Composite indicator at variable geometry in cohesion analysis

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### Where to find this talk: www.andreasaltelli.eu



sensitivity analysis, sensitivity auditing, science for policy, impact assessment

Is a theory for composite indicators possible?

"The role of statistical indicators" has increased significantly over the last two decades. This reflects improvements in the level of education in the population, increases in the complexity of modern economies and the widespread use of information technology."



Jean-Paul Fitoussi, Amartya Sen, Joseph Stiglitz

CMEPSP (2009). Commission on the Measurement of Economic Performance and Social Progress, URL: http://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report, last accessed June 2017. CI as boundary objects, between analysis and advocacy

CI as instruments in a changing styles of governance of knowledge for policy; of democratization of expertise; of social discovery (John Dewey); the semiotic of CI's (Charles Sanders Peirce)



Paul-Marie Boulanger

Paul-Marie Boulanger, 2014, Elements for a comprehensive assessment of public indicators, Report EUR 26921 EN. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC92162/lbna26921enn.pdf A triadic conception of the sign as structure connecting three elements: the sign properly said (S), an object (O) and an "interpretant"(I). But an example is needed …



Charles Sanders Peirce, the father of semiotics "This monkey possess a sophisticated repertory of vocal signs for signaling the presence of a predator [distinguishing a] terrestrial stalking one such as a leopard, an aerial raptor such as an eagle or a ground predator such as a snake."



African vervet monkey (Cercopithecus aethiops)

Paul-Marie Boulanger, 2014, Elements for a comprehensive assessment of public indicators, Report EUR 26921 EN. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC 92162/lbna26921enn.pdf

# Sign **←→** Cry



# $Object \leftarrow \rightarrow Predator$



# Interpretant **C** Behaviour



CI as instrumental to the creation of a new public, through a process of social discovery (J. Dewey)

Why are 'social discoveries' needed?

Because there are 'publics' affected by transaction taking place somewhere else. "[...] machine age has so enormously expanded, multiplied, intensified and complicated the scope of the indirect consequences [...] that the resultant public cannot identify and distinguish itself."

Dewey, J., 1938. The Public and its Problems, Read Book Ltd. Edition, 2013.

Social facts – unlike physical facts, are only meaningful in a context of desired ends

→Peirce's interpretant

From J. Dewey 'Social Science and Social Control' in John Dewey: The Later Works, 1925–1953: 1931– 1932, Vol. 6-ExLibrary,





Building a composite indicator can be seen as a process of social discovery for which a model of extended participation comes natural

Frames and indicators are coproduced in the process which must be designed as to have a meaningful 'interpretant', or 'end-in-sight'



Paul-Marie Boulanger, 2014, Elements for a comprehensive assessment of public indicators, Report EUR 26921 EN. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC92162/lbna26921enn.pdf

Ubiquity of composite indicators



Critique of composite indicators

"a general criticism ... frequently addressed at composite indicators, i.e. the arbitrary character of the procedures used to weight their various components ... an aggregation procedure always means putting relative values on the items that are introduced in the index ...



Jean-Paul Fitoussi, Amartya Sen, Joseph Stiglitz

CMEPSP (2009). Commission on the Measurement of Economic Performance and Social Progress, URL: http://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report, last accessed June 2017.

"The problem is not that these weighting procedures are hidden, nontransparent or non-replicable – they are often very explicitly presented by the authors of the indices, and this is one of the strengths of this literature. The problem is rather that their normative implications are seldom made explicit or justified.



Jean-Paul Fitoussi, Amartya Sen, Joseph Stiglitz

CMEPSP (2009). Commission on the Measurement of Economic Performance and Social Progress, URL: http://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report, last accessed June 2017. The problem is not the non-neutrality of a measure but its purported neutrality (R. Pielke's Jr 'stealth advocacy')

Roger A. Pielke, Jr., 2007, The honest broker, Cambridge University Press



For Ravallion there are types two indices: those built on economic theory / monetary aggregates / shadow prices, and all others (=mashup indices)



Martin Ravallion

+ existing measures of e.g. development or poverty (Human Development Index, HDI, the Multidimensional Poverty Index, MPI) are bad at coping with tradeoffs

Martin Ravallion, 2010, Mashup indices of development, Policy Research Working Paper 5432, The World Bank Development Research Group, http://documents.worldbank.org/curated/en/454791468329342000/pdf/WPS5432.pdf

To illustrate the distinction, consider two stylized examples of composite indices, both formed from the data on household assets and consumer durables found in the Demographic and Health Surveys (DHS). For index A the variables and their weights are set by the analyst, who has some concept of -economic welfare in mind, and thinks this is related to certain variables in the DHS, which are aggregated based on the analyst's judgments.  ${
m FOr}$ index B, the variables and weights are instead based on a regression model calibrated to another survey data set for which a comprehensive measure of consumption (though still containing measurement errors) could be derived. The model is calibrated to common variables in the

expenditure survey and the DHS, and the regression model is used to predict wealth in the DHS.

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A is a mashup index, B is not.
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Martin Ravallion

Economics theory is not always helpful

Caution is needed with reliance on formal methods / models; recent famous blunders:

Carmen Reinhart and Kenneth Rogoff MS-Excel based theorem; the econometrics of Daron Acemoğlu; use of DSGE ...



John Cassidy, 2013, The Reinhart and Rogoff Controversy: A Summing Up, April 26, 2013 http://www.newyorker.com/news/john-cassidy/the-reinhart-and-rogoff-controversy-a-summing-up

Ruth Alexander, Reinhart, Rogoff... and Herndon: The student who caught out the profs, BBC News, April 20, 2013, http://www.bbc.com/news/magazine-22223190

David Y. Albouy, The Colonial Origins of Comparative Development: An Empirical Investigation: Comment, American Economic Review, vol. 102, no. 6, October 2012, (pp. 3059-76) https://www.aeaweb.org/articles?id=10.1257/aer.102.6.3059

Philip Mirowski, 2013, Never let a serious crisis go wasted, Verso Books.

Since composite indicators are here to stay …

Better try to built them with a theory





### Sensitivity analysis



# Series A Statistics in Society

Uncertainty and sensitivity analysis techniques as tools for the quality assessment of composite indicators

M. Saisana, A. Saltelli, S. Tarantola

First published: 3 March 2005 Full publication history

DOI: 10.1111/j.1467-985X.2005.00350.x View/save citation

Cited by (CrossRef): 181 articles for updates

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View issue TOC Volume 168, Issue 2 March 2005 Pages 307–323 CI problematic just because of weights?

Sources of arbitrariety: What to include, what to exclude How to organize the dimensions How to populate dimensions with indicators …



# Using sensitivity analysis the volatility of rankings can be exposed

Research Policy 40 (2011) 165-177



# Rickety numbers: Volatility of university rankings and policy implications Michaela Saisana\*, Béatrice d'Hombres, Andrea Saltelli

Econometrics and Applied Statistics, Joint Research Centre, European Commission, Enrico Fermi 2749, 21027 Ispra, Italy



One can test whether assigned weights correspond to real importance

Journal of the Royal Statistical Society



J. R. Statist. Soc. A (2013) 176, Part 3, pp. 609–634

### Ratings and rankings: voodoo or science?

Paolo Paruolo

University of Insubria, Varese, Italy

and Michaela Saisana and Andrea Saltelli

European Commission, Ispra, Italy



Assigned weights (dark grey) versus measured importance for the 2010 HDI (Paruolo et al., 2011)

> A. Saltelli, M. Ratto T. Andres, F. Campolongo, J. Cariboni, D. Gatelli M. Saisana, S. Tarantola, GLOBAL ANALYSIS The Primer WILEY



A CI corresponds to a fixed framing but this maybe be undesirable when different constituencies are affected

Thus a CI can be deconstructed  $\rightarrow$  CI need to be build keeping the possibility of deconstruction in mind, hence internalizing the multiplicity of frames

Araujo, L., Saltelli, A. & Schnepf, S. V. Do PISA data justify PISA-based education policy? Int. J. Comp. Educ. Dev. 19, 20-34 (2017).

More deconstructions: http://www.andreasaltelli.eu/file/repository/Saltelli\_Bergen\_September2017\_Methods.pdf



### Do PISA data justify PISA-based education policy?

PISA-based education policy



International Journal of Comparative Education and Development Vol. 19 No. 1, 2017 pp. 1-17 © Emerald Publishing Limited 2396-7404 DOI 10.1108/IJCED-12-2016-0023



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Chemistry class at the Dong Tien Secondary School, That Nguyen Province, Vietnam, Asian Development, Berliefficier, CC 2008A

### A condensed version of the article

# An example in the making: cohesion policy



### Composite indicators for cohesion policy? A work in progress



Brussels, 26.4.2017 SWD(2017) 200 final

#### COMMISSION STAFF WORKING DOCUMENT

Social Scoreboard

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Establishing a European Pillar of Social Rights

{COM(2017) 250 final} {SWD(2017) 201 final} {SWD(2017) 206 final}

### Investment for jobs and growth

Promoting development and good governance in EU regions and cities











Sixth report on economic, social and territorial cohesion



### Classical vs. Variable geometry CI





# Empirical analysis – Level 0 example

### Variables (Social scoreboard)

Net disposable income (purchasing power standard based on final consumption per inhabitant) (DI) Participation rate in education and training (last 4 weeks) (% from 25 to 64 years) (E)

**Objects:** Visegrad Group (4 countries, 35 NUTS-2 regions)

**Period:** 2004 - 2014



### More progress but more spread

### Disposible income and participation rate in education in 2004 and 2014 (V4 regions)



## CI\_Nations (averaging V4 regions)

CI\_N for V4 regions

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
C.V.	85%	83%	80%	84%	75%	80%	81%	77%	80%	81%	79%



# Coefficient of variation of the CI\_Regional, within countries

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CZ	134%	99%	79%	69%	52%	52%	52%	37%	27%	26%	24%
HU	113%	103%	82%	88%	68%	77%	45%	79%	47%	44%	28%
PL	48%	52%	50%	44%	36%	38%	33%	33%	35%	37%	38%
SK	134%	122%	113%	92%	79%	79%	61%	60%	65%	66%	67%

CI (within countries inequalities)



	2014	2013	2012	2011	2010
	24%	26%	27%	37%	52%
	28%	44%	47%	79%	45%
PL	38%	37%	35%	33%	33%
SK	67%	66%	65%	60%	61%



# Conclusions: CI – instructions for use

Awareness of the imperfections and non-neutrality of measures

Investigate properties and assumptions

Use for social discovery, (deliberative) extended participation; quality as fitness for purpose

Don't commit to a single view

### Further research:

Level 0 example shows that based on the same data one can say two different stories, i.e. regional convergence and within countries divergence.

- Extend the analysis for more countries,
- Extend the analysis for more variables (final set of variables based on sensitivity analysis),
- Composite indicator at variable geometry?



