Green Economy Index: What really matters?

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Objective

The aim of this article is to provide a new index of sustainability, called Green Economy Index, the Magic Triangle, which is associated to Kaldorian ideas.

1. Index of Sustainable Economic Welfare - ISEW, Daly and Cobb (1989)
2. Ecological Footprint, Wackernagel and Rees (1995)
3. Planetary Boundaries, Rockstrom et al (2009)
4. Actual Net Income Available Per Household, Stiglitz-Sen-Fitoussi Commission (2009)

History

- In the quest to contribute in this area of measurement by means of indicators that are multi-varied, the use of the Magic Square of Kaldorian inspiration appears as an appropriate analytical tool, since it allows for the comparison of results between countries of different levels of development
    - It permits the study of several variables simultaneously and a more direct comparative performance, evolving socioeconomic and environmental issue of sustainable development.

History

- The idea of evaluating and comparing the accomplishment of countries appeared in a seminal paper of Kaldor (1971), in which the author has studied the macroeconomic performance of the United Kingdom)
- Karl Schiller introduced a graphical representation of the ideas of Kaldor during the decade of 1970, which has been applied by researchers of the OECD and called "Magic Square"

History

- Medrano-B and Teixeira (2013) extended this geometric vision, providing a numerical evaluation of the area of the figure, which could not be done properly due to the different units of the variables' dimension

History

- The use of the "Magic Square" as the analytical instrument is not limited to the macroeconomic. The index may favor different interpretations, depending on the variables chosen to compose it
  - This theory was tested in the article of Teixeira, Pinheiro and Vilasboas (2015), where it was used to compare the performance of China and the USA in relation to their respective paths of socioeconomic development

History

- In a recent work of Saavedra-Rivano & Teixeira (2016), a problem in the ordering of the variables has been observed, which if changed, different results may generate for the index
  - They proposed a solution called "Hypercube Magic"

Magic Triangle

- In this new geometric form, we chose only three variables, which make the results of the index indifferent to the ordination of the variables, because it provides always a single value for the indicator
  - We assume that our collection of variables to compose the overall green economics index attends the Occam's razor principle for modeling and measuring multi-dimensional characteristics that would be hard to explain using a small number of variables

Magic Triangle

- Our methodology also aims an immediate leap in understanding sustainable green economy using a theoretical framework as simpler as possible.
- We question whether more information is necessarily the same thing as more understanding. It seems that the present framework far exceeds the limitations involved.

Normalization

Low carbon	CO2 emission (τ)
Efficient use of resources	Supply of renewable energy (?)
Socially inclusive	Per capita income (γ)

Variables

$$-1 \leq \gamma \leq 1; \qquad -1 \leq \tau \leq 1; \qquad -1 \leq \varphi \leq 1.$$

$$0 \leq \gamma' \leq \beta; \qquad 0 \leq \tau' \leq \beta; \qquad 0 \leq \varphi' \leq \beta.$$

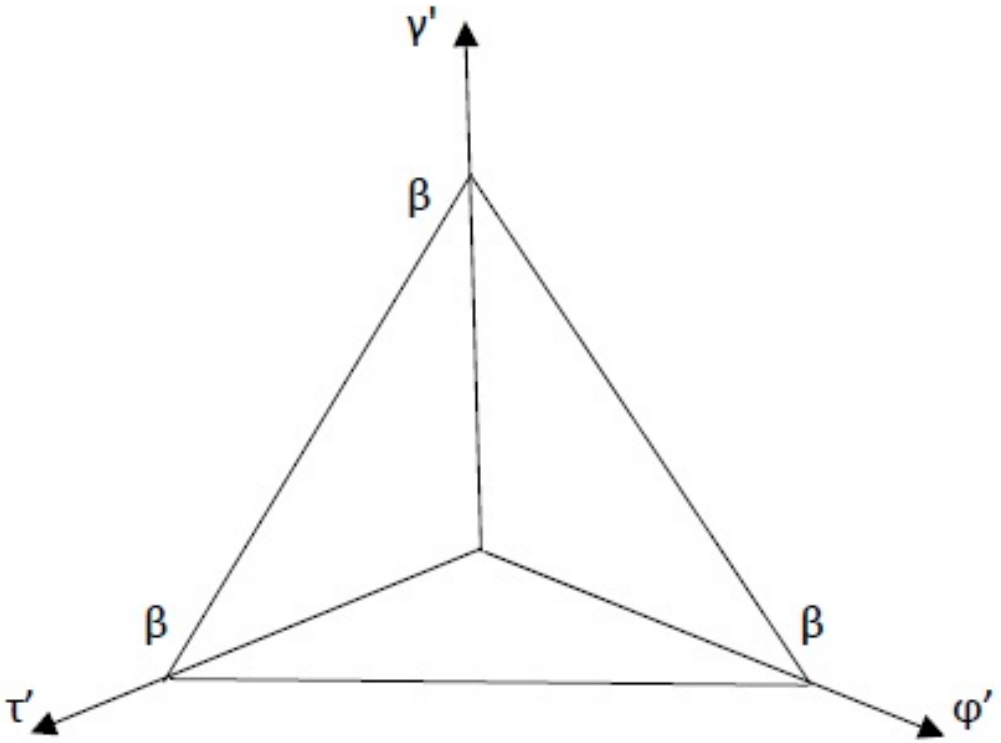
Normalization

$$\gamma` = \frac{\beta(\gamma + 1)}{2}$$

$$\tau` = \frac{\beta\,(1 - \tau)}{2}$$

$$\varphi` = \frac{\beta\,(\varphi + 1)}{2}$$

Figure 3: Magic Triangle's Area



Source: elaborated by the authors.

Area of the Triangle

$$Aw = 3\,x\,\frac{h\,\beta}{2}$$

where h is the height and β is the side of Figure 3. Therefore, $\beta^2 = \frac{4\sqrt{3}}{9}$.

Area of the Triangle formed by the actual values

$$A' = \frac{\sqrt{3}}{4}\left(\gamma'\tau' + \tau'\varphi' + \varphi'\gamma'\right)$$

Brazil

Table 2- Normalized Variables

Period	*Per capita* income(γ)	CO2 emissions (τ)	Sypply of renewable energy (φ)	Ideal
2001-07	0.487	0.445	0.446	0.877
2008-14	0.481	0.449	0.430	0.877

Source: elaborated by the authors.

Results

Table 3- Green Economy Index (Brazil)

Period	Green Economy Index	Ideal
2001-07	0.274	1.000
2008-14	0.267	1.000

Source: elaborated by the authors.

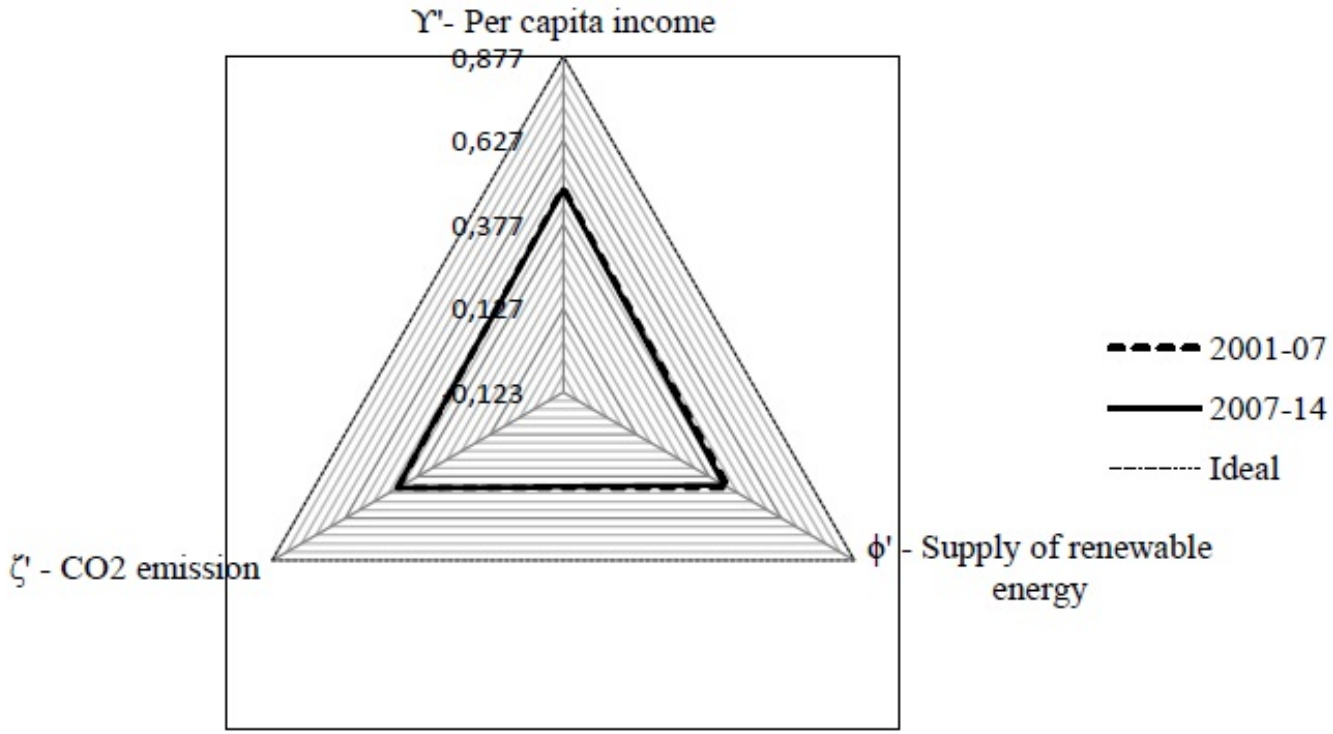
Geometric formula to the rate of variation

$$variation = 100 \cdot \left(\sqrt[n]{\frac{\text{green index}_{\frac{2008}{2014}}}{\text{green index}_{\frac{2001}{2007}}}} - 1 \right)$$

Brazil's rate of variation

$$variation = 100 \cdot \left(\sqrt[7]{\frac{0{,}267}{0{,}274}} - 1\right) = \text{-}0{,}370\%$$

Figure 4: Magic Triangle - Brazil



Source: elaborated by the authors.

Gini Index as social pillar

$$variation = 100 \cdot (\sqrt[7]{\frac{0{,}252}{0{,}257}} - 1) = -0.252\%$$

Hypercube

$$variation = 100 \cdot \left(\sqrt[7]{\frac{0{,}137}{0{,}143}} - 1\right) = -0.559\ \%$$

Analysis of the results

- Brazil is stagnating in the major variables that characterize a green economy
- This performance resulted in a variation of the green economy index close to zero (-0,370%)
- Why Brazil stopped?
  1. Water crisis;
  2. Environmental policies adopted do not include the formal control of emissions;
  3. Economic crisis.

- The implementation of a green economy is a profound challenge for governance at all levels;
- Society needs to be cautions and use rash measures in which the thresholds of the planet become global commons;

- The present work had the purpose of building a new indicator of sustainability: the Green Economy Index. It was assembled from an analytical instrument, called the Magic Triangle;
  - Due to its simplicity of measurement and graphical representation, this index appears as a fair analytical tool among the various indicators of sustainability.

According to Georgescu-Roegen (1971):

In a different way than in the past, man will have to return to the idea that his existence is a free gift of the sun.

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