INTRODUCTION

The present paper illustrates a non-reductionist approach to composite indicators aimed at communicating the uncertainty that unavoidably arises when information about different dimensions is synthesized into a single number. To this purpose the approach is applied to the Human Development Indicator.

Starting from the guidelines for constructing composite indicators elaborated by the OECD and JRC (Nardo et al., 2008), my proposal is to put the sensitivity step at the centre of the analysis approach. Actually, rather than building a single composite indicator (score) for each country, different normalization, aggregation rules, and weighting systems can be combined to calculate many different composites. As a result, a frequency distribution of the ranks and a plausible rank range for each country is obtained. The further step is to go deep into the reasons for the results.

By using such an approach, the paper reassess the HDI ranking, the dataset of which is available on the HDI website.

THE HDI

A first paragraph describes the HDI and the changes that has been made in the past few years. The HDI is a composite indicators that measures three basic dimensions —**health**, **knowledge** and **income**. Today it is calculated as the geometric mean of normalized indices for each of the three dimensions, The health dimension s assessed by the life expectancy at birth, the education component by schooling and the standard of living dimension by gross *national* income per capita.

THE REASSESSMENT

The next section describes my sensitivity exercise. The following normalization methods were used

Table 3. Normalization methods

Name	*Rule*	*Range*
Borda Count	$I_c^q = 1 - \frac{R_c^q - 1}{n}$	(0;1]
Z-score	$I_c^q = \frac{x_c^q - \bar{x}^q}{\sigma^q}$	95% of the distribution ∈[-1;1]
Min-max	$I_c^q = \frac{x_c^q - \min(x^q)}{\max(x^q) - \min(x^q)}$	[0;1]
Distance from the leader	$I_c^q = \frac{x_c^q}{\max(x^q)}$	[0;1]
Distance from the average	$I_c^q = \frac{x_c^q}{\bar{x}^q}$	>0

Where
I_c^q is the normalised indicator for variable *q* and Country *c*,
R is the rank, $\bar{x}$ the average, s the standard deviation, min and max the minimum and the maximum values, of the indicator q across countries.

Aggregation was done by using the linear, geometric, and concave rules

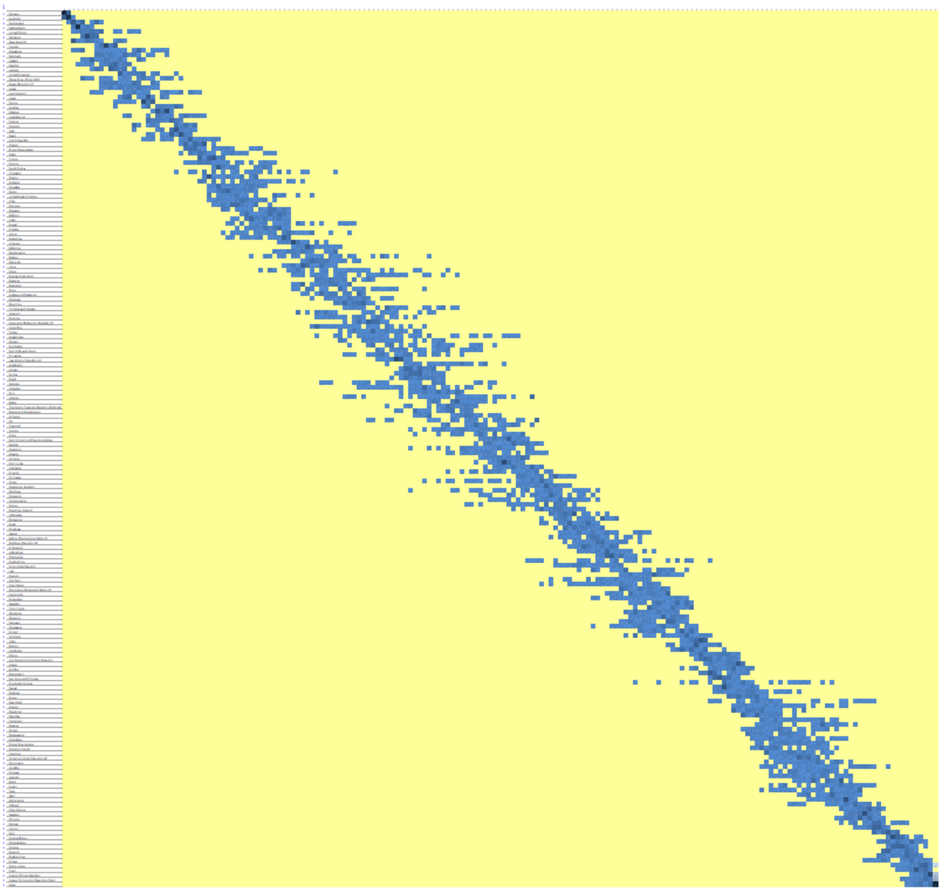
Table 4. Aggregation rules

Name	Rule
linear	$CI_c = \sum_{q=1}^{Q} w^q I_c^q$
geometric	$CI_c = \prod_{q=1}^{Q} (I_c^q)^{w_q}$
Min-max	$CI_c = \sum_{q=1}^{Q} w_q (I_c^q - he^{-kI_c^q})$

Where I_c^q is the normalised indicator for variable *q* and Country *c*, *w* the weight, h and k parameters

Finally, weighting system based on the Benefit-of-the-Doubt was also used. (20% weight to the worst indicator)

As a result we got 2256 new composites (11 new composites plus the HDI + 12 composites for each of the 187 countries).
The following is the picture of the 2256 rankings (on the x-axis) for each country (on the y-axis)



By combining different possible sensitivity "experiments", I propose that a range of plausible rankings rather than a single ranking, should be communicated, for instance the following table (the first column is the HDI rank):

HDI		H		L
1	Norway	1	-	2
2	Australia	1	-	2
3	Switzerland	3	-	8
4	Netherlands	3	-	6
5	United States	4	-	15
6	Germany	5	-	8
7	New Zealand	3	-	13
8	Canada	9	-	12
9	Singapore	4	-	21
10	Denmark	8	-	19
11	Ireland	6	-	17
12	Sweden	7	-	15
13	Iceland	8	-	14
14	United Kingdom	13	-	21
15	Hong Kong, China (SAR)	5	-	23
16	Korea (Republic of)	10	-	20
17	Japan	10	-	19
18	Liechtenstein	8	-	28

In this case, one can notice that the HDI ranking is rather robust. One reason for this is that only three dimensions are used. Nonetheless, the approach presented here does communicate the unavoidable uncertainty coming from aggregation. Hence such an approach looks as a good compromise between the need of synthesis when looking at many variables and the loss of relevant information that occurs when indicators are aggregated into a single composite indicator.

MAIN REFERENCES

Floridi M., Pagni S., Falorni S., Luzzati T (2011), An exercise in composite indicators construction: Assessing the sustainability of Italian regions, *Ecological Economics*, 70 (8), 1440-1447.

Kemeny J. (1959), Mathematics without numbers, *Daedalus*, 88, 571-591.

Luzzati T., Gucciardi G. (2013), *La sostenibilità delle regioni italiane: la classifica Leonardo-IRTA*, Felici Editore, Pisa.

Melyn W. and Moesen W.W. (1991), Towards a synthetic indicator of macroeconomic performance: unequal weighting when limited information is available, Public Economic research Paper 17, CES, KU Leuven, Belgium.

Munda G. (2008), *Social Multi-Criteria Evaluation for a Sustainable Economy*, Springer.

Nardo M., Saisana M., Saltelli A., Tarantola S., Hoffmann A., Giovannini E. (2008), *Handbook on Constructing Composite Indicators – methodology and user guide*. OECD publishing

Paruolo P., Saisana M., Saltelli A. (2013), Ratings and rankings: Voodoo or Science?, *Journal of the Royal Statistical Society* A, 176 (2), 1-26.

Saisana, M., Munda, G. (2008) Knowledge Economy: Measures and drivers. *EUR Reports 23486*, EN, European Commission, JRC-IPSC.