



JRC work on poverty measurements

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**European Commission,
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**La multidimensionalità della povertà:
come la ricerca può supportare le politiche per l'inclusione
ROMA, 22 E 23 MAGGIO 2012**



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**Michaela Saisana,
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MPAT: Multidimensional poverty assessment tool (a scoreboard)

The Multidimensional Poverty Assessment Tool

Design, development and application
of a new framework for measuring rural poverty



Enabling poor rural people to overcome poverty



Enabling poor rural people
to overcome poverty



WHAT: a methodology and a framework for the development community to implement better poverty reduction programmes.

BY WHOM: International collaborative effort including

- UN International Fund for Agricultural Development
- European Commission JRC (statistical support)

The Multidimensional Poverty Assessment Tool

Design, development and application
of a new framework for measuring rural poverty



How:

Survey based;

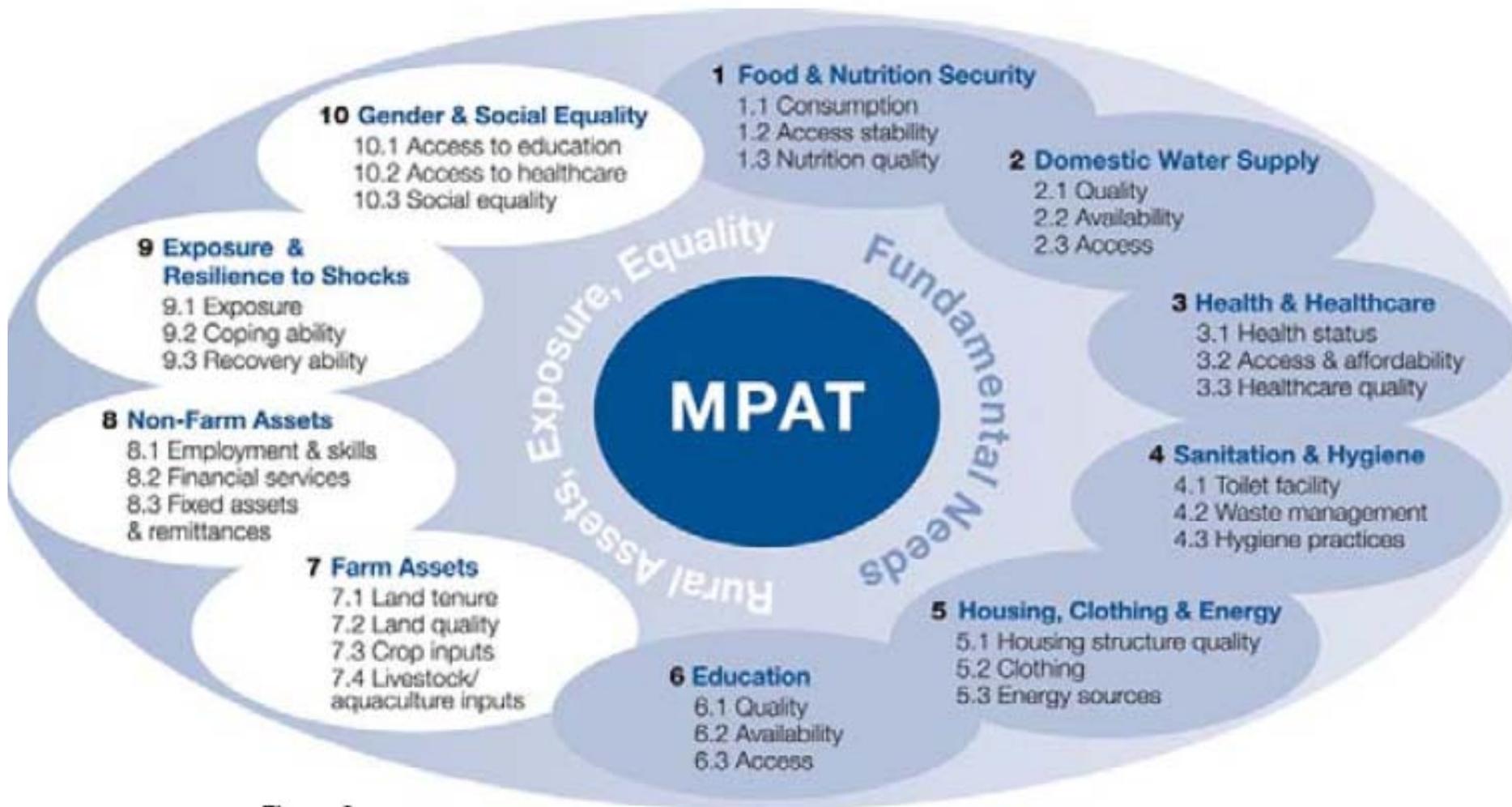
Six of MPAT's ten components = Basic or fundamental needs;

Four MPAT components = dimensions of rural livelihoods, life and well-being, "new rurality";

Quest for transparency;



European
Commission



10
Components

*Subcomponents are combined
with weighted geometric averages*

31 Subcomponents

Values are combined with weighted arithmetic averages

Valued MPAT Survey Data

All survey responses are transformed to 1-10 values (expert valuation)

RAW DATA

MPAT Household Survey

MPAT Village Survey



European Commission

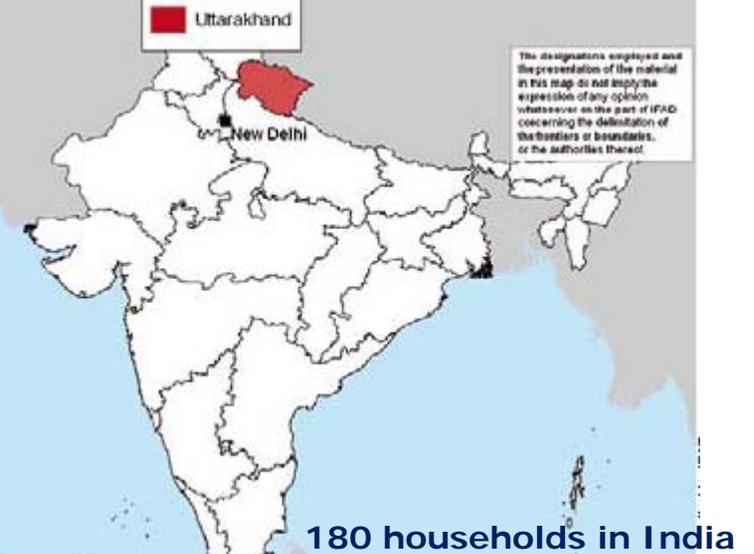


China

300 households in China



India



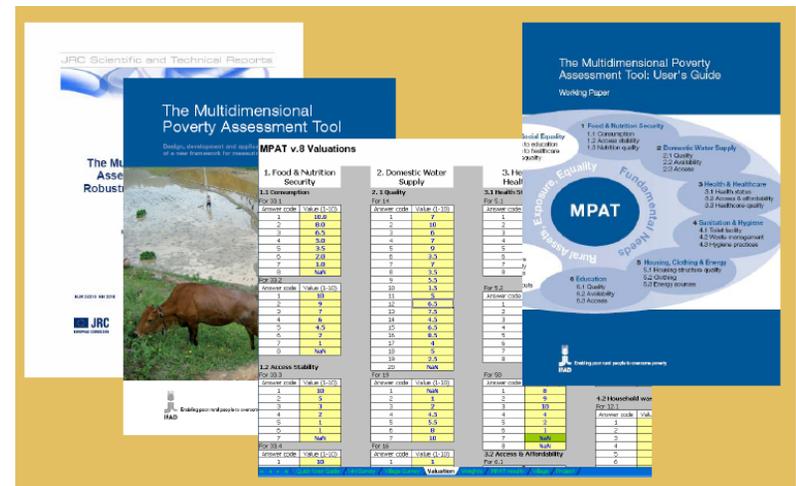
180 households in India

Joint Research Centre

JRC analysis



- ✓ A well-balanced structure (not dominated by few subcomponents)
- ✓ Robust with respect to alternative weighting and aggregation rules at the subcomponents level.
- ✓ No highly statistically significant correlations between the main ten components → not worth a linearly built CI





Project profile

General information

Number of HHs surveyed	105	[min, max] within village
Average survey time (minutes)	29	[20, 60]
Average respondent's age (years)	46	[20, 78]
Average head of HH age (years)	46	[24, 75]

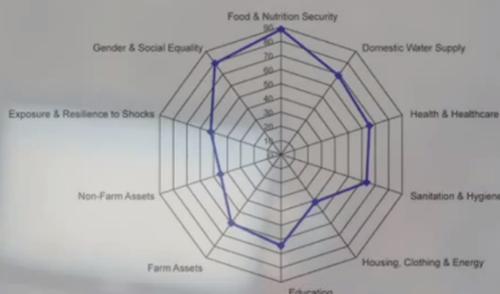
Gender statistics

Male respondents	27	25%
Female respondents	12	11%
Male headed HHs	23	22%
Female headed HHs	11	10%
Female & male headed HHs	5	4%

Head of household's marital status

Married	19	18%
Single	7	7%
Divorced	9	8%
Widowed	4	4%

note: HH = household



MPAT (v.8) components

Scores across households
Average [min, max]

Food & Nutrition Security	88.4	[77.8, 95.3]
Domestic Water Supply	68.9	[52.1, 82.1]
Health & Healthcare	65.7	[48.8, 78.5]
Sanitation & Hygiene	63.6	[48.5, 76.6]
Housing, Clothing & Energy	41.3	[26.3, 77.2]
Education	64.3	[33.5, 73.7]
Farm Assets	59.7	[39, 73.4]
Non-Farm Assets	44.9	[37.6, 62.9]
Exposure & Resilience to Shocks	52.2	[34.5, 63.7]

MPAT (v.8) subcomponents

Scores across households
Average [min, max]

Food & Nutrition Security	Consumption	92.3	[81.8, 100]
	Access Stability	98.0	[72.5, 100]
	Nutrition Quality	72.5	[59.6, 89]
Domestic Water Supply	Quality	69.6	[52.3, 81.8]
	Availability	89.5	[59.5, 100]
	Access	52.1	[24.9, 74]
Health & Healthcare	Health Status	76.8	[40.3, 95]
	Access & Affordability	56.6	[29.5, 79]
	Healthcare Quality	67.0	[56.1, 81.9]

MPAT
Excel Spreadsheet
designed &
developed by the
JRC

<http://www.youtube.com/watch?v=9rOB4fwv4w8>

Statistical methodology to test MPAT:

- OECD, European Commission, Joint Research Centre, 2008, Handbook on Constructing Composite Indicators: Methodology and User Guide, OECD publication Code: 302008251E1.
- Saisana, M., A. Saltelli, and S. Tarantola, 2005, Uncertainty and sensitivity analysis techniques as tools for the quality assessment of composite indicators. *Journal of the Royal Statistical Society - A* **168**(2), 307–323.



Human Development Index (a composite indicator)

The analysis in a nutshell:

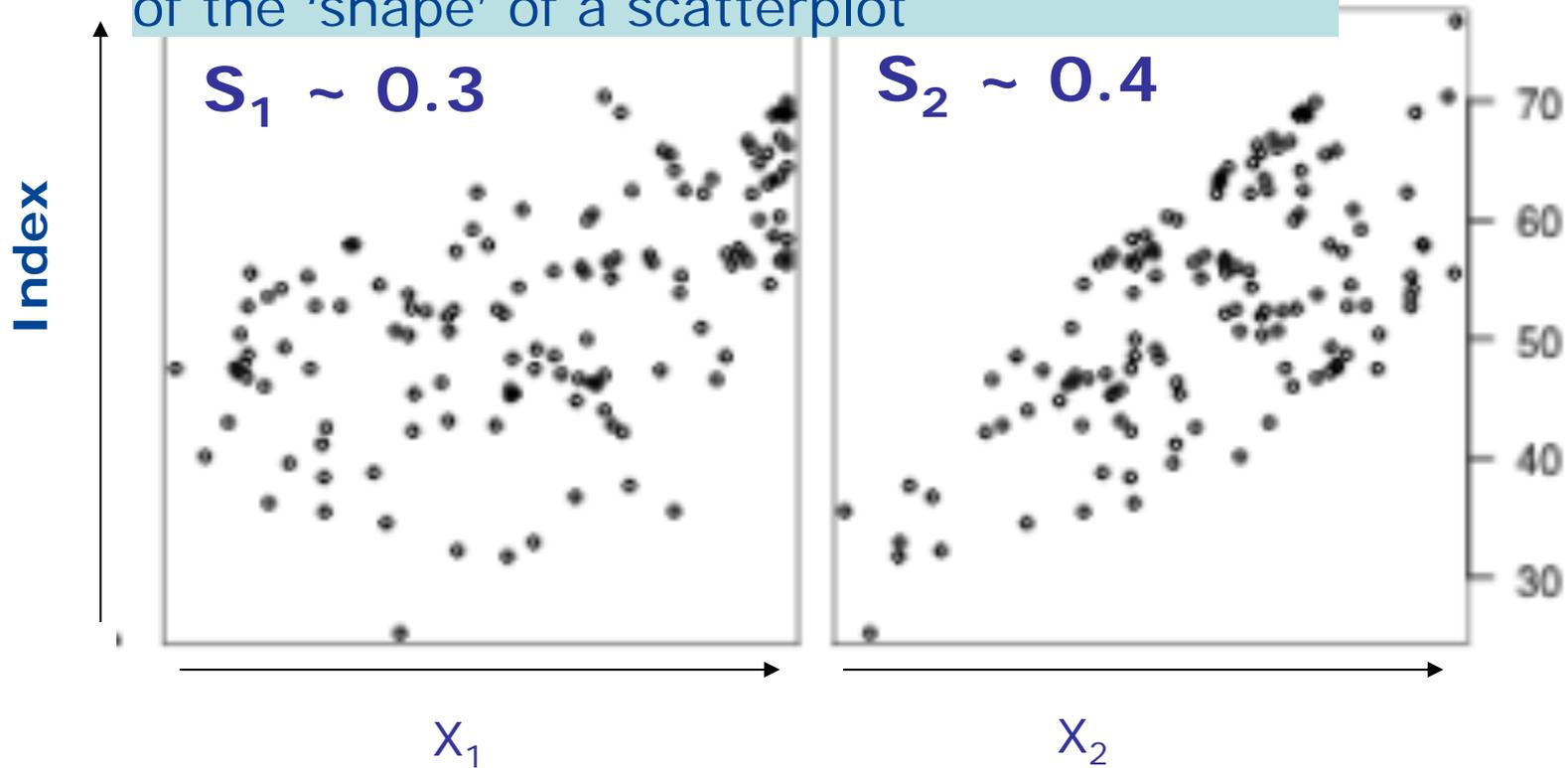
Test the internal coherence of the index – do the weights assigned by the developers

Declared weights
(declared importance)



Effective weight:
how important is a given
variable or pillar ?

The measure S_i is the numerical translation of the 'shape' of a scatterplot



Explaining S_i

$$y = y(x_1, x_2, \dots, x_k)$$

Sensitivity index of the first order =
= Pearson correlation ratio η^2

$$S_i \equiv \eta_i^2 := \frac{V_{x_i} (\mathbf{E}_{\mathbf{x}_{\sim i}} (y \mid x_i))}{V(y)}$$

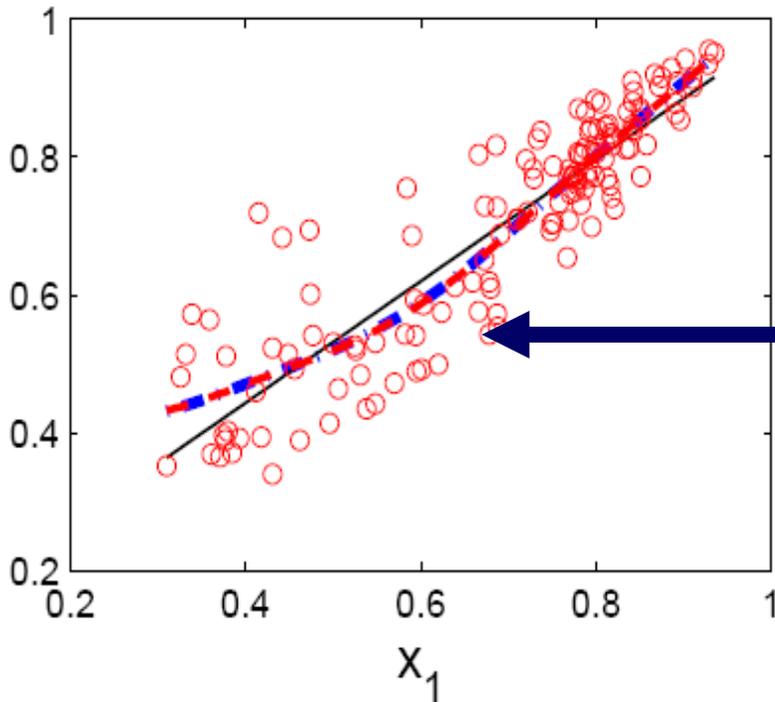
Pearson's correlation
ratio

Smoothed curve

$$S_i \equiv \eta_i^2 := \frac{V_{x_i} (\mathbf{E}_{\mathbf{x}_{\sim i}} (y \mid x_i))}{V(y)}$$

First order sensitivity index

Unconditional
variance



Smoothed curve

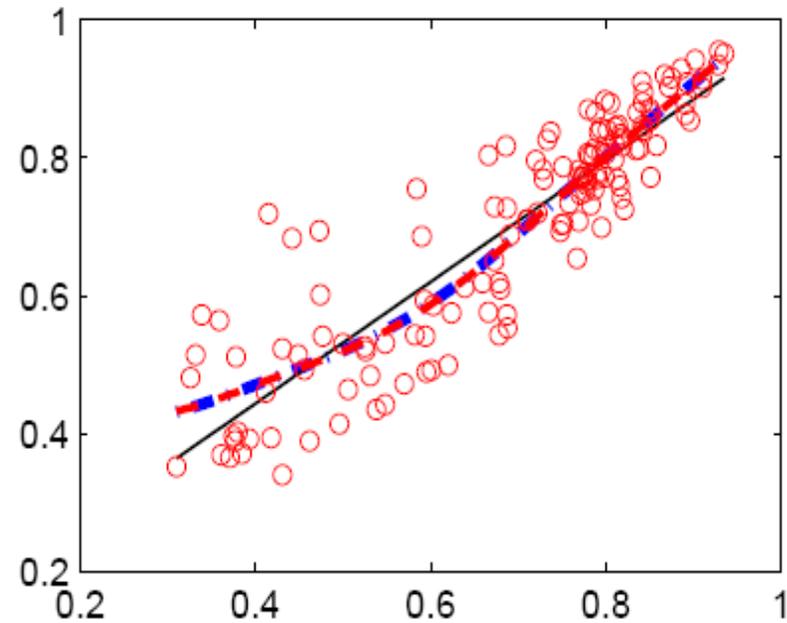
$$E_{\mathbf{x} \sim i} (y \mid x_i)$$

First order sensitivity
index:

$$\frac{V_{x_i} (E_{\mathbf{x} \sim i} (y \mid x_i))}{V(y)}$$

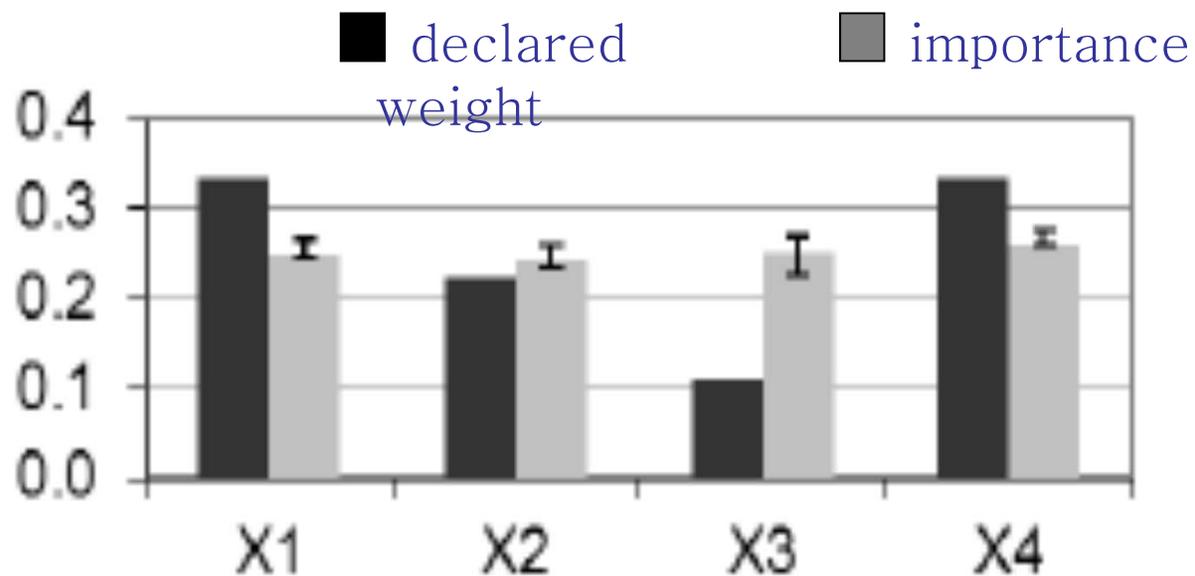
index

Si [linear/non
linear] is the
variance of the
[linear/non linear]
interpolation
curve



variable

HDI 2009



Life expectancy, 33%

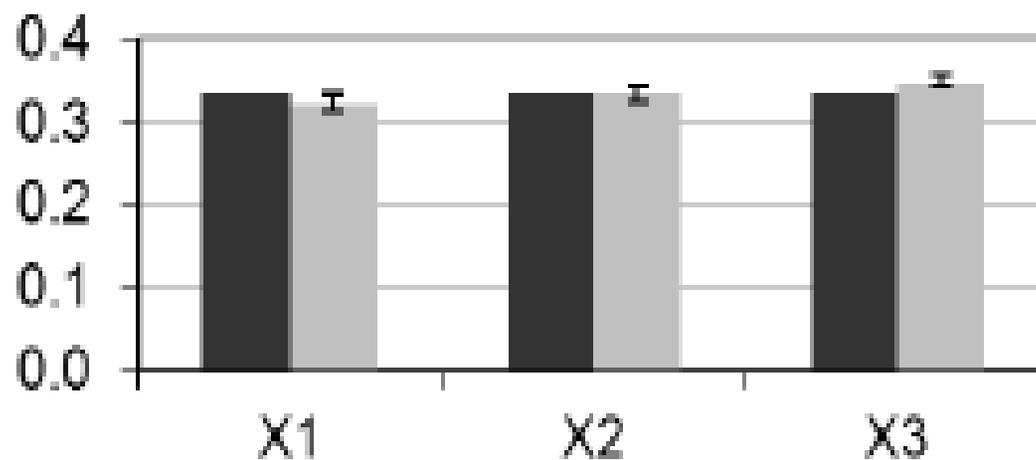
Adult literacy, 22%

Enrollment education, 11%

GDP per capita, 33%

HDI 2010

■ declared ■ importance



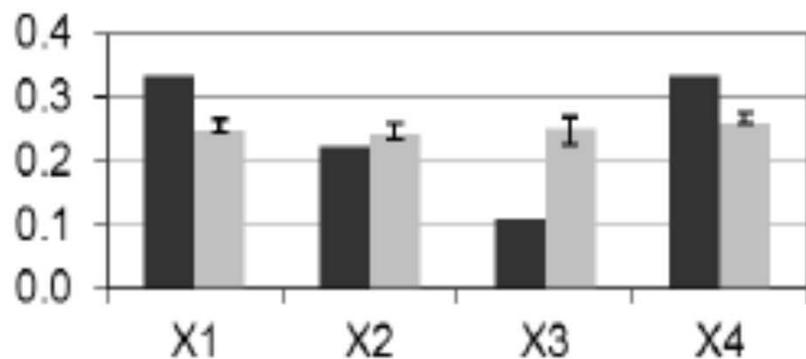
Life expectancy, 33%

Education, 33%

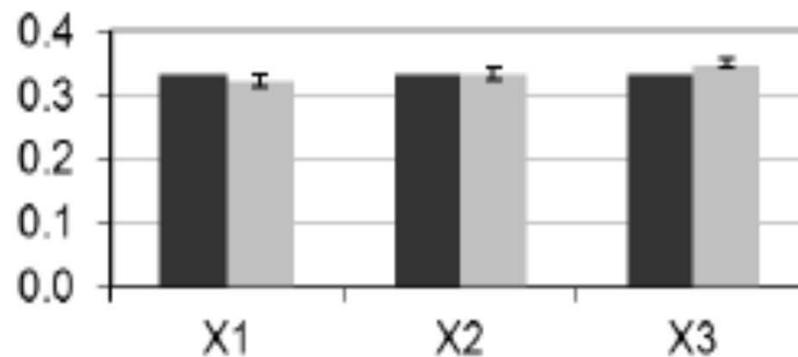
GNI per capita, 33%

■ declared weight ■ importance

HDI2009



HDI2010



HDI 2010 more coherent than HDI 2009

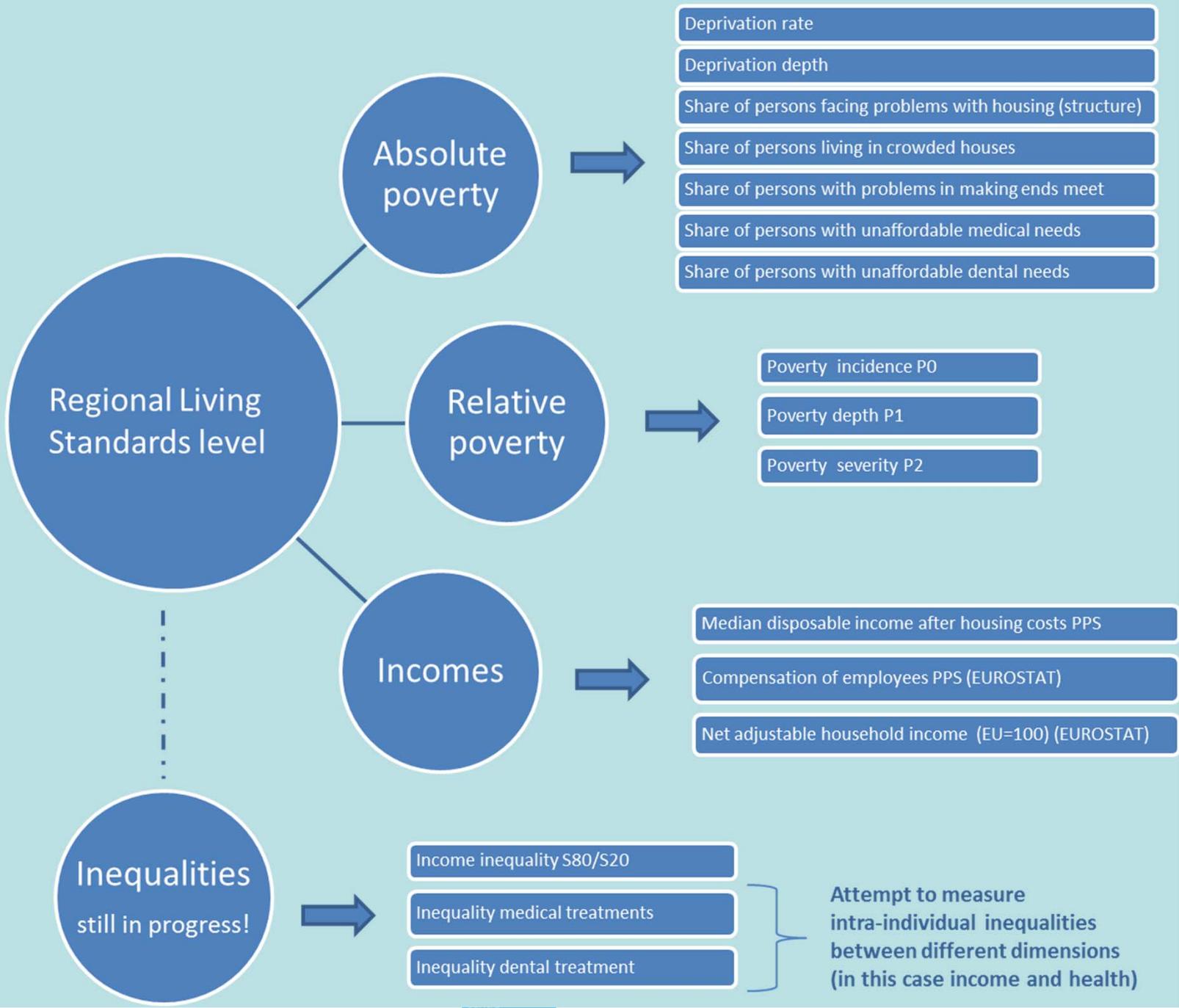


Methodology used for HDI:

- Paruolo, P., Saisana, A., Saltelli, A., 2011, Ratings and rankings: Voodoo or Science? Accepted Journal Royal Statistical Society A, Available on arXiv submit/0231794 [stat.AP].
- 2012 Environmental Performance Index and Pilot Trend Environmental Performance Index, Yale & Columbia Universities in collaboration with WEF & JRC, <http://epi.yale.edu>



Regional quality of life: the living standard dimension (a work in progress)





Regional QoL: the Living Standards dimension (DG REGIO & JRC)

- Micro-data sources: EUSILC cross sectional Users' Data Base (UDB) (waves 2007 – 2008 – 2009) + German Household Survey (SOEP) + United Kingdom Household Survey (USS)
- The three EUSILC waves are averaged to improve the precision of sub-national estimates
- Macro-data sources: EUROSTAT, EQLS

NB: WORK STILL IN PROGRESS

Analysis at the lowest (proper) geographical level

- EUSILC:

NUTS2 for CZ, ES, FI and RO

NUTS1 for AT, BE, BG, FR, GR, HU, IT, PL and SE

NUTS0 for all the rest

- SOEP: NUTS1 for DE

- USS: NUTS1 for UK

NB: many issues of variable comparability across different data-sets still under analysis

Relative poverty sub-dimension



Combining

P0 poverty incidence = share of population below the poverty line;

P1 poverty depth = normalized income gap measure which indicates the gap between the incomes of poor individuals and the poverty line;

P2 = poverty severity, computed as the poverty depth but with a squared gap. P2 measures the degree of inequality in the distribution of income within poor people.

Note: Housing costs included in the computation of individual disposable income to get a better description of real income (high level of within-country variability)

Relative poverty sub-dimension



	Poverty incidence P0	Poverty depth P1	Poverty severity P2
Poverty incidence P0	1	0.94	0.86
Poverty depth P1		1	0.98
Poverty severity P2			1

Relative poverty sub-dimension

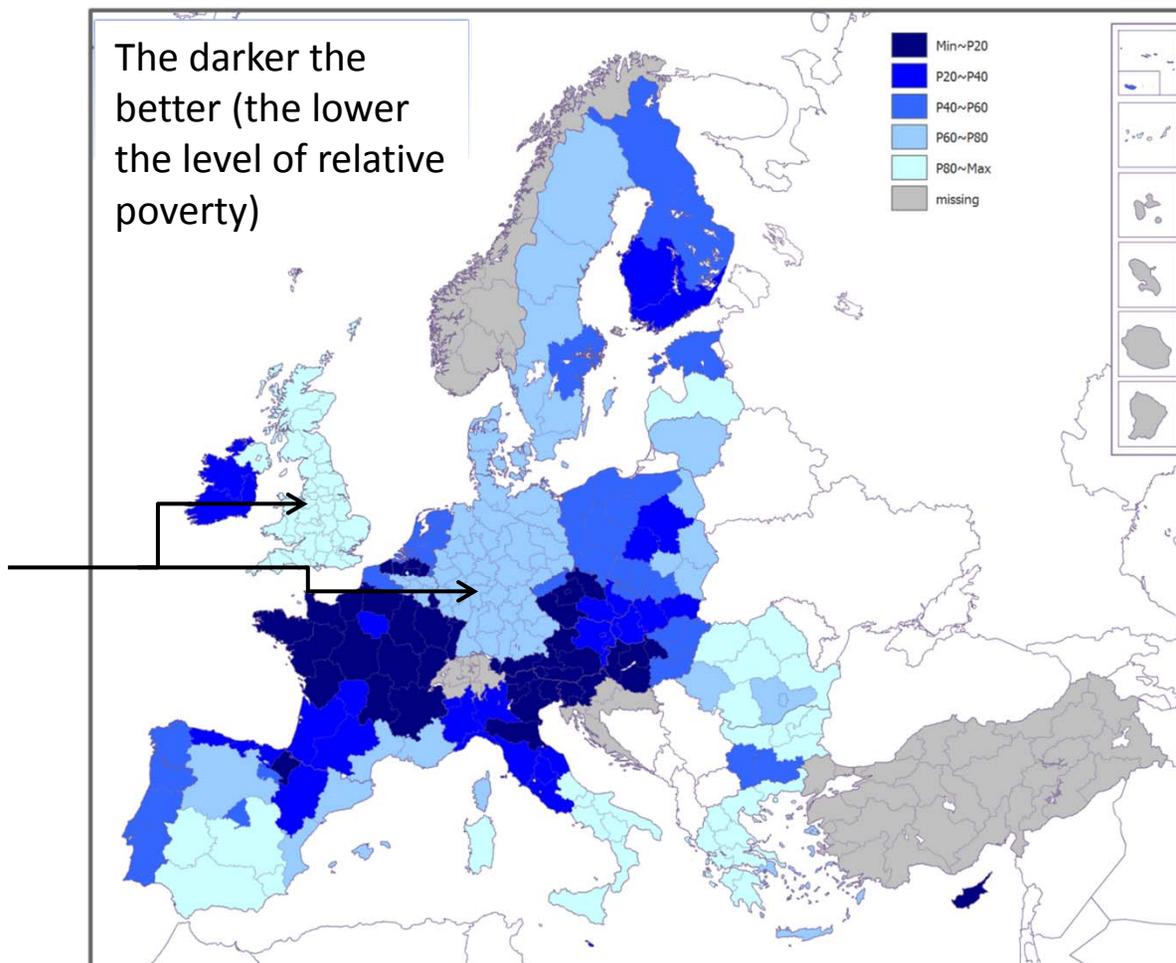


Level of relative poverty

Notes

Poverty lines set at 60% of national median disposable income with housing costs

Some countries at the national level only (e.g. DE and UK)



Conclusions



Quality issue for composite indicators are our focus

Linear aggregations are highly problematic. They are theoretically inconsistent (beware with 'synthetic').

A coherence analysis can limit the damage.

Regrettable that social choice theory was and is neglected by most developers; which country would be the HDI 2010 Borda winner? ... the Condorcet/Copeland winner? ... the Balinski winner?



Additional background material

Further Reading on aggregation problems:

- Saisana, M., d’Hombres, B., Saltelli, A., 2011, Rickety numbers: Volatility of university rankings and policy implications, *Research Policy*, **40**, 165–177.
- Munda, G., 2008, Social Multi-Criteria Evaluation for a Sustainable Economy, Berlin Heidelberg: Springer-Verlag.
- Balinski, M. and R. Laraki (2010). Majority Judgment. Measuring, ranking and electing. MIT Press.

Relative poverty sub-dimension



- P0 =: poverty incidence = share of population below the poverty line (poverty line computed at the national level from EUSILC by including housing costs – poverty line = $0.60 \times$ national median of individual income after subtracting housing costs)
- P1 =: poverty depth = normalized income gap measure which indicates the gap between the incomes of poor individuals and the poverty line. Assuming perfect targeting of transfers, the poverty depth index describes the minimum amount of wealth (in terms of net income) that needs to be transferred to pull poor people up to the poverty line.
- P2 =: poverty severity = computed as the poverty depth but with a squared gap. It measures the degree of inequality in the distribution of income within poor people. As it gives greater importance to poor people at the bottom of the income distribution, the higher P2 the higher the level of inequality across the sub-population of poor.