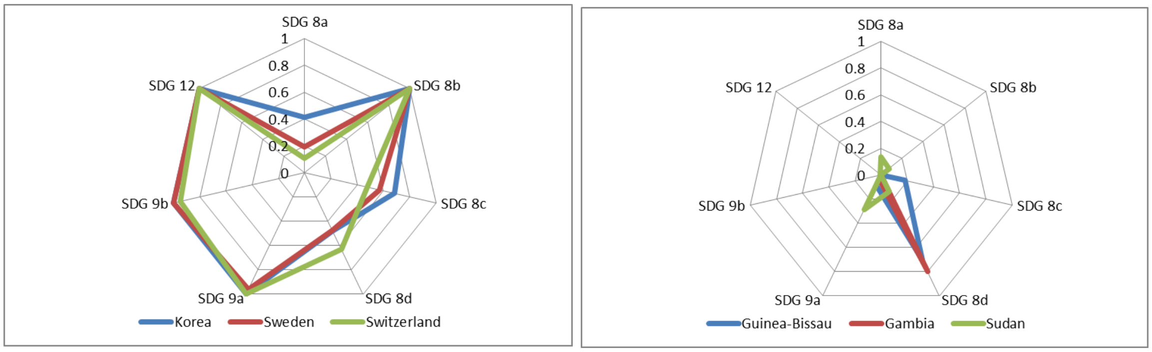

Figure 4 - Performance by economic indicators (normalized), top (left) and bottom (right) performers.

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 5 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), 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$PPP, respectively) and on R&D expenditure share (2% versus 0.13%), but the latter is completely sustainable in terms of public debt/GDP share (20% compared to China's 41%) and material productivity (4.57 versus China's 0.52 ml$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. However, 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 the underdeveloped sector for raw materials transformation (i.e. low domestic consumption of these materials) and a high reliance on revenues from raw materials export.

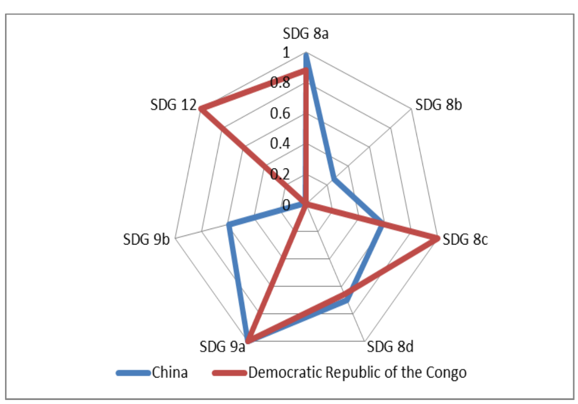

Figure 5 - Performance by economic indicators, China vs. the Democratic Republic of the Congo.

4.2 The Social Dimension

The feature for catalyzing attention and facilitating the comparison proper to aggregate indexes is particularly evident when we consider the second sustainability dimension. Figure 6 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 3 are characterized by a good level of economic sustainability are in this map highlighted 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.

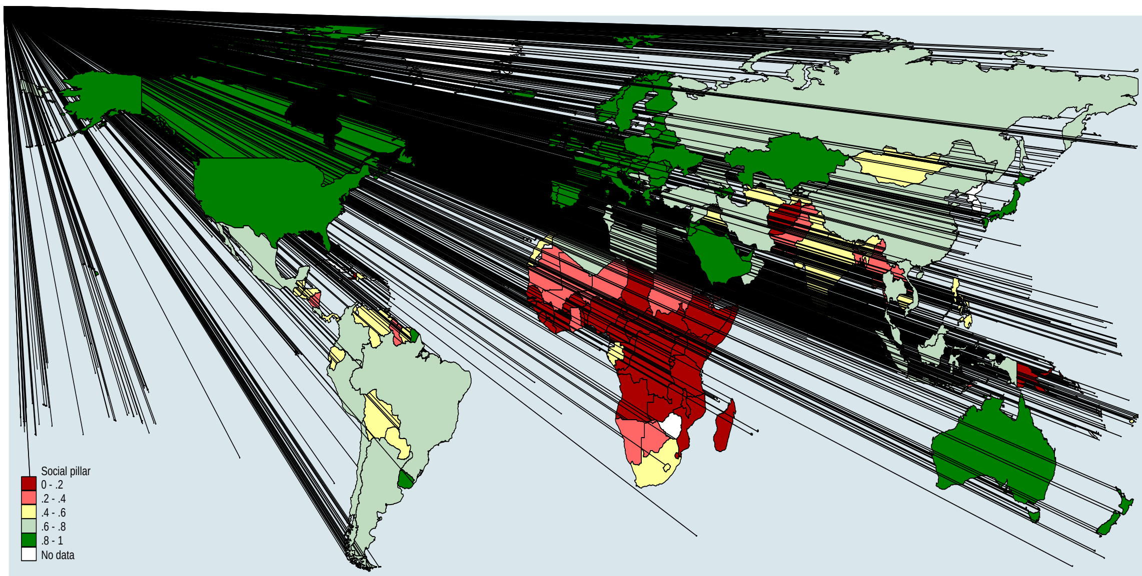

Figure 6 - Social Pillar

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 7 (left), 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). 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) determine the higher ranking of Qatar as compared to the UK. Overall, this result has to be judged carefully. On the one hand, it is worth noting that the 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, with reference to the Palma ratio, the missing data for Qatar has been replaced with the average Palma ratio in the Arab world.[11] 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 not sufficient to compensate for this.

Figure 7 (right) 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).

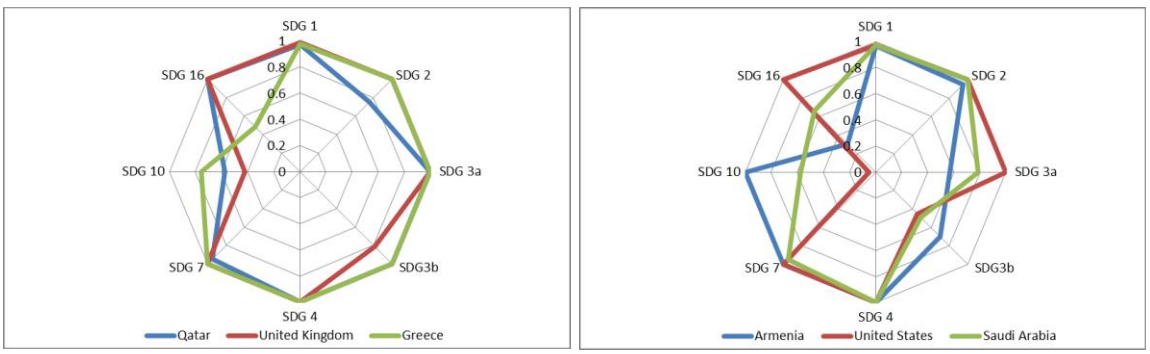

Figure 7 - Performance by social indicators: from the 25th to 27th rank (right) and from the 46th to 48th rank (left).

4.3 The Environmental Dimension

Mapping performance in environmental sustainability (Figure 8) 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.

[11] UNDP, 2015.

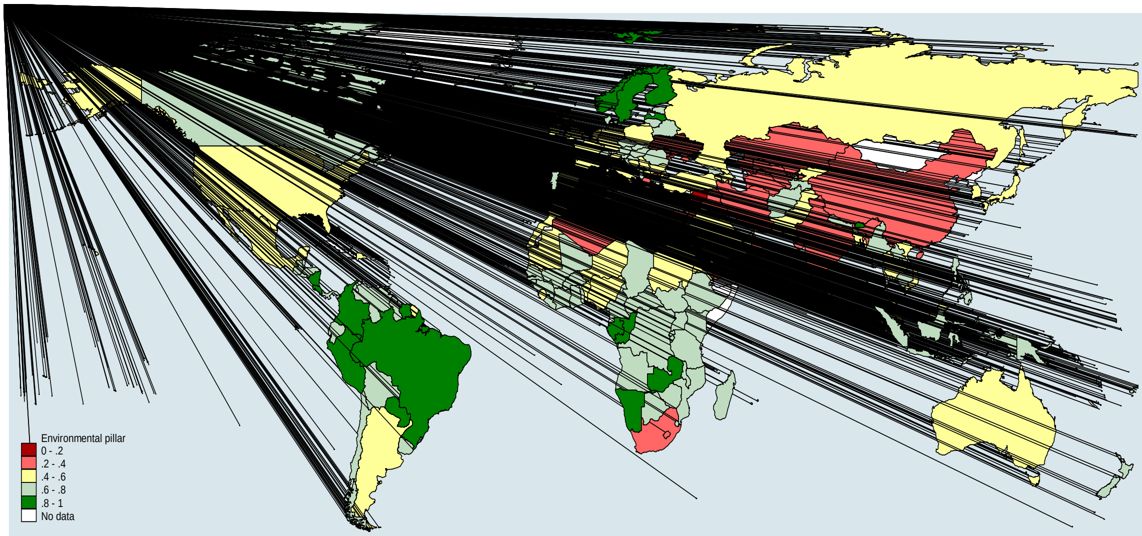

Figure 8 - Environmental Pillar

Figure 9 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 with respect 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 9 (right) 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).[12]

[12] We invite readers not to forget that for all normalized indicators "the higher the better" rule applies, irrespective of the direction on pre-normalization values (see Section 3).

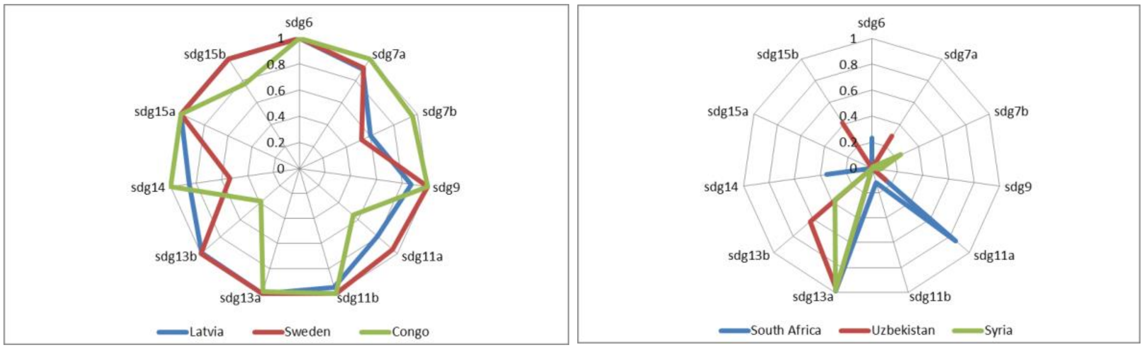

Figure 9 - Performance by environmental indicators (normalized), high (left) and low (right) performers

4.4 The Multi-Dimension Sustainability

The final and perhaps most remarkable outcome of the present analysis is the construction of the composite index for overall sustainability. As opposed to the mono-dimensional performance presented earlier, there is in this case a further methodological improvement in the application of the *Choquet* Integral to define different weights for the various dimensions based on experts' elicitation.

The map below (Figure 10) reports the aggregate sustainability covering 139 countries across the world. The only country in the world that shows 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 their linkage to environmental drawbacks. Other countries worth mentioning are Japan (44th), Russia (45th), the USA (52nd), China (80th) and India (102nd).

Not surprisingly, the bottom ten all belong to Sub-Saharan Africa, with the Comoros, the Central African Republic and Chad ranking, respectively, 137th, 138th and 139th, with huge gaps, especially in the social pillar, balanced out only partially by their performance in the environmental pillar, mainly explained by their low rate of industrialization. The first non-Sub Saharan country near the bottom is Syria, ranking 122nd. The Annex reports the overall ranking and the score by pillar for the 139 countries considered in the global analysis.[13]

Figure 11 provides another graph illustration of sustainability, connecting overall sustainability (vertical axis) with the economic pillar (horizontal axis).[14] There emerges a clear correlation between the two, but also several interesting features of the sustainable development assessment.

[13] Each pillar takes several countries into consideration, but we have streamlined the sample for the multi-dimensional index by using only those countries for which all dimensions are covered.
[14] Names are only provided for a few countries, to enable a clear reading of the graph.

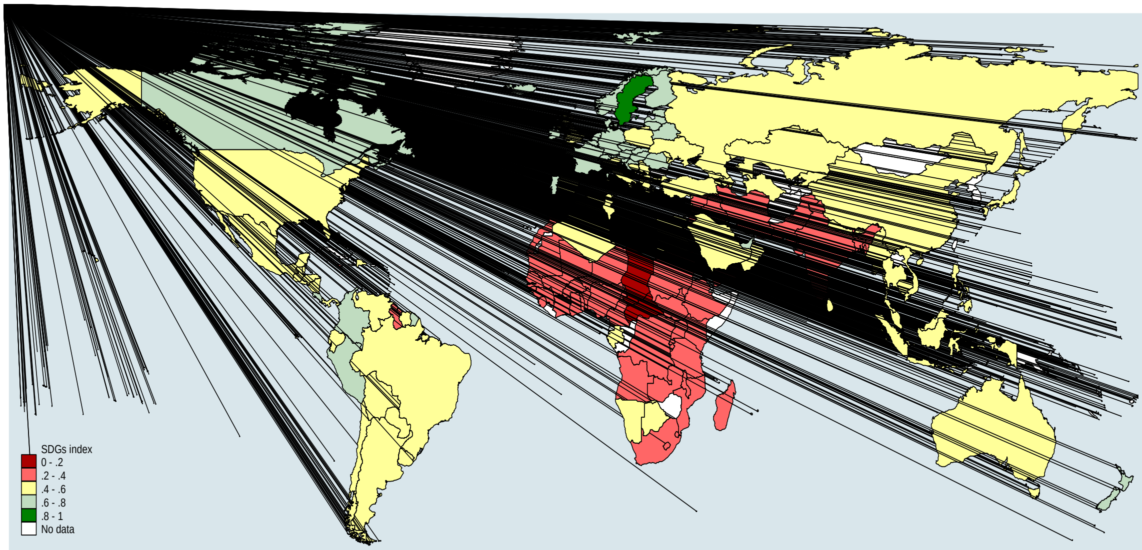

Figure 10 – Multi-Dimension Composite Index

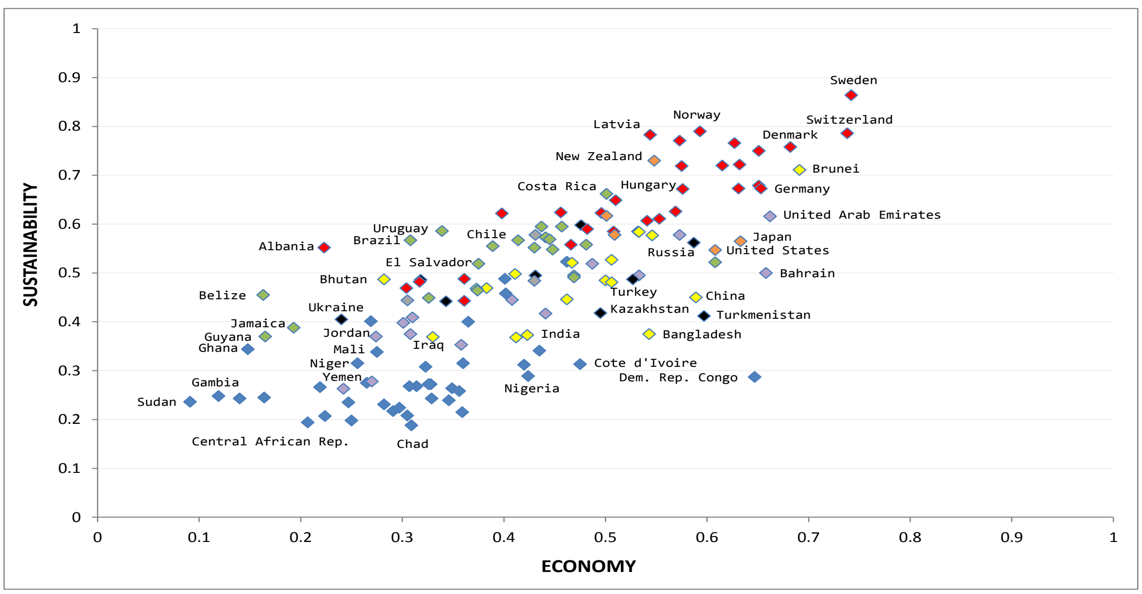

Figure 11 - Economy and Sustainability mapping

Color legend. Blue: Sub-Saharan Africa; purple: Middle East and North Africa; yellow: Southern Asia; black: former Russian countries and Turkey; green: Latin America; red: Europe; orange: other developed (non-European) countries.

On one hand, it enables us to group together countries by continent, by juxtaposing the two dimensions. Sub-Saharan Africa is located at the bottom-left, which denotes a lag in both the economic and the sustainability dimension, 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 is on the same level of sustainability as Asia, with a reduced economic performance but benefiting from lower environmental deterioration. The situation appears more heterogeneous for the previous Russian countries and Turkey. Other (non-European) developed countries 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 it can become fully sustainable, even if we look only at the economic dimension.

On the other hand, it is important to highlight similarities and divergences between countries in different parts of the world by looking at the different components of sustainability. In fact, 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. This is the case, for instance, for Norway, Russia and China, 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 performing (much) better than 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 and Germany, 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).

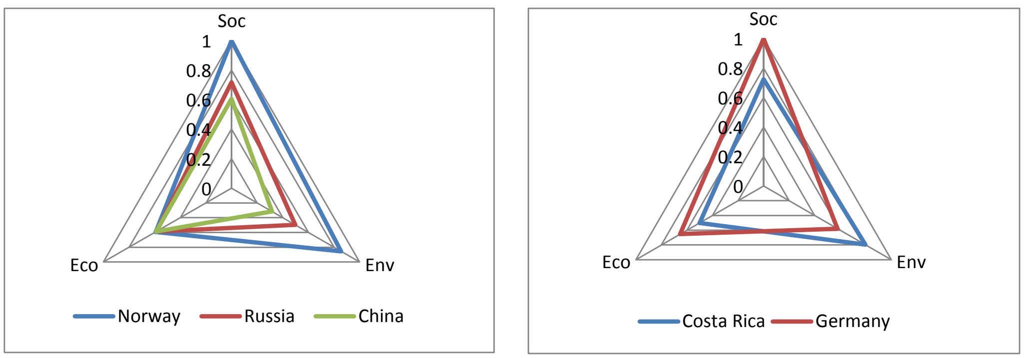

Figure 12 – Performance by (normalized) pillar for similar levels of economic (left) and sustainability (right) score

5. An introduction to the prospective analysis

Will SDGs be achieved by 2030 worldwide? Which is the socio–economic–environmental path more consistent with the SDGs achievement? Which countries will present major problems to meet SDGs and in which areas? Which policies could support this process and which is the most efficient way to allocate the costs of these interventions?

Answering to all these questions requires a model-based assessment relying upon a comprehensive and multi-dimensional setting. Since main drivers and challenges for future development are linked to socio-economic drivers in a globalized context, we employ a macro-economic model, traditionally used for scenario analysis, adapted to this scope.

The core of this framework is the recursive-dynamic Computable General Equilibrium (CGE) model ICES (Intertemporal Computable Equilibrium System; see Eboli et al., 2010), applied to climate change impact and policy assessment. As standard in CGE models, ICES is suited to assess world-wide and economy-wide implications of environmental as well as other policies and/or economic shocks on variables such as income per capita, commodities outputs and demand, commodities prices, international trade.

The macro-economic framework – based on perfect competitiveness in all markets and stylized behavior of economic agents that maximize profits (firms) and consumption (households) respectively – and the explicit inter-connections among domestic and international markets allow highlighting higher-order costs and benefits at global and country level, going beyond the perspective of the sector/country/indicator originally impacted by the policy/shock. For this reason, CGE models provide an integrated view of the economy and its future development, which can mimic endogenous changes in production and consumption patterns induced by social economic drivers such as population and economic growth characterizing different future scenarios.

In the present application, the basic ICES model is purposely enriched with social and environmental indicators to cover all dimensions of sustainability, namely the SDGs indicators presented in Table 1 and used for the retrospective analysis in this paper. This allows assessing in an internally consistent framework how and at which extent changes in macro-economic variables may affect the achievement of SDGs all around the world. This approach considers the actual response of economic agents to the perturbation occurred in the socio-economic system (market-driven or autonomous adaptation) and the interactions among SDGs (synergies and/or trade-offs), such to capture more realistically the likely future outcomes of all sustainability indicators in different scenarios (e.g. reference and policy).

The sectoral and regional specification considers around 20 productive sectors and 40 countries/regions covering the whole world. Economic benchmark is taken for 2007 by Narayanan et al. (2012). The historical records of indicators' values rely on international databases (Table 1) and defining the starting point in the baseline scenario design. The model solves in one-year time steps. The time horizon of the analysis is 2007-2030 (and possibly beyond). The interval 2007-2013 replicates historical trends of SDGs. Thereafter, exogenous (e.g. population) and endogenous (e.g. Gross Domestic Product and sectoral value added) socio-economic variables move based upon assumptions taken by Socio-Economic Shared Pathways - SSPs[15] and indicators will move according to the dynamic mechanism assumed for each of them.

These future reference scenarios are then used as terms of comparison to evaluate the so-called "counterfactual" scenarios, consisting of social and environmental policies implementation aimed to achieve one or more sustainability targets not reached in the reference. The rationale behind the analysis is multi-fold: a) quantifying the country specific distance from the SDG targets; b) designing effective policies to bridge the gap, such to not undermine other dimensions not explicitly considered by the policy action; c) defining the financial effort required to implement the policies above.

Modelling social indicators in a CGE framework is a difficult task, especially when these imply dispersion measures such as poverty prevalence and Palma ratio (SDG1 and SDG10). In these cases, we relax the relatively rigid representative agent structure proper of CGE models and rely on the empirical literature (Ravallion 1997, 2001; Bourguignon 2003) and on few modelling exercises (Lofgren et al. 2013; Hilderink et al. 2009). Regarding the first indicator, a key element to consider is the growth elasticity of poverty i.e. a measure of the responsiveness of poverty prevalence to a change in average income per capita and its distribution. Using the lognormal approximation of the original income distribution to compute the growth elasticity of poverty allows taking into account both mean and standard deviation changes affecting poverty prevalence (Bourguignon 2003).

[15] https://secure.iiasa.ac.at/web-apps/ene/SspDb/dsd?Action=htmlpage&page=about

Future patterns of income inequality are even more complex to predict. While most of global CGE models assume only one type of household, Lofgren et al. (2013) and Hilderink et al. (2009) assume that income distribution is constant over time. We try to overcome this assumption relying on the recent empirical literature on determinants of within-country inequality, both country-specific and across-countries analyses, such as differentials in labour productivity between agricultural and non-agricultural sectors (Bourguignon and Morrison 1998), sectoral wage differentials between skilled and un-skilled labour, globalization, education rates, market reforms and policy interventions (Alvaredo and Gasparini 2015). Alternatively, a more straightforward approach consists in imposing an exogenous, but not constant, trend of inequality in our future scenarios (van der Mensbrugghe 2015).

The indicator on malnutrition prevalence (SDG 2) also presents several challenges in a modelling exercise. Following FAO methodology, we isolate the two main drivers of change of undernourishment: the variation of average dietary energy consumption and the change in its distribution. Developing this indicator in a CGE framework allows us to endogenously obtain a scenario-specific evolution of food consumption consistent with macroeconomic projections, assumptions on agricultural sector productivity and food price changes. Therefore, the resulting change in household consumption of food is used to project the change in average dietary energy consumption. Setting a scenario-specific pattern for the coefficient of variation is instead more complicated; FAO methodology estimates it using GDP PPP per capita, Gini index, an indicator on food prices and regional dummies as explanatory variables of the coefficient of variation (FAO 2008).

The evolution of other social indicators, i.e. physician density (SDG 3a), healthy life expectancy at birth (SDG 3b) and literacy rate (SDG 4) are directly linked to the endogenous evolution of economic variables in the ICES model, such as changes in per capita expenditure in public education and health relatively to the base-year levels. In addition, the share of population with access to electricity - a proxy of energy access (SDG 7) - evolves endogenously driven by the reduction of the gap between a country's GDP per capita and the OECD average GDP per capita.

With reference to the environmental pillar, the CGE modelling literature of the past decades has highlighted that CGE models are a powerful tool also to assess the evolution of some key environmental indicators, such as land use determined by land owners' revenues maximisation or GHG and CO_2 emissions directly linked to agents' production and consumption choices (Böhringer and Löschel 2006).

Nevertheless, a few indicators require further modelling developments. The indicator on water use (SDG 6) accounts for the intensiveness of water employed by agriculture, industry and households. Its dynamics depends on the demand of water services by the three sectors endogenously computed by the ICES model, while the country-specific water availability will either kept constant to the base-year levels or, according to data availability, changed accounting for the climate change influence on water reserves. The indicator on concentration of urban air pollution of particulate matter - PM2.5 - (SDG 11) is related to the evolution of PM2.5 emissions in urban areas and on the trend of urban population.

Results obtained by using the CGE modeling framework briefly described in this section will be presented in a companion paper.

6. Conclusions

This paper has described the methodological steps and reported the main results of a new assessment of sustainability worldwide. The originality of this work lies in its effort to organize the data collected for 27 indicators and 139 countries covering almost all the 17 UN SDGs adopted by the UN in New York in September 2015, in order to provide a comprehensive measurement of sustainability for its three dimensions as well as a multi-dimensional index. This latter index, which enabled us to compute a world sustainability ranking, is derived from the application of a non-linear method based on the Choquet Integral.

According to our analysis, best performances in terms of sustainability occurred in Europe, due to its economic and social development. Some industrialized countries, however, are penalized by environmental pollution, which negatively affects their sustainability. Environmental protection is the only pillar in which poor countries perform at sustainable levels, given their embryonic stage of economic growth, especially in Sub-Saharan Africa. Our analysis allows for both a graphical and an in-depth numerical assessment of similarities/divergences between geographically or economically different or similar countries.

This paper constitutes the first part of a twofold research effort. The retrospective analysis of this paper will be followed by an ex-ante prospective assessment performed using a macro-economic model integrated with a social and an environmental module. The ultimate purpose is to evaluate to what extent 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 policy choices necessary to follow a sustainable development path.

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Annex – Full ranking (ordered by multi-dimensional sustainability)

		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 Emirate	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 Tobag	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

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