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Methodological and Ideological Options

A non-simplistic approach to composite indicators and rankings: an illustration by comparing the sustainability of the EU Countries

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ABSTRACT

Composite indicators are very popular, despite being affected by several problems that often result in lack of robustness of the rankings involved. The aim of this paper is to show that composite indicators can be safely used, provided that rankings are built via uncertainty analysis rather than using a single composite. For this purpose, the approach we follow first combines different normalisation, aggregation rules, and weighting systems to calculate many different composites, and then derives the rankings from the frequency distribution of the rankings of each "competitor" according to each composite. Such an approach appears to be a good compromise between the need for a more concise overview when looking at many variables and the loss of relevant information occurring when indicators are aggregated into a single composite indicator. To illustrate the approach, we rank EU Countries in terms of their sustainability.

1. Introduction

This paper compares the sustainability of the EU-27 Countries,[1] by ranking them according to their sustainability. The issue of rankings is easily seen as the social choice problem of aggregating individual preferences into a social ordering. What was the ranking of the last Olympic games? Who won the Formula 1 championship? Who should be elected as a president? Which is the least sustainable country? … In all these instances we have voters, either human beings or indicators, and candidates, i.e., the possible alternatives. The debate over the best method to build an ordering dates back at least to the end of the 18th century, e.g., to the Borda–Condorcet controversy about the method to elect the president of the French Academy of Science (see e.g., Brian, 2008). Kenneth Arrow's famous impossibility theorem gives support to the idea that no perfect method for building a social order exists. Such impossibility is in some sense comforting since it is consistent with the difficulty we experience when assessing and ranking our individual alternatives, especially when they have a multifaceted nature. At the same time, in order to evaluate (and choose), we need to synthesise information (e.g., Simon 1971, 40–41). In other words we need to solve the tension between our need for simplification and the epistemological and ontological irreducibility of complex and multidimensional objects, such as sustainable development. (e.g., Kapp, 1970: 846; Giampietro, 2003). While Condorcet proposed to build rankings through pairwise comparisons,[2] Borda suggested using a composite indicator which sums the scores each candidate obtains on the basis of each voter's rankings, similar to the score a driver obtains on the basis of his placement in each Grand-Prix. Mainly due to the computational problems of Condorcet's method when the alternatives are many (see, e.g., Munda, 2012a, p. 352), the usual way to proceed is by using composite indicators, as in the case of The Index of Sustainable Economic Welfare (Cobb, 1989), the Human Development Index of the UN Development Programme (1990), the Adjusted Net Savings (Pearce and Atkinson, 1993), the Index of Economic Well-being

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[1] Our analysis does not include Croatia, which entered the EU after most of this work was completed.

[2] For a description/presentation and a complete axiomatisation of Condorcet's approach see Kemeny (1959) and Young and Levenglick (1978).

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(Osberg and Sharpe, 2002), and the Environmental Sustainability Index (Esty et al., 2005).[3]

Composite indicators have becoming increasingly popular, both at the institutional level and in policy debate (see, e.g., Paruolo et al., 2013), especially in the field of measuring progress and the related 'beyond-GDP' debate (see e.g., Fleurbaey, 2009, and the report of the Stiglitz–Sen–Fitoussi commission).[4] A major issue with composite indicators[5] involves their strong communicative power than can be disproportionate in comparison to their reliability, which is generally low because composite indicators (and the resulting rankings) are strongly affected both by the indicators and the methods chosen to build them. Hence, they can easily lead to a simplistic if not misleading (see Böhringer and Jochem, 2007) use among the general public and policy-makers.

The methodological contribution we hope to give here is to show that composite indicators can be used without giving an excessively simplistic view of the phenomenon under inquiry. For this purpose, similarly to Saisana and Munda (2008), Munda and Saisana (2011), Floridi et al. (2011), Luzzati and Gucciardi (2013), and Luzzati et al. (forthcoming), our approach hinges on uncertainty analysis.[6] We do not deduce a single ranking from a single composite index; rather we obtain many rankings on the basis of many different composites. Hence, we can compute the frequency distribution of the different rankings obtained by each alternative (country, in this case) and infer a plausible ranking. It will become clear later that such an approach also has the merit of attenuating the issue of choosing the appropriate underlying indicators.

To illustrate this approach we applied it in order to compare the sustainability of the EU-27 Countries. Sustainability is a key policy goal of the European Union. The European Council of June 2006 adopted an ambitious and comprehensive renewed Sustainable Development Strategy (SDS)[7] (reaffirmed and reviewed in 2009[8]) "aiming to continuously improve the quality of life and well-being for present and future generations, by linking economic development, protection of the environment and social justice" (European Commission, 2011, 11). The SDS will serve as a basis for our analysis.

The paper is organised in the following manner. The next section illustrates the methodology; Section 3 shows our ranking of the EU Countries and how we built it; Section 4 goes back to the data and scrutinises the reasons for our result; Section 5 presents the conclusions.

2. Methodology

Our methodology followed the guidelines for constructing composite indicators elaborated by the OECD and JRC (Nardo et al., 2008). The steps suggested in these two works are the following: 1. choice of a theoretical framework, 2. selection of the indicators, 3. imputation of missing data, 4. multivariate analysis on the dataset, 5. standardisation/normalisation, 6. weighting and aggregation, 7. uncertainty and sensitivity analysis, 8. go back to the data, 9. link the composite to other indicators, and 10. visualisation of the results. In this section we will see how we proceeded through steps 1 to 6.

2.1. Theoretical Framework

As stated in the introduction, we choose a widely agreed theoretical framework, the Sustainable Development Strategy of the European Union. A major merit of this framework is its broad definition of sustainability. In contrast, our collective imagination often associates sustainability with natural environment protection. This is potentially harmful because we still tend to separate the environmental sphere from the economic considerations, with the consequence that we are tempted to take care of the natural environment only when the economic conditions are good, that is, to accept the interpretation of environment quality as a luxury good. Why should we allocate resources to environmental quality in the presence of such a serious economic crisis? The answer to this question comes precisely from economics, in the sense that sustainability underpins one of the main economic notions, i.e., the notion of income. According to Hicks, for instance,

> the purpose of income calculations in practical affairs is to give people an indication of *the amount which they can consume without impoverishing themselves*. Remembering that the practical purpose of income is to serve as a guide for prudent conduct, I think it is fairly clear that this is what the central meaning must be.
>
> [(Hicks, 1939, 172, Chapter. 14, our emphasis)]

The natural environment is a crucial asset, both for production and welfare, hence, we should consider how much of it we "can consume without impoverishing" ourselves rather than overlooking its depreciation. Hence, sustainability has a general character and, as emphasised by the institutionalist economist KW Kapp, preventing environmental degradation is a matter of sustainability, because an unregulated competitive economy, via non-market physical flows (i.e., externalities), can "threaten the economic process, its social reproduction, and hence the continued guarantee of human well-being and survival" (Kapp, 1976, p. 91; see also Kapp, 1977, p. 205; Luzzati, 2009, 2010).

2.2. Selection of Indicators

Given that measuring progress towards sustainability is an integral part of SDS, Eurostat has built a set of sustainable development indicators (SDIs) which, since 2007 (European Commission, 2007), has been the basis for the EUROSTAT biennial monitoring report of the SDS. Indicators are grouped into the following ten themes: 1. socio-economic development, 2. sustainable consumption and production, 3. social inclusion, 4. demographic changes, 5. public health, 6. climate change and energy, 7. sustainable transport systems, 8. natural resources, 9. global partnership, and 10. good governance.

Among the SDIs we selected those indicators for which data are available for all EU-27 Countries. We found 73 indicators giving a fair representation of each theme except for that of 'natural resources', for which only 2 indicators are available for all countries. In the European Environmental Agency database we found another two relevant indicators, 'artificial surfaces' and 'forest increment and fellings'. We did not select any other variable from the SDI dataset, also in order to avoid the tricky/dangerous issue of imputation of missing data.[9] In the theme 'good governance' we included the six composites developed by the "Worldwide Governance Indicators" of the World Bank.[10] Appendix 2 synthetically describes the selected indicators.

Multivariate analysis was then performed to analyse the dataset and to verify whether some variables were redundant. The correlation matrix (Pearson's correlation coefficients, ρ) shows that some

[3] For an overview of sustainability indices see, e.g., Singh et el. (2012).
[4] http://www.stiglitz-sen-fitoussi.fr/en/index.htm.
[5] For a detailed discussion of their pros and cons see Saltelli, 2008.
[6] A different, and interesting, although different, approach to robustness analysis is proposed by Cherchye et al., 2008.
[7] http://register.consilium.europa.eu/pdf/en/06/st10/st10917.en06.pdf.
[8] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0400:FIN:en:PDF.
[9] For the same reason, in few instances, we did not take the most recent available year.
[10] The WGIs are six aggregate composite indicators for governance for over 200 countries over the period 1996–2011. They are based on thirty different data sources provided by several survey institutes, private firms and international organisations. For details see http://info.worldbank.org/governance/wgi/index.asp.