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A new tool to facilitate quantitative assessment of green activities — A trial application for Rio de Janeiro

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ABSTRACT

A multi-criteria methodology for assessing the Rio de Janeiro State's green economy level, considering the most representative activity sectors, is proposed. Representative partial indicators on economic, social and environmental aspects are identified, leading to the multidimensional performance of each activity sector. The calculation of a single green economy index was avoided. Instead, a performance classification of the activity sectors is obtained. For each partial indicator, thresholds were chosen in order to define the classification ranges. The aggregation among the dimensions, looking for a global classification of the activity sectors, is done utilizing an interactive non-compensatory approach, i.e., an extension of the conjunctive method. A dashboard was built hence enabling a simple and interactive sensitivity analysis. The system proposed here is a user-oriented tool, very simple, in both conceptual and operational terms and supported by graphical representations with great flexibility. For instance, interactive sensitivity analysis experiences to adjust thresholds, i.e., the range of the classes concerning each partial indicator, can be done directly on the screen by using a mouse. In this paper, after outlining the used package, we present and discuss a case study regarding the evaluation of green economy level in the State of Rio de Janeiro. Some final considerations and future trends are sketched.

1. Introduction

Rio + 20 conference has established green economy as a world priority. To reinforce the local commitment to the event goals, the authorities of Rio de Janeiro State (RJS) commissioned a methodology for measuring its green economy level, aiming at applying it to monitor the economy evolution towards the goals established by the conference.

The very first hurdle is to define green economy. UNEP United Nations Environmental Program (2011) defines a green economy "as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". This comes in the sense of the Brundtland Commission, which established that "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). Unfortunately, the present situation is very far from these wise principles. As it is explained in Matsushita (2011): "60% of the world's major ecosystem goods and services that underpin livelihoods have been degraded or used unsustainably". The author draws our attention to the incompatibility between the short-term rationality of the financial economy and the sustainability issues, emphasizing that dealing with the present crisis implies changing of economic paradigm, namely incorporating global environment and energy issues. However, environmental threats and economic crisis also create opportunities. With appropriate policies and investments, the transition to a green economy could enable reaching up social goals (such as equity and employment) and reducing

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environmental risks (leading to low carbon level economy and resource efficiency).

The aim of this paper is not to discuss alternative policies for the transition to a green economy, but to discuss the usefulness of a new tool to evaluate the green economy level, in order to advise interested policymakers. As somebody told 'you cannot manage what you do not measure'. Moreover, note that, our proposal, based on the use of a new tool, is not based on the more usual, fragmentary approach of green economy. Namely, most of the literature considers that it consists of only a few number of activity sectors that supposedly show a better environmental performance, such as ecotourism, renewable energies, and green building (U.S. Department of Commerce Economics and Statistics Administration — DCESA, 2010; Davulis, 2010; Washington State Department of Community, CTED, 2012; Labor Market Partnership Program — LMPP, 2010).

An alternative option is to evaluate all the relevant activity sectors of a given economy, assuming that migration to a more sustainable performance should be a conjoint desideratum. After prioritizing economical, environmental and social aspects and subsequently identifying partial indicators of performance, data on the most relevant activity sectors of RJS economy has been sought. Available databases were analyzed, to check what is actually measured, and how. Then, partial indicators allow a multidimensional evaluation of performance for each activity sector.

Traditionally, the aggregation of partial indicators is made using the additive model, i.e., calculating a weighted sum of partial indicators after its normalization. In this case, in order to avoid the drawbacks of this very disputable approach, it was decided not to aggregate the set of partial indicators into a single green economy index. Instead of rankings, in this paper we present and discuss the use of a package looking for a global classification of the activity sectors. The aggregation among the partial indicators is based on the use of the conjunctive method, where, in few words, the acceptable alternatives must pass a minimal performance threshold for all criteria (Linkov et al., 2004; Hwang and Yoon, 1981). In our case (SABILOC-MAT 1.0 package), it is utilized an extended interactive version of the conjunctive method. The SABILOC-MAT 1.0 package (Climaco et al., n.d.) considers thresholds (values that define intervals delimitating different levels of performance) for each partial indicator. Even though the use of thresholds also requires subjective choices, there is less loss of information than in the case of an aggregation of all indicators into a single index. The used software enables a clear communication between policymakers and stakeholders, thanks to a dashboard that enables a simple and useful visual interactive sensitivity analysis. For instance, in some cases it is possible to conclude that the strength of green economy can be improved by small variation(s) of a single (or a few) partial indicators.

In Section 2, the package SABILOC-MAT 1.0 is introduced.

In Section 3 the partial indicators and the evaluated activity sectors concerning the case study dealt with in this paper are introduced. A more detailed description can be found in Anon. (2012).

In Section 4 we deal with the major goal of this paper, presenting and discussing the potentialities of SABILOC-MAT package in practice. The RJS's green economy level evaluation is presented and discussed.

In Section 5 some final considerations and future trends are outlined.

2. On the SABILOC-MAT package — implementing a non-compensatory aggregation of multidimensional evaluation

The software SABILOC-MAT 1.0 was initially developed in a context of location analysis and it was integrated in a DSS (Decision Support System). It is a methodology based on an interactive implementation of the Conjunctive Method, enabling the consideration of up to three performance thresholds, having in mind to classify the objects under evaluation into four classes: non-acceptable, acceptable, good and very good. Further details can be found in Climaco et al., (n.d.) and Fernandes et al. (2014).

The above referred to interactive dashboard (here adapted to RJS's green economy evaluation level) is presented in Fig. 1. In the top left we have a set of sliding controls that enable the fixation of thresholds for the various dimensions. In the bottom one can find the matrix of the objects under evaluation with the corresponding performance on each partial indicator. In general, both quantitative and qualitative indicators are admitted.

On the right a radar chart presenting the dimensions under evaluation for each of the considered RJS's activity sector is shown. The profiles of the different activity sectors are displayed. Choosing one to analyze it will appear filled. In this case it is the chemical industry, filled in blue. The 12 vertices of its external contour/profile indicate the partial indicators evaluation corresponding to an activity sector.

The fixation of each of the three thresholds, which bound the four performance levels, may be carried out through the sliding controls on the top left or through the adjustable pinpoints on the radar chart, on the right. The representation of the thresholds in the radar chart is made through a colored broken ring, not filled for the thresholds delimitating "unacceptable", "acceptable", "good" and "very good" performance levels. The thresholds for "acceptable", in red, delimit a region that corresponds to unacceptable activity sectors.

The associated colors are: Red: unacceptable (below the reservation level); Orange: acceptable (above the reservation level); Yellow: good (above the threshold of "good"); Green: very good (above the threshold of "very good").

The following formal protocol was built in order to improve the thresholds eliciting process:

a. Hierarchize the criteria importance: in dialog with policymakers and stakeholders, the criteria are ranked according to a non-increasing order of importance. In draw cases the facilitator decides which one appears first.
b. Starting with the "most important criterion", policymakers and stakeholders evaluate whether the worst alternative regarding this criterion could be accepted or not. If it is unacceptable, the process continues with the next alternatives, until the first acceptable alternative is identified. The red threshold for the considered criterion is introduced in the central point of the interval between the last unacceptable criterion value and the first one acceptable.
c. The other thresholds (orange and yellow) are identified following a similar procedure, starting by the first alternative for which the criterion value under consideration is above the threshold fixed immediately before.

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